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SUB-COMMITTEE ON STANDARDS OF TRAINING AND WATCHKEEPING
43rd session
Agenda item 3

STW 43/3/6
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VALIDATION OF MODEL TRAINING COURSES

Model Course – Master and Chief mate

Note by the Secretariat

SUMMARY

Executive summary:	This document contains a revised draft model course on Master and Chief mate
Strategic direction:	5.2
High-level action:	5.2.2
Planned output:	5.2.2.5
Action to be taken:	Paragraph 3
Related document:	STW 40/14

1 Attached in the annex is the revised draft model course on Master and Chief mate.

2 The preliminary revised draft of this model course was forwarded to members of the validation panel for their comments. Relevant comments on the revised draft course have been received from the validation panel and incorporated, as appropriate.

Action requested of the Sub-Committee

3 The Sub-Committee is invited to consider the above information and take action as appropriate.

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ANNEX

DRAFT IMO MODEL COURSE ON MASTER AND CHIEF MATE

MODEL COURSE

7.01

MASTER AND CHIEF MATE

XXXX Edition

ACKNOWLEDGEMENTS

This course for Master and Chief Mate is based on material developed by Anglo Eastern Maritime Training Centre for IMO under the guidance of GlobalMET.

IMO wishes to express its sincere appreciation to GlobalMET for its provision of expert assistance, valuable cooperation, and generous funding in support of this work.

Contents

Introduction

■ Purpose of the model courses

The purpose of the IMO model courses is to assist maritime training institutes and their teaching staff in organizing and introducing new training courses, or in enhancing, updating or supplementing existing training material where the quality and effectiveness of the training courses may thereby be improved.

It is not the intention of the model course programme to present instructors with a rigid "teaching package" which they are expected to "follow blindly. Nor is it the intention to substitute audio-visual or "programmed" material for the instructor's presence. As in all training endeavours, the knowledge, skills and dedication of the instructors are the key components in the transfer of knowledge and skills to those being trained through IMO model course material.

The educational systems and the cultural backgrounds of trainees in maritime subjects vary considerably from country to country. For this reason the model course material has been designed to identify the basic entry requirements and trainee target group for each course in universally applicable terms, and to specify clearly the technical content and levels of knowledge and skill necessary to meet the technical intent of IMO conventions and related recommendations.

This is the second major revision to this Model Course. In order to keep the training programme up to date in future, it is essential that users provide feedback. New information will provide better training in safety at sea and protection of the marine environment. Information, comments and suggestions should be sent to the Head of the STCW and Human Element Section at IMO, London.

■ Use of the model course

To use the model course the instructor should review the course plan and detailed syllabus, taking into account the information provided under the entry standards specified in the course framework. The actual level of knowledge and skills and the prior technical education of the trainees should be kept in mind during this review, and any areas within the detailed syllabus which may cause difficulties, because of differences between the actual trainee entry level and that assumed by the course designer, should be identified. To compensate for such differences, the instructor is expected to delete from the course, or reduce the emphasis on, items dealing with knowledge or skills already attained by the trainees. He should also identify any academic knowledge, skills or technical training which they may not have acquired.

By analysing the detailed syllabus and the academic knowledge required to allow training in the technical area to proceed, the instructor can design an appropriate pre-entry course or, alternatively, insert the elements of academic knowledge required to support the technical training elements concerned at appropriate points within the technical course.

Adjustment of the course objective, scope and content may also be necessary if in your maritime industry the trainees completing the course are to undertake duties which differ from the course objectives specified in the model course.

Within the course plan the course designers have indicated their assessment of the time which should be allotted to each area of learning. However, it must be appreciated that these allocations are arbitrary and assume that the trainees have fully met all entry requirements of the course. The instructor should therefore review these assessments carefully and may need to re-allocate the time required to achieve each specific learning objective or training outcome.

■ Lesson plans

Having adjusted the course content to suit the trainee intake and any revision of the course objectives, the instructor should draw up lesson plans based on the detailed syllabus. The detailed syllabus contains specific references to the textbooks or teaching material proposed to be used in the course. Where no adjustment is found necessary in the learning objectives of the detailed syllabus, the lesson plans may simply consist of the detailed syllabus with keywords or other reminders added to assist the instructor in making his presentation of the material.

■ Presentation

The presentation of concepts and methodologies must be repeated in various ways until the instructor is satisfied, by testing and evaluating the trainee's performance and achievements, that the trainee has attained each specific learning objective or training outcome. The syllabus is laid out in learning objective format and each objective specifies a required performance or, what the trainee must be able to do as the learning or training outcome. Taken as a whole, these objectives aim to meet the knowledge, understanding and proficiency specified in the appropriate tables of the STCW Code.

■ Implementation

For the course to run smoothly and to be effective, considerable attention must be paid to the availability and use of:

- Properly qualified instructors
- Support staff
- Rooms and other spaces
- Equipment
- Suggested references, textbooks, technical papers, bibliography
- Other reference material.

Thorough preparation is the key to successful implementation of the course. IMO has produced a booklet entitled "Guidance on the implementation of IMO model courses", which deals with this aspect in greater detail.

In certain cases, the requirements for some or all of the training in a subject are covered by another IMO model course. In these cases, the specific part of the STCW Code which applies is given and the user is referred to the other model course.

■ Course objective

This model course comprises three functions at the management level. On successful completion of the course and the requisite watchkeeping experience, officers will be capable of taking full responsibility for the safety of the ship, its passengers, crew and cargo. They will be aware of their obligations under international agreements and conventions concerning safety and the protection of the marine environment and will be able to take the practical measures necessary to meet those obligations.

In this model course, one combined course has been written for both chief mate and master! The material is set out so that it can be run separately from the course for officer in charge of a navigational watch, but this is not intended to imply that it has to be run separately. It has been written in this manner so as to give Administrations the opportunity to arrange a structure best suited to their needs.

The teaching schemes should be carefully scrutinized to ensure that all of the tabulated training outcomes are covered, that repetition is avoided and that essential underpinning knowledge at any stage has already been covered. A certain amount of duplication under different subjects will probably occur, provided it is not excessive, the different approaches can provide useful reinforcement of work already learned. Care should be taken to see that items not included in the syllabus or treatment beyond the depth indicated by the objectives have not been introduced except where necessary to meet additional requirements of the Administration. The teaching scheme should be adjusted to take account of those matters and the timing of any modular courses (such as training in Fire Fighting, Medical Care) which are to be included.

■ Entry standards

Entrants should have successfully completed a course covering the minimum standards required for certification as officer in charge of a navigational watch on ships of 500 gross tonnage or more (see IMO Model Course No. 7.03, Officer in Charge of a Navigational Watch).

■ Class intake limitations

Class sizes should be limited to not more than 24 in order to allow the instructor to give adequate attention to individual trainees. Larger numbers may be admitted if extra staff and tutorial periods are provided to deal with trainees on an individual basis. But in no case should the number of students exceed 40 in any class. In addition, for scheduling access to learning facilities and equipment, attention to strict time management is necessary. In large classes students should have their own reference books, unless sufficient copies can be provided in a central library. Classrooms should be big enough to seat all students so they can see and hear the instructor.

During practical sessions and group activities there will be additional restraints on class size. Where applicable, a recommendation on class size is contained in the frameworks for each of the individual functions.

■ Textbooks and bibliography

References to books and bibliography are made in the syllabuses of the individual subjects to aid both instructors and trainees in finding relevant information and to help in defining the scope and depth of treatment intended.

The mention of a particular textbook does not imply that it is essential to use that book, only that it appeared to be best suited to the course at the time of its design. In many instances there are a number of suitable books, and instructors are free to use whatever texts they consider to be most suited to their circumstances and trainees.

Every effort has been made to quote the latest editions of the publications mentioned but new editions are constantly being produced Instructors should always use the latest edition for preparing and running their courses.

Full use should be made of technical papers and other publications available from maritime and other professional organizations. Such papers contain new developments in techniques, equipment, design, management and opinion and are an invaluable as set to a maritime training establishment.

■ English language

The requirements for knowledge of the English language are the same at the management level as they are at the operational level. However, Administrations may consider that a knowledge of English at a higher level would be desirable for a master and chief mate and may wish to include a further course in English for conducting ship's business, as outlined below:

- reads and understands charter parties, bills of lading, mate's receipts, marine insurance clauses, port and canal regulations
- interprets appropriate endorsements on mate's receipts and bills of lading
- completes a note of protest in English
- writes reports on damage to ship or cargo, on and off-hire surveys accidents and incidents
- writes letters to agents, port authorities and stevedores concerning ship's business and reads replies from them
- writes requests for surveys and interprets requests and instructions from surveyors
- requests fuel, water, ship's stores and spares, verbally and in writing
- reads and understands manufacturers' instructions for operation and maintenance of equipment.

■ IT and computer applications

In view of the rapid growth of information technology (IT) and widespread use of computers aboard ship, it is recommended that at the discretion of the Administration, computer applications at an advanced level should be included in the training for

master and chief mate. If this topic has not been covered during training as officer in charge of a navigational watch some basic training will also be required.
Particulars of the training will depend upon the computer facilities available and the needs of the trainees. The following outline provides guidance on topics which could be included.

- The care and storage of magnetic media; use of simple utility programs for identifying disk problems and fixes; LAN maintenance; back-up management; virus protection
- IT and the use of applications, for communications (e-mail, data, etc), the internet, intranets and the world-wide web (WWW)
- The installation and setup of multi-media applications.

In addition applications of computers and micro-processors to instrumentation and control systems, including:

- simple digital circuits, binary logic switches, bistable circuits
- logic gates, truth tables of simple logic circuits
- representation of data by bits, bytes and words, binary and hexadecimal representation
- binary-coded decimal representation, fixed- and floating-point numbers, ASCII Code
- analogue-to-digital and digital-to-analogue converters
- computer architecture, information transfer between principal units
- memory, ROM, RAM, direct access memory, virtual memory
- input and output devices, data transfer, modems, multiplexers
- block diagrams of computer supervisory control systems and direct digital control systems
- automatic monitoring, data-recording and alarm systems.

The use of multi-media applications can enhance learning in topics in many areas of knowledge and prove of value to junior officers and crew members. Many of the IMO rules and Assembly Resolutions are available on CD-ROM. Up to date details may be found on the IMO web site at http://www.imo.org

■ Shipping economics

It is recommended that, at the discretion of the Administration, the subject of shipping economics should be included in the course of studies for master and chief mate!! The objective is to make trainees aware of economic considerations in ship management and how sound operational practices can contribute to the economic success of a voyage.

The following general objectives provide guidance on topics which could be included. Matters of national or regional interest regarding local trade and the operation of shipping should be incorporated where appropriate:

- outlines the main world seaborne trade routes in various commodities
- describes the main features of the following trades:

  - tramp or general traders
  - liner
  - specialized (tanker, container, timber products, etc!)
  - passenger (cruising, ferries)
- describes the structure and organization of:
  - a typical shipping company
  - a ship management company
- schedules economic purchasing of stores, bunkers etc based on the ship's area of operation
- establishes the safe and economic manning of a ship based on valid arguments and proper usage of repair and maintenance assistance
- plans the operation of the ship for a 12 month period
- prepares an annual operating cost budget
- describes the division of a shipping company between capital and labour
- describes the operation of the freight market with reference to the price elasticity of supply and demand
- explains how freight rates vary:
  - under free competition
  - under monopolistic competition
  - conferences, cartels, pooling arrangements, etc.
- describes fluctuations in the freight markets
- explains the significance of the following with regard to operating policy:
  - capital costs
  - fixed costs
  - variable costs
  - marginal costs
  - interest rate
  - depreciation or amortization
  - risk element
  - return on capital
- lists and describes the following voyage costs:
  - crew
  - fuel
  - repairs and maintenance
  - insurance
  - port dues
  - cargo handling
- identifies cost elements on which the shipboard management team can influence the results
- explains how voyage costs are influenced by the operation of a ship and describes measures which can be taken to minimise those costs
- describes how costs are apportioned under the various types of charter party

■ Training and the STCW 2010 Convention

The standards of competence that have to be met by seafarers are defined in Part A of the STCW Code in the Standards of Training, Certification and Watchkeeping for Seafarers Convention, as amended in 2010. This IMO model course has been revised and updated to cover the competences in STCW 2010. It sets out the education and training to achieve those standards.

In common with the Convention, the course is organised under the seven functions at three levels of responsibility. Specifically, this course covers the minimum standard of competence for masters and chief mates on ships of 500 gross tonnage or more, see STCW Code Table A-II/2.
For ease of reference, the course material is organised in three separate Functions as per the STCW Code. These functions are:

Function 1	Navigation at the management level
Function 2	Cargo handling and stowage at the management level
Function 3	Controlling the operation of the ship and care for the persons on board at the management level.

Each function is addressed in 5 parts: Part A which is common for all functions, Part B Part C, Part D and Part E, which again addresses all the functions.

Part A provides the framework for the course with its aims and objectives and notes on the suggested teaching facilities and equipment. A list of useful teaching aids which includes videos, CBT, IMO references, textbooks and bibliography is included in function 1, which affects all the 3 functions.

Part B provides an outline of lectures, demonstrations and exercises for the course. No detailed timetable is suggested. From the teaching and learning point of view, it is more important that the trainee achieves the minimum standard of competence defined in the STCW Code than that a strict timetable is followed. Depending on their experience and ability, some students will naturally take longer to become proficient in some topics than in others.

Part C gives the Detailed Teaching Syllabus. This is based on the combined, theoretical and practical knowledge specified in the STCW Code. It is written as a series of learning objectives, in other words what the trainee is expected to be able to do as a result of the teaching and training. Each of the objectives is expanded to define a required performance of knowledge, understanding and proficiency. Suggested teaching aids including IMO references, textbook references, videos, CBT's and bibliography are integrated to assist the teacher in designing lessons.

Part D gives the Instructor Manual, which contains guidance notes for the Instructor and additional explanations. There are also new annexes accompanying Part D of Function 1, which provides the Instructor with Sample lesson plan, participant's handout, powerpoint presentation and 6 sheets to aid classroom activities, incorporated in the lesson plan and participant's handout. All these are provided to aid the for reference only.

Part E provides the Evaluation which addresses all the functions. A separate IMO model course 3.12 also addresses Assessment of Competence. This course explains the use of various methods for demonstrating competence and criteria for evaluating competence as tabulated in the STCW Code. Extract of this model course is also included in Part E to aid the Instructors.

The Convention defines the minimum standards to be maintained in Part A of the STCW Code. Mandatory provisions concerning Training and Assessment are given in Section A-I/6 of the STCW Code. These provisions cover: qualification of instructors; supervisors as assessors; in-service training; assessment of competence; and training and assessment within an institution. The corresponding Part B of the STCW Code contains guidance on training and assessment.

The criteria for evaluating competence specified in the minimum standard of competence tables of Part A of the STCW Code are to be used in the assessment of all competences listed in those tables.

The STCW code 2010, also addresses the training of seafarers which can be imparted through distance learning and e-learning. A substantial portion of the course, especially learning in the cognitive domain, can be delivered as computer based learning modules over the web or through software programmes.

Section B-I/6 of the STCW code gives guidance on the training of seafarers which can be carried out by distance learning and e-learning in accordance with the standards of training and assessment set out in section A-I/6 of the STCW code.

Administrations are encouraged to approve the use of e-learning. The code includes guidelines for how the e-learning shall be conducted, but it is up to each administration to approve any e-learning provider. The administration must register approved training providers.

Web-based course with material delivered via a combination of text, presentations, webinar, recorded events and expert tutor assistance can be used. Student can select online learning material, online quiz, assessment, online discussion forum with other students and tutor. Live interaction and replying questions with tutor via Webinar session are some of the advantages of this type of learning.

To improve the facilitation of the carriage of IMDG Code class 7 materials including those in packaged form used in medical or public health applications, IMO has prepared a class 7 e-learning package which is available for use by interested parties, free of cost, by clicking on the link www.class7elearning.com

As previously mentioned a separate model course 3.12 also addresses Assessment of Competence and use of the criteria for evaluating competence tabulated in the STCW Code.

■ Responsibilities of Administrations

Administrations should ensure that training courses delivered by colleges and academies are such as to ensure officers completing training do meet the standards of competence required by STCW Regulation II/1 paragraph 2.

■ Validation

The information contained in this document has been validated by the Sub-Committee on Standards of Training and Watchkeeping for use by technical advisers, consultants and experts for the training and certification of seafarers so that the minimum standards implemented may be as uniform as possible. Validation in the context of this document means that no grounds have been found to object to its content. The Sub-Committee has not granted its approval to the document, as it considers that this work must not be regarded as an official interpretation of the Convention.

Part A: Course Framework for all functions

■ Aims

This model course aims to meet the mandatory minimum requirements for knowledge, understanding and proficiency in Table A-ll/2 of STCW 2010 for the function Navigation at the Management Level, for the function Cargo Handling and Stowage at the Management Level and the background knowledge to support Controlling the Operation of the Ship and Care for Persons on Board at the Management Level.

■ Objective

Function 1

The syllabus for Function 1, covers the requirements of the 2010 STCW Convention Chapter II, Section A-II/2. This functional element provides the detailed knowledge to support the training outcomes related to the Navigation at the Management Level.

This section provides the background knowledge to support the tasks, duties and responsibilities in:

- planning a voyage and conducting navigation
- determining position and the accuracy of resultant position fix by any means
- determining and allowing for compass errors
- co-ordinating search and rescue operations
- establishing watchkeeping arrangements and procedures
- maintaining safe navigation through information from navigation equipment and systems to assist command decision-making
- maintain the safety of navigation through the use of ECDIS and associated navigation systems to assist command decision making
- forecasting weather and oceanographic conditions
- response to navigational emergencies
- manoeuvring and handling a ship in all conditions
- operation of remote controls of propulsion plant and engineering systems and services.

Function 2

The syllabus of Function 2 covers the requirements of the 2010 STCW Convention Chapter II, Section AII/2. This functional element provides the detailed knowledge to support the training outcomes related to Cargo Handling and Stowage at the Management Level.

This section provides the background knowledge to support the tasks, duties and responsibilities in:

- planning, safe loading, stowage, securing and care during the voyage and unloading of cargoes
- the carriage of dangerous goods.

This includes topics such as ship trim, stability, ballasting, cargo securing, tankers and tanker operations and carriage of dangerous, hazardous and harmful cargoes.

Function 3

The syllabus of Function 3 covers the requirements of the 2010 STCW Convention Chapter II, Section A-II/2. This functional element provides the detailed knowledge to support the training outcomes related to Controlling the Operation of the Ship and Care for Persons on Board at the Management Level.

This section provides the background knowledge to support the tasks, duties and responsibilities in:

- controlling trim, stability and stress
- monitoring and controlling compliance with legislation to ensure
  - safety of life at sea
  - protection of the marine environment
- maintaining safety and security of crew and passengers
- developing emergency and damage control plans
- organising and managing the crew
- organising and providing medical care on board

This includes topics such as ship construction and stability, dry-docking, search and rescue, personnel management and contingency planning.

■ Entry standards

This course is principally intended for officers for certification as master and chief mate on ships of 500 gross tonnage or more. Entrants should have successfully completed a course covering the minimum standards required for certification as officer in charge of a navigational watch on ships of 500 gross tonnage or more (see IMO Model Course No. 7.03, Officer in Charge of a Navigational Watch).

■ Course certificate

On successful completion of the course and assessments, a document may be issued certifying that the holder has successfully completed a course of training which meets or exceeds the level of knowledge and competence specified in Table A-ll/2 of STCW 2010, for the function.

A certificate may be issued only by centres approved by the Administration.

■ Staff requirements

Instructors shall be qualified in the task for which training is being conducted and have appropriate training in instructional techniques and training methods (STCW Code Section AI/6). Depending on the complexity of the exercises set, an assistant instructor with similar experience is desirable for certain practical exercises.

■ Teaching facilities and equipment

Below is a comprehensive list of Teaching Aids that may be used for the purpose of teaching in the course. It is not advocated that all the Aids mentioned here must be used nor does it mean that other Teaching Aids not mentioned here are excluded from being used. The Instructor is free to use additional teaching material that may be best suited for the transference of knowledge and skills to the trainees.

A classroom equipped with an overhead projector and a blackboard or whiteboard or interactive board or flipchart should be provided for teaching the theory of the course and holding group discussions.

The following items are necessary for use in group work:

For Function 1:

COLREGS ‘72 — a set of table-top models displaying proper signals or lights, a magnetic board or a navigation light simulator

Manoeuvring — a set of models to represent ships, jetties, piers and other dock configurations, which can be used on a table top to illustrate ship handling techniques

For Function 2 and Function 3:

- a collection of photographs, drawings and plans, illustrating various types of ship and constructional details, should be provided. Cutaway models should be used to re-enforce this knowledge

- a floating ship stability demonstration model and a flotation tank are recommended. The model should be capable of demonstrating the effects of adding or removing masses, of shifting masses, of suspending masses and of free surface liquid

- a ship's loading instrument or manufacturers' descriptions of examples of them

- capacity plans and hydrostatic data for one or more ships

- electronic calculators.

■ Teaching aids (A)

Note: - Other equivalent teaching aids may be used as deemed fit by the instructor.

A1 Instructor’s Manual (Part D of this course)
A2 Catalogue of British Admiralty charts and other hydrographic publications
A3 British Admiralty Notices to Mariners
A4 Nautical Almanac
A5 Nautical tables (Norie’s, Burton’s or others)
A6 Pre-computed altitude and azimuth tables (eg. H0229)

A7 Pocket calculator
A8 Working chart
A9 Ocean plotting sheet
A10 Passage planning charts
A11 Routeing charts
A12 Ocean Passages for the World (NP 136), (Taunton, Hydrographer of the Navy, 1987)
A13 Distance tables
A14 British Admiralty list of lights
A15 National list of lights and buoyage system
A16 British Admiralty tide table of the area concerned
A17 Local tide table
A18 Tidal stream atlas
A19 British Admiralty 'Pilot' book for the area concerned
A20 National sailing directions
A21 Port information books
A22 IALA Maritime Buoyage System, Admiralty NP 735
A23 British Admiralty List of Radio Signals, Vol. 2: Radio Aids to Navigation, Satellite Navigation Systems, legal Time, Radio Time Signals and Electronic Position Fixing System
A24 British Admiralty List of Radio Signals, Vol. 5: Global Maritime Distress and Safety System (GMDSS)
A25 British Admiralty List of Radio Signals, Vol. 6: Pilot Services, Vessel Traffic Services and Port Operations. 7 volumes
A26 British Admiralty List of Radio Signals, Vol. 3: Maritime Safety Information Services
A27 Ship's log-book
A28 Loran-C Receiver
A29 Magnetic compass in a binnacle with necessary correcting devices for identification of various parts only
A30 Pelorus and azimuth mirror
A31 Gyro-compass
A32 GPS Receivers
A33 Differential GPS (DGPS) Receiver
A34 Enhanced Loran (eLoran) Receiver
A35 Global Navigation Satellite System (GLONASS) Receiver
A36 Galileo Receiver
A37 Automatic Identification System (AIS) Receiver
A38 Long Range Identification and Tracking (LRIT) Receiver
A39 Voyage Data Recorder (VDR) and Simplified Voyage Data Recorder (S-VDR)
A40 Bridge Navigational watch alarm system (BNWAS)
A41 Ship's Drawings / Plan (GA, Mid section)
A42 Simulators (wherever applicable to enhance understanding of topics, especially, COLREGS and Ship handling)

■ Videos (DVDs), CD-ROMs, CBT's (V)

Note: - Other equivalent videos, CD-ROMs, CBT's may be used as deemed fit by the instructor.

V1 Ships' Routeing on CD, Version 4 (2008) (IMO Code No. DC927E ISBN 978-92-801-70207)
V2 IMO – Safe, Secure and Efficient Shipping on Clean Oceans on DVD (2006 Edition) (IMO Code No. V010M ISBN 978-92-801-70023)

Available from: IMO Publishing
4 Albert Embankment
London SE1 7SR, UK
Tel: +44 20 7735 7611, Fax: 44 20 7587 3348
Internet Site: http://www.imo.org

V3 Shiphandling — Part 1 (Code No 95)
V4 Shiphandling — Part 2 (Code No 129)
V5 Shiphandling — Part 3 (Code No 321)
V6 Anchoring safely (Code No 928)
V7 Interaction (Code No 13)
V8 Ship handling in following seas (Code No 636)
V9 Ship handling in head seas (Code No 661)
V10 Ship handling in restricted waters - ship squat and shallow (Code No 697)
V11 Ship handling in restricted waters - bank effect & interaction (Code No 748)
V12 Manoeuvring characteristics of special car carriers (Code No 696)
V13 Manoeuvring and control characteristics of special type ships: Part 1 Focusing on the wind pressure effect on a PCC (Code No 9985)
V14 Manoeuvring and control characteristics of special type ships: Part 2 Anchoring and mooring of a PCC (Code No 9986)
V15 Working with tugs (Code No 972)
V16 Tractor tugs (Code No 165)
V17 Shiphandling with Tractor Tugs (Code No 359)
V18 Navigating in ICE (Code No 927)
V19 Helicopter operations at sea (edition 2) (Code No 704)
V20 Margins of safety (Code No 73)
V21 Voyage planning (Code No 758)
V22 Bridge watchkeeping (Code No 497)
V23 Master/pilot relationship (Code No 498)
V24 Accident prevention - the human factor (Code No 637)
V25 Emergency procedures (Code No 638)
V26 Navigational charts & associated publications (Code No 639)
V27 Working with VTS(Code No 640)
V28 Five case studies (Code No 781)
V29 Shipping Casualty Emergency response (Code No 467)
V30 Safer mooring (Code No 997)
V31 Theory of mooring - edition 4 (Code No 1104)
V32 Safe mooring practice- edition 4 (Code No 1105)
V33 Maintenance of mooring systems - edition 4 (Code No 1106)
V34 Pilot on board! working together (Code No 945)
V35 Basic instincts (passenger mustering & crowd control) (Code No 603)
V36 The cold and heavy weather file (Code No 626)
V37 Meteorology for safe navigation in cyclones (Code No 695)
V38 Wind, waves and storms Part 1 - understanding weather system (Code No 738)
V39 Wind waves and storms Part 2 - coping with hazardous weather (Code No 743)

V40 AIS - automatic identification systems (Code No 926)
V41 The safe use of electronic charts (Code No 705)
V42 Target tracking devices (Code No 948)
V43 Gyro compass - Part 1 (Code No 9897)
V44 Gyro compass - Part 2 (Code No 9898)
V45 Gyro compass - Part 3 (Code No 9899)
V46 Watchkeeping in port code no: 659
V47 Dangerous goods at sea series (edition 5) (Code No 713)
V48 Dangerous goods at sea series part 2 (edition 5) (Code no: 719)
V49 Centrifugal pumps - theory & operation (Code no: 9)
V50 Crude oil washing operations (edition 3) (code no: 707)
V51 Operation & maintenance of inert gas systems (edition 3) code no: 708
V52 The ship-shore interface (petroleum tankers) code no: 709
V53 Safe cargo stowage & securing code no: 747
V54 Ship to ship transfer - petroleum and liquid cargoes code no: 751
V55 Tank purging and line cleaning onboard chemical tankers code no: 752
V56 Introduction to liquified gas carriers (edition 2) code no: 753
V57 Safe log carrier operations code no: 760
V58 Successful reefer container operations code no: 788
V59 Bulk carriers - handle with care code no: 691
V60 Hatch covers - a practical guide code no: 938
V61 Chemical tank cleaning & inspection (edition 2) code no: 950
V62 Chemical tanker operations: safety and pollution prevention part 1 code no: 951
V63 Chemical tanker operations: safety and pollution prevention part 2 code no: 952
V64 Tank cleaning practice code no: 982
V65 Over and under pressurisation of tanks (edition 2) code no: 984
V66 Handling vegetable oils code no: 988
V67 Dangerous & difficult bulk cargoes code no: 1101
V68 Vapour emission control code no: 1118
V69 Ro-Ro safety and cargo operations code no: 162
V70 Portable tanks and tank containers code no: 314
V71 Reefer container operations code no: 481
V72 Fire fighting & safe cargo operations on car carriers code no: 540
V73 Don't gamble with safety on chemical tankers code no: 595
V74 Cargo loss prevention on board bulk carriers code no: 598
V75 Cargo lashing operations (ro-ro) code no: 631
V76 Safe use of rigging equipment code no: 700
V77 Manual handling techniques code no: 703
V78 Tanker practices series
Pumping cargo part 1 code no: 501
Pumping cargo part 2 code no: 502
Tank cleaning - part 3 code no: 503
Heating cargo - part 4 code no: 504
Measuring cargo - part 5 code no: 505
V79 Fighting pollution - preventing pollution at sea (edition 3) code no: 755
V80 Good bunkering practice (edition 2), code no: 962
V81 Permit to work code no: 621
V82 Safe gangway and ladder operations, code no: 946
V83 Personal safety on tankers (edition 2), code no: 970
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■ IMO references (R)

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R2 International Convention for the Safety of Life at Sea (SOLAS), as amended (IMO SaleNo. IE110E) SOLAS - Consolidated Edition, 2009 (ISBN Number: 9789280115055)

R3 Ships' Routeing (2010, 10th ed.) (IMO Sales No. ID927E)

R4 Assembly resolution A.665 (16): Performance standards for radio direction-finding systems

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R6 Assembly resolution A.382 (X): Magnetic compasses: carriage and performance standards

R7 Assembly resolution A.424 (XI): Performance standards for gyro-compasses

R8 Convention on the International Regulations for Preventing Collisions at Sea, (COLREGS 1972), as amended (IMO Sales No. IB904E) Consolidated Edition, 2003 (ISBN 978-92-801-41672)

R9 International Convention for the prevention of Pollution from Ships, 1973 (MARPOL 1973) (in IMO sales No. IC520E) (Consolidated Edition, 2006) (ISBN 978-92-801-42167)

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T6 Frost, A. Practical Navigation for Second Mates. 6th ed. Glasgow, Brown, Son & Ferguson, 1985 (ISBN 0-851 7-4397-8)
T7 Frost, A. The Principles and Practice of Navigation. 3rd ed. Glasgow, Brown, Son & Ferguson, 1988 (ISBN 0-851 7-4443-3)

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T23 Meteorological Office, Marine Observer's Handbook. 11th ed. (Met.0.887). London, HMSO, 1995 (ISBN 0-1 140-0367-X)
T24 Meteorological Office, Meteorology for Mariners, 3rd ed. 8th impression. London, HMSO, 1978 (ISBN 0-1 140-031 1-4)
T25 Rowe, R.W. The Shiphandler's Guide. The Nautical Institute. 1996. (ISBN 1-870077 35 0)
T26 Ship Captain's Medical Guide. 1985. Department of Transport HMSO published by HMSO
T27 Swift, Capt. A.J. Bridge Team Management. - A Practical Guide. The Nautical Institute, 1993. (ISBN 1-8700-771 4-8)
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T30 The Mariner's Handbook. (NP 100). 6th ed. Taunton (UK), Hydrographer of the Navy,1989
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T34 Guidelines for the Inspection and Maintenance of Double Hull Tanker Structures. OCIMF. London, Witherby. 1995 (ISBN 1-8560-9090-9)
T35 Bulk Carriers: Guidance and information on bulk cargo loading and discharging to reduce the likelihood of overstressing the hull structures. IACS. London 1997
T36 Code of Safe Working Practices for Merchant Seamen, London. The Stationery Office Publications Centre, 1998 (ISBN 01 1551 8363)
T37 Holder, L.A. Training and Assessment on Board. 3rd ed. London, Witherby & Co Ltd,2002 (ISBN 1 85609 228 3)
T38 Anwar, Capt. N.- Navigation Advanced - Mates/Masters, Witherby Seamanship International Ltd, 2006, (ISBN 1-905331-15-0)
T39 Anwar, Capt.N.& Khalique, A. - Passage Planning – Practice, Witherby Seamanship International Ltd, 2006 (ISBN 1-8560-9323-9)
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■ Bibliography (B)

B1. ANDERSON, P. – ISM Code: A guide to the legal and insurance implications. London, Lloyd's of London Press. (ISBN 1-859-786-21-9)
B2. ARROYO, D.W. - International maritime conventions. Deventer (Netherlands), Kluwer Law and Taxation Publishers, 1991. (ISBN 90-6544-4408)
B3. BARRASS, C.B. – Ship stability: Notes and examples. 3rd ed. Oxford, Butterwoth-Heinemann, 2001. (ISBN 0-7506-4850-3)
B4. BAUGHEN, S. - Shipping law. London: Cavendish Publishing Ltd, 1998. (ISBN 1-85941-313-7)
B5. BENNET, H. – Law of marine insurance. 2nd ed. Oxford, Oxford University Press, 2006 (ISBN 0-19-927359-6)
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B7. Bowditch, N. - American practical navigator. (Combined edition Vol. 1& 2). Riverdale, (MD) (USA), National Ocean Servicing, 1995.
B8. Brown & Perring Ltd. - Admiralty charts. London, Brown & Perrings Ltd. (Various regions, published individually)
B9. BROWN, E.D. - The International law of the sea. 2 Vols. Aldershot, Dartmouth Publishing Co. Ltd., 1994 (ISBN 1-85521-306-0)
B10. BROWN, R. H. - Marine insurance. Vol. 1 - Principles and basic practice. 6th ed. London, Witherby & Co. Ltd., 1999. (ISBN 1-85609-150-3)
B11. BROWN, R. H. - Marine insurance. Vol. 2 - Cargo practice. 5th ed. 1997, (ISBN 1-85609-132-5); Vol. 3 - Hull practice. 2nd ed. 1992. (ISBN 0-948691-45-X).

B12. Brown, Son & Ferguson. - Brown's nautical almanac daily tide and tables. Glasgow : Brown, Son & Ferguson Ltd. (Annual)
B13. Brown, Son & Ferguson. - Regulations for preventing collisions at sea. Revised. Glasgow (UK), Brown, Son & Ferguson Ltd, 1995. (ISBN 0-85174-645-4)
B14. BRUBAKER, D. - Marine pollution and international law: principles and practices. London, Belhaven Press, 1993. (ISBN 1-85293-273-2)
B15. BUNDOCK, M. - Shipping law handbook. 3rd ed. London, Lloyd's of London Press, 2003 (ISBN 1-84311-209-4)
B16. Buyese, Capt.J. - Handling Ships in Ice. A practical guide to handling class 1A and 1AS ships. The Nautical Institute, 2007 (ISBN 1-8700-7784-2)
B17. Cahill, R.A. - Collisions and their causes. 2nd ed. London, The Nautical Institute, 2002. (ISBN1- 870077- 60- 6; Ref: 0268)
B18. Cahill, R.A. - Disaster at sea: From the Titanic to the Exxon Valdez. London, Century Publishing, 1990.
B19. Cahill, R.A. - Strandings and their causes. 2nd Ed. London, The Nautical Institute, 2002. (ISBN : 1-870077- 61- 3 Ref: 0269)
B20. CAMINOS, H. (Ed.) - Law of the sea. Aldershot : Dartmouth Publishing Co., 2001 (ISBN : 1-84014-090-9)
B21. CHEMICAL INDUSTRIES ASSOCIATION - Guidelines for shipping packaged dangerous goods by sea. London: Chemical Industries Association, 1997. (ISBN 1-85897-062-8)
B22. CHEN, X. – Limitation of liability for maritime claims. The Hague, Kluwer Law International, 2001. (ISBN 90-411-1598-6)
B23. CHURCHILL, R. & LOWE, A. - Law of the sea. 3rd ed. Manchester University Press, 1989. (ISBN 0-7190-4381-6)
B24. Clark, I.C. – Mooring and Anchoring Ships Vol 1- Principles and Practice. London, The Nautical Institute, 2009 (ISBN 1-870077-93-4)
B25. Clark, I.C. – Ship dynamics for mariners. London, The Nautical Institute, 2005 (ISBN 1-870077-68-7)
B26. Cockroft, A.N. - Nicholl's seamanship and nautical knowledge. 26th ed. Glasgow (UK), Brown, Son & Ferguson Ltd. 1993. (ISBN 0-85174-407-1)
B27. Collins, L. - Global Positioning System (GPS): Theory and practice. 5th ed.. New York: Springer-Verlag, 2001. (ISBN : 3-211-83534-2)
B28. Cornish, M. & Ives, E. - Reed’s maritime meteorology. 3rd ed. Hampton Court (UK), Reed (Thomas) Publications, 2009. (ISBN 0-901281-67-0)
B29. CURTIS, S. - The law of shipbuilding contracts. 3rd ed. London, Lloyd's of London Press, 2002.
B30. DAVIES, D. - Commencement of laytime, 3rd. ed. London, Lloyd's of London Press, (ISBN 1-85978-196-9)
B31. DAVIES, M. & DICKEY, A. - Shipping law. 3rd ed. Sydney, Lawbook Co. 2004 (ISBN 0-455-22081-6)
B32. DAVISON, R. & SNELSON, A. - The law of towage. London, Lloyd's of London Press, 1990. (ISBN 1-85044-347-5)
B33. DURNFORD, J.R. Technical sketching for deck and engineer officers. London, Nautical Institute, 1996. (ISBN 1 87007734 2)
B34. EMBLETON, W, - Engineering knowledge: Instruments and control systems for deck officers. 5th ed. Hampton Court (UK), Reed (Thomas) Publications Ltd., 1995. (ISBN 0-90128-115-8)
B35. FAIRPLAY PUBLICATIONS - Tonnage measurement of ships. 2nd ed. Coulsdon, (UK), Fairplay Publications Ltd, 1980. (ISBN 0-905045-03-3)

B36. Fifield, L.W.J. - Navigation for watchkeepers. Oxford, Heinemann Professional Publishing, 1980. (ISBN 0-434-90564-X)
B37. FISHER, A. / ECON, D. – Principles of marine insurance. London, Chartered Insurance Institute, 1999. (ISBN 1-85369-267-0)
B38. FISHER, W. - Engineering for nautical students. Glasgow (UK), Brown, Son & Ferguson (ISBN 0-851740-40)
B39. FOGARTY, - Merchant shipping legislation. 2nd ed. London, Lloyd's of London Press, 2004. (ISBN 1-84311-329-5)
B40. Forsberg, G. - Salvage from the sea. Glasgow, Brown, Son & Ferguson Ltd, 1977. (ISBN 0-71008698-9)
B41. Frampton, R. & Uttridge, P. - Meteorology for seafarers. 3rd ed. Glasgow, Brown, Son & Ferguson Ltd. 2008. (ISBN 978-0-85174-799-6)
B42. Gale, Capt. H- From Paper Charts to ECDIS - A practical voyage plan. The Nautical Institute, 2009 (ISBN 1-8700-7798-9)
B43. GASKELL, N. et al – Bills of lading: Law and contracts. London, Lloyd’s of London Press, 2000. (ISBN 1-85978-480-1)
B44. GAUCI, G. - Oil pollution at sea: Civil liability and compensation for damage. Chichester (West Sussex): John Wiley & Sons, 1997. (ISBN : 0-471-97066-2)
B45. Gibilisco, S- Meteorology Demystified, McGraw-Hill. 2006. (ISBN 0-071-48790-0)
B46. GOLD, E. - Gard handbook on marine pollution. 2nd ed. Arendal, (Norway), Assurance for engine Gard, 1997. (ISBN 82-90344-11-2)
B47. GORTON, L. / HILLENIUS, P. / IHRE, R. / SANDERVARN, A. - Ship broking and chartering practice. 6th ed. London, Lloyd's of London Press, 2004 (ISBN 1-8431-322-8)
B48. GUERRERO Jr, J. – Maritime cargo insurance. London, Witherby & Co. Ltd., 2003. (ISBN 1-85609-263-1)
B49. HAZELWOOD, S.J. - P & I Clubs: Law and practice. 3rd ed. London, Lloyd's of London Press, 2000 (ISBN 1-85978-531-X)
B50. Hensen, Capt, H. – Ship bridge simulators: A project handbook. London, Nautical Institute, 1999.
B51. Hobbs, R.R. - Marine navigation. Piloting, celestial and electronic navigation. 3rd Ed. Annapolis (MD) (USA), Naval Institute Press, 1994. (ISBN 0-87021-294-X)
B52. HODGES, S & HILL,C. – Principles of maritime law. London, Lloyd’s of London Press, 2001. (ISBN 1-85978-998-6)
B53. HODGES, S. - Law of marine insurance. London, Cavendish Publishing Ltd, 1996 (ISBN 1-85941-227-0)
B54. HOPKINS, F.N. - Business and law for the shipmaster. 7th ed. Glasgow (UK), Brown, Son & Ferguson Ltd, 1989. (ISBN 0-85174537-7)
B55. House, D.J. - Anchor Practice: A Guide for Industry, London, Witherby & Co. Ltd. 2006 (ISBN 1-8560-9212-7)
B56. House, D.J. - Marine survival and rescue systems. 2nd Ed. London, Witherby & Co. Ltd. 1997 (ISBN 1-85609-127-9)
B57. House, D.J. - Navigation for masters. 3rd Ed. London, Witherby & Co. Ltd, 2006 (ISBN 1-85609-271-2.
B58. House, D.J. - Seamanship techniques. 3rd. ed. Oxford, Elsevier Butterworth-Heinemann, 2005. (ISBN 0-7506-6315-4)
B59. House, D.J. - Seamanship techniques: for shipboard & maritime operations. 3rd ed. Butterworth-Heinemann, 2004 (ISBN 0-7506-6315-1)

B60. House, D.J. – Ship Handling- Theory and practice. Butterworth-Heinemann, 2007 (ISBN 0-7506-8530-6)
B61. House, D.J. - The Command companion of seamanship techniques. Vol. 3. Oxford, Butterworth-Heinemann, 2000 (ISBN 0-7506-4443-5)
B62. House, D.J. & Saeed, F - The Seamanship Examiner: For STCW Certification Examinations. Butterworth-Heinemann, 2005 (ISBN 0-7506-6701-2)
B63. House, Lloyd, Toomey & Dickin - The Ice Navigation Manual, Witherby Seamanship International Ltd, 2009 (ISBN 1-9053-3159-8)
B64. HUDSON, N and ALLEN, J. - Marine claims handbook. 5th ed. London, Lloyd's of London Press, 1996. (ISBN 1-85978-048-2)
B65. Hydrographer Of The Navy - Admiralty list of radio signals. 6 Vols. Taunton, (UK), Hydrographer of the Navy, 2001
B66. Hydrographer of the Navy (UK). - Admiralty manual of hydrographic surveying. Vol. 1, 1965. Taunton (UK), Hydrographer of the Navy
B67. Hydrographer of the Navy (UK). - Admiralty manual of hydrographic surveying. Vol. II, Taunton (UK), Hydrographer of the Navy
B68. Hydrographer of the Navy (UK). - Catalogue of admiralty charts and publications 2000. Taunton (UK): Hydrographer of the Navy, 2000.
B69. Hydrographer of the Navy (UK). - Symbols and abbreviations used on admiralty charts. (Chart 5011), 2nd. Ed. Taunton (UK), Hydrographer of the Navy, 1998.
B70. Hydrographer of the Navy (UK). - The mariner's handbook. 7th ed. Taunton (UK), Hydrographer of the Navy, 1999. (ISBN 0-707-71123-1)
B71. INTERNATIONAL ASSOCIATION OF CLASSIFICATION SOCIETIES (IACS) - Bulk carriers: Guidance and information to shipowners and operators. London : IACS, 1992
B72. INTERNATIONAL ASSOCIATION OF CLASSIFICATION SOCIETIES (IACS) - Bulk carriers: Guidelines for surveys, assessment and repair of hull structure. 3rd ed. London : Witherby and Co. Ltd, 1995 (ISBN : 1-85609-135-X)
B73. INTERNATIONAL ASSOCIATION OF CLASSIFICATION SOCIETIES (IACS) - Bulk carriers: Handle with care. London, IACS, 1998.
B74. INTERNATIONAL ASSOCIATION OF CLASSIFICATION SOCIETIES (IACS) - Bulk carriers: Guidelines for surveys, assessment and repair of hull structure. 3rd ed. London, Witherby & Co. Ltd, 1995 (ISBN 1-85609-135-X)
B75. INTERNATIONAL ASSOCIATION OF CLASSIFICATION SOCIETIES (IACS) – Container ships: Guidelines for surveys, assessment and repair of hull structures. London, Witherby & Co. Ltd, 2005. (ISBN 1-85609-296-8)
B76. INTERNATIONAL ASSOCIATION OF CLASSIFICATION SOCIETIES (IACS) - General cargo ships: Guidelines for surveys, assessment and repair of hull structure. London, Witherby & Co. Ltd, 1999 (ISBN 1-85609-189-9)
B77. INTERNATIONAL ASSOCIATION OF CLASSIFICATION SOCIETIES (IACS) - Guidelines for coatings maintenance and repairs. London, Witherby & Co. Ltd., 2005. (ISBN 1-85609-308-5)
B78. INTERNATIONAL ASSOCIATION OF DRY CARGO SHIPOWNERS (INTERCARGO) - Bulk carrier casualty report 2005, the previous ten years (1996-2005) and the trends. London, Intercargo, 2006
B79. INTERNATIONAL ASSOCIATION OF DRY CARGO SHIPOWNERS (INTERCARGO) - Port state control: A guide for ships involved in the dry bulk trades. London, Intercargo, 2000
B80. INTERNATIONAL ASSOCIATION OF DRY CARGO SHIPOWNERS (INTERCARGO) - Bulk carriers: Guidelines for surveys, assessment and repair

of hull structures. 2nd ed. London, Witherby & Co. Ltd, 2002 (ISBN 1-85609-223-2)

B81. INTERNATIONAL ASSOCIATION OF INDEPENDENT TANKER OWNERS (INTERTANKO) – A guide to crude oil washing and cargo heating criteria. Oslo, Intertanko, 2004.

B82. INTERNATIONAL ASSOCIATION OF INDEPENDENT TANKER OWNERS (INTERTANKO) - A guide for correct entries in the Oil Record Book (Part I – Machinery space operations). Revised edition. Oslo, Intertanko, 2006.

B83. INTERNATIONAL ASSOCIATION OF INDEPENDENT TANKER OWNERS (INTERTANKO) - A guide for vetting inspections. 3rd ed.. Oslo : Intertanko, 1997

B84. INTERNATIONAL ASSOCIATION OF INDEPENDENT TANKER OWNERS (INTERTANKO) - A Guide to International Environmental Management Systems (EMS). Oslo : Intertanko,

B85. INTERNATIONAL ASSOCIATION OF INDEPENDENT TANKER OWNERS (INTERTANKO) - A guide to bunkering of ships for the purposes of Annex VI to MARPOL. Oslo, Intertanko, 2004.

B86. International Association of Lighthouses Authorities (IALA). - IALA aids to navigation guide (NAVGUIDE). Edition 4. Paris : IALA, 2001

B87. International Association of Lighthouses Authorities (IALA). - IALA Vessel Traffic Services manual. Paris, IALA, 1993. (ISBN 2-910312-01-1)

B88. INTERNATIONAL CARGO HANDLING CO-ORDINATION ASSOCIATION (ICHCA) - The loading and unloading of solid bulk cargoes. London: ICHCA, 1998. (ISBN : 1-85330-096-9)

B89. INTERNATIONAL CARGO HANDLING COORDINATION ASSOCIATION (ICHCA) - The loading and unloading of solid bulk cargoes. London, ICHCA, 1998 (ISBN 1-85330-096-9)

B90. INTERNATIONAL CHAMBER OF SHIPPING (ICS) - Condition evaluation and maintenance of tanker structure. London, Witherby & Co. Ltd., 1992. (ISBN 1-85609-039-6)

B91. INTERNATIONAL CHAMBER OF SHIPPING (ICS) - International Safety Guide for Oil Tankers and Terminals (ISGOTT). 5th ed London, Witherby & Co. Ltd., 2006 (ISBN 1-85609-291-7)

B92. INTERNATIONAL CHAMBER OF SHIPPING (ICS) - Safety in chemical tankers. London, Witherby & Co. Ltd., 1977.

B93. INTERNATIONAL CHAMBER OF SHIPPING (ICS) - Safety in liquefied gas tankers. London, Witherby & Co. Ltd., 1980

B94. INTERNATIONAL CHAMBER OF SHIPPING (ICS) - Safety in oil tankers. London. Witherby & Co. Ltd., 1978.

B95. INTERNATIONAL CHAMBER OF SHIPPING (ICS) - Ship shore safety checklist for bulk carriers. London, ICS, 2000

B96. INTERNATIONAL CHAMBER OF SHIPPING (ICS) - Shipping and the environment: A code of practice. 3rd. Ed, London, ICS, 1999.

B97. INTERNATIONAL CHAMBER OF SHIPPING (ICS) - Tanker safety guide: Chemicals. 3rd. ed. London, ICS, 2002. (ISBN 0-906270-04-9)

B98. INTERNATIONAL CHAMBER OF SHIPPING (ICS) - Tanker safety guide: Liquefied gas. 2nd ed. London, ICS, 1995. (ISBN 0-906270-03-0)

B99. International Chamber of Shipping (ICS) / Oil Companies International Marine Forum (OCIMF) - Peril at sea and salvage: A guide for masters. 5th ed. London, Witherby & Co. Ltd., 1998. (ISBN 1- 5609-095-7)

B100. INTERNATIONAL CHAMBER OF SHIPPING (ICS) / OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF) - Clean seas guide for oil tankers. 4th ed. London Witherby & Co. Ltd., 1994 (ISBN 1-85609-058-2)
B101. INTERNATIONAL CHAMBER OF SHIPPING (ICS) / OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF) - Guidance manual for the inspection and condition assessment of tanker structures. London, Witherby & Co. Ltd., 1986. (ISBN 0-948691-11-5);
B102. INTERNATIONAL CHAMBER OF SHIPPING (ICS) / OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF) - Ship to ship transfer guide: Liquefied gases. 2nd ed. London, Witherby & Co. Ltd., 1995. (ISBN 1-85609-082-5);
B103. INTERNATIONAL CHAMBER OF SHIPPING (ICS) / OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF) - Ship to ship transfer guide: (Petroleum). 4th ed, London, Witherby & Co. Ltd., 2005. (ISBN 1-85609-258-5)
B104. INTERNATIONAL CHAMBER OF SHIPPING et al - Bulk carrier checklists. London, ICS, 1996
B105. International Hydrography Organization (IHO) - IHO/IMO world-wide navigational warning service. Guidance document. Monaco, IHO, 1995. (Special Publication No. 53. Language(s): E, F.
B106. INTERNATIONAL INSTITUTE OF MARINE SURVEYING -Code of practice for draught surveys. London, Witherby & Co. Ltd, 1998. (ISBN 1-85609-152-X)
B107. INTERNATIONAL LABOUR ORGANIZATION (ILO) - Maritime labour convention 2006. CD-ROM. Geneva, ILO, 2006. (ISBN 92-2-018784-1)
B108. International Maritime Pilot's Association (IMPA) – Required boarding arrangements for pilots. London, Witherby & Co. Ltd, 1995.
B109. INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO) - Ships and marine technology: Bulk carriers: Construction quality of hull structure. Geneva, ISO, 2000. (ISO 15401)
B110. INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO) - Ships and marine technology: Bulk carriers: Repair quality of hull structure. Geneva, ISO, 2000. (ISO 15402)
B111. INTERNATIONAL SHIPPING FEDERATION (ISF) - ILO Maritime Labour Convention: A guide for the shipping, London, ISF, 2006
B112. Irving, M. - Marine pilot safety. London, Nautical Institute, 1996. (ISBN 1-870077-31-8)
B113. ISBESTER, J. - Bulk carrier practice. London : The Nautical Institute, 1993 (ISBN : 1-870077-16-4)
B114. JACKSON, D. - Enforcement of maritime claims. 4th ed. London, Lloyd's of London Press, 2005. (ISBN 1-84311-424-0)
B115. JERVIS, B. – Reeds marine insurance. London, Adlard Coles Nautical, 2005. (ISBN 0-7136-7396-6) (http://www.adlardcoles.com)
B116. Jones, T.G. - Seamanship notes. 5th ed. Oxford, Butterworth-Heinemann, 1992. (ISBN 0-7506-0281-3)
B117. KEMP, J. F. & YOUNG, P, - Kandy: Cargo work. 5th ed. oxford, Butterworth-Heinemann, 1982. (ISBN 0-7506-0524-3)
B118. KEMP, J.F. & YOUNG, P. - Ship construction: Sketches and notes. Oxford, Butterworth-Heinemann, 1991. (ISBN 0-7506-0381-X)
B119. Khalique, A - Nav Basics. Witherby Seamanship International Ltd, 2009, (ISBN 9781905331581)

B120. Lee, Capt.G.W.U and Parker.C.J. - Managing Collision Avoidance at Sea. The Nautical Institute, 2007.(ISBN 1-8700-7786-6)
B121. Lloyd, Capt, M. - Captains Legal. Witherby Seamanship International Ltd, 2009 (ISBN 9781905331406)
B122. Lloyd, Capt, M. - In Command. Witherby Seamanship International Ltd, 2007 (ISBN 978 1 85609 353)
B123. Lloyd, Capt, M. - The Complete Chief Officer. Witherby Seamanship International Ltd, 2006 (ISBN 1-8560-9359-0)
B124. Lloyd, Capt, M. - The Masters Pocketbook Series – Checklists. Witherby Seamanship International Ltd, 2009 (ISBN 9781905331444)
B125. Lloyd, Capt, M. - The Pocket Book of Anchoring. Witherby Seamanship International Ltd, 2006, (ISBN 9781905331451)
B126. LLOYD'S OF LONDON PRESS (LLP) - Marine claims: A guide for the handling and prevention of marine claims. Lloyd's list practical guide. 2nd ed. London, LLP, 1996. (ISBN 1-85978-047-4)
B127. Lloyd's of London Press. - Lloyd's Nautical Yearbook, 2000. LLP Professional Publishing, 1999. (ISBN 1-85978-540-9)
B128. LLOYD'S REGISTER OF SHIPPING - Bulk carriers - The safety issues. London : Lloyd's Register of Shipping, 1991
B129. LLOYD'S REGISTER OF SHIPPING - Bulk carriers: An update (January 1996). London : Lloyd's Register of Shipping, 1996
B130. LLOYD'S REGISTER OF SHIPPING - Bulk carriers: Guidance to operators on the inspection of cargo holds. London : Lloyd's Register of Shipping, 1991
B131. LLOYD'S REGISTER OF SHIPPING - Lloyd’s register and the Standard. A master’s guide to hatch cover maintenance. London, Witherby & Co. Ltd, 2002 (ISBN 1-85609-232-1)
B132. LUDDEKE, C. & JOHNSON, A. - The Hamburg Rules. 2nd ed. London, Lloyd's of London Press, 1995. (ISBN 1-85044-84-1)
B133. LUX, J. (Ed). - Classification societies. London, Lloyd's of London Press, 1993. (ISBN 1-85044-491-9)
B134. M Notices - Consolidated list to August 1996. 3 Vols. (ISBN 0-11-551853-3)
B135. MANDARAKA-SHEPPARD, A. – Modern admiralty law. London, Cavendish Publishing Ltd, 2001. (ISBN 1-85941-531-8)
B136. Maritime And Coastal Agency - Code of safe working practice for merchant seamen. London, HMSO, 1998. (ISBN 0-11-551836-3)
B137. MEESON, N. - Admiralty jurisdiction and practice. 3rd. ed. London, LLP Professional Publishing, 2003. (ISBN 1-84311-271-X)
B138. Meteorological Office, The marine Observer’s Handbook. 11th ed (Met.0.,887).. London, HMSO, 1996 (ISBN 0-1140-0367-X)
B139. Ministry Of Defence (UK) - Admiralty manual of navigation. Vol. 1 - General navigation, 1986. London, HMSO
B140. Ministry Of Defence (UK) - Admiralty manual of navigation. Vol. 2 - Ocean navigation, 1973. London, HMSO
B141. Ministry Of Defence (UK) - Admiralty manual of navigation. Vol. 3 - Radio aids, etc... 1987. London, HMSO
B142. Moore, D.A. - International light, shape and sound signals. 2nd ed. Oxford, Butterworth-Heinemann, 1982. (ISBN 0-434-913-103)
B143. Morgans Technical Books - Seaman’s guide to the rule of the road. 6th Ed. Morgans Technical Books Ltd, 1995. (ISBN 0-948254-00-9)

B144. NAUTICAL INSTITUTE - Improving ship operational design. London, The Nautical Institute, 1998.
B145. NAUTICAL INSTITUTE - Master's role in collecting evidence. London, Nautical Institute, 1989. (ISBN 1-870077-05-9)
B146. NAUTICAL INSTITUTE - Safe operation of bulks carriers. London, Nautical Institute, 1991.
B147. NAUTICAL INSTITUTE - Seaworthiness: The Marine and the Maritime La w Series No. 3. London, Nautical Institute, 1992.
B148. NAUTICAL INSTITUTE - Signing bills of lading. London, Nautical Institute, 1992.
B149. NAUTICAL INSTITUTE - Unsafe berths and ports. London, Nautical Institute, 1992.
B150. Norris, Dr. A. - Radar and AIS-Vol 1 Integrated Bridge Systems. The Nautical Institute, 2008.(ISBN 1-8700-7795-8)
B151. Norris, Dr.A. - Integrated Bridge Systems, Vol 2 ECDIS and Positioning. The Nautical Institute, 2010. (ISBN 1-9069-1511-3)
B152. OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF) - Guide on marine terminal fire protection and emergency evacuation. London, Witherby & Co. Ltd., 1987. (ISBN 0-948691-30-1)
B153. OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF) - Marine and terminal operations survey guidelines. London, Witherby & Co. Ltd., 1994. (ISBN 1-85609-62-0)
B154. OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF) - Oil spill contingency planning: A brief guide. London, Witherby & Co. Ltd. 1990. (0-900886-40-4)
B155. OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF) - Oil spill fate and impact on the marine environment. London, Witherby & Co. Ltd., 1980. (ISBN 0-900-80086-49-8)
B156. OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF) - Recommendations for oil tanker manifolds and associated equipment. 4th ed. London, Witherby & Co. Ltd., 1991. (ISBN 1-85609-017-5)
B157. OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF) - Recommendations on equipment for towing of disabled tankers. London, Witherby & Co. Ltd., 1981. (ISBN 0-900886-65-X)
B158. OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF) - Safety guide for terminals handling ships carrying liquefied gases in bulk. 2nd ed. London. Witherby & Co. Ltd. 1993. (ISBN 1-85609-057-4)
B159. OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF) - Vessel inspection questionnaire for bulk oil/chemical carriers and gas carriers – V.I.Q. 2nd ed. London, Witherby & Co. Ltd, 2000. ISBN 1-85609-200-3)
B160. OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF) / INTERNATIONAL TANKER OWNERS POLLUTION FEDERATION (ITOPF) - Guidelines for the preparation of shipboard oil spill contingency plans. London, Witherby & Co. Ltd., 1990. (ISBN 1-85609-016-7)
B161. OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF) / SOCIETY OF INTERNATIONAL GAS TANKERS AND TERMINAL OPERATORS (SIGTTO) - Inspection guidelines for ships carrying liquefied gases in bulk. 2nd ed. London: Witherby & Co. Ltd, 1998. (ISBN :1-85609-139-2)
B162. OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF) / SOCIETY OF INTERNATIONAL GAS TANKERS AND TERMINAL OPERATORS (SIGTTO) -

Ship information questionnaire for gas carriers. 2nd ed. London, Witherby & Co. Ltd, 1998 (ISBN 1-85609-138-4)
B163. Oil Companies International Marine Forum (OCIMF). - Anchoring Systems and Procedures, 2nd edition. Witherby Seamanship International Ltd, 2010 (ISBN 1-8560-9404-9)
B164. Oil Companies International Marine Forum (OCIMF). - Effective mooring. London, Witherby & Co. Ltd., 1989. (ISBN 0-948691-88-3)
B165. Oil Companies International Marine Forum (OCIMF). - Guidelines and recommendations for the safe mooring of large ships at piers and sea islands. 2nd ed. London, Witherby & Co. Ltd., 1992. (ISBN 1-85609-041-8)
B166. Oil Companies International Marine Forum (OCIMF). - The Use of Large Tankers in Seasonal First-Year Ice and Severe Sub-Zero Conditions. Witherby Seamanship International Ltd 2010. (ISBN 1-8560-9429-4)
B167. OIL INTERNATIONAL COMPANIES MARINE FORUM (OCIMF) – Vessel inspection questionnaire for bulk oil/chemical carriers and gas carriers – V.I.Q. 2nd ed. London: Witherby & Co. Ltd, 2000 (ISBN : 1-85609-200-3)
B168. Owen, P. - High speed craft: A practical guide for deck officers. London, The Nautical Institute, 1995 (ISBN 1-870077-22-9)
B169. OZCAYIR, Z.O. - Liability for oil pollution and collisions. London, Lloyd's of London Press (ISBN 1-85978-179-9)
B170. PAMBORIDES, G.P. – International shipping law: Legislation and enforcement. The Hague : Kluwer Law International, 1999 (ISBN 90-411-1193-X)
B171. PAYNE & IVAMY - Marine insurance. 4th ed. Seven oaks (UK), Butterworth & Co. Ltd, 1985. (ISBN 0-406-25313-7)
B172. Peacock, Lt Cmdr A. - Astro Navigation- Admiralty Manual of Navigation Vol 2, 2004. (ISBN 1-8700-7765-1)
B173. Peacock, Lt Cmdr A. - The Principles of Navigation- The Admiralty Manual of Navigation Vol 1, 10th ed. 2008. (ISBN 1-8700-7790-3)
B174. PHILIPS, N. / CRAIG, N. – Merchant shipping act 1995 – Annotated guide. 2nd ed. London, Lloyd's of London Press, 2001. (IBSN 1-8597-8563-8)
B175. POLAND, S. ROOTH, T. - Gard handbook on P & I insurance. 4th ed. Arendal (Norway), Assuranceforeningen Gard , 1996 (ISBN 82-90344-16-3)
B176. RAINEY, S. - The Law of tug and tow. 2nd ed. London, Lloyd's of London Press, 2002. (ISBN 1-84311.169.1)
B177. Reed (Thomas) Publication Ltd - Reed marine distance tables. 7th Ed. Hampton Court (UK). Reed (Thomas) Publication Ltd, 1992. (ISBN 0-947637-27-3)
B178. REYNOLDS, M. - Arbitration. London, Lloyd's of London Press, 1995. (ISBN 1-85044-550-8)
B179. RHIDIAN THOMAS, D. (Ed) - Modern law of marine insurance. Vol. 1. London, Lloyd's of London Press, 1996. (ISBN 1-85978-033-4)
B180. RHIDIAN THOMAS, D. (Ed) - Modern law of marine insurance. Vol. 2. London Lloyd's of London Press, 2002. (ISBN 1-84311-120-9)
B181. RICHARDSON, J. - The Hague and Hague-Visby rules. 4th ed. London: Lloyd's of London Press, 1999. (Lloyd's Practical Shipping Guides) (ISBN : 1-85978-180-2)
B182. ROGERS, P, et al - Coal: Carriage by sea. 2nd ed. London, Lloyd's of London Press, 1997. (ISBN 1-85978-108-X)
B183. Rose, F. – Marine Insurance: law and practice. Informa, 2004 (ISBN 1-8431-1247-7)

B184. ROSES, F. - General average: Law and practice. London, Lloyd's of London Press, 1997. (ISBN 1-85978-158-6)
B185. SANDS, P. - Principles of international environmental law. 2nd. Ed. Cambridge, Cambridge University Press, 2003 (ISBN 0-521-81794-3)
B186. SCHOENBAUM, T.J. - Admiralty and maritime law. 3rd. Ed. St. Paul (Minn.) (USA), West Publishing Co., 2001. (ISBN 0-314-02711-4)
B187. SCHOFIELD, J. - Laytime and demurrage. 5th. Ed. London, Lloyd's of London Press, 2005. (ISBN 1-84311- 419-4)
B188. Society Of International Gas Tanker And Terminal Operators (SIGTTO) – A guide for passage planning for the transit of the Straits of Malacca and Singapore for vessels of draughts of less than 12 metres London, Witherby & co. Ltd, 2000. (ISBN 1-85609-195-3)
B189. SOCIETY OF INTERNATIONAL GAS TANKER AND TERMINAL OPERATORS (SIGTTO) - Crew safety standards and training for LNG carriers: Essential best practices for the industry. London, Witherby & Co. Ltd, 2003 (ISBN 1-85609-257-7)
B190. SOCIETY OF INTERNATIONAL GAS TANKER AND TERMINAL OPERATORS (SIGTTO) - Liquefied gas fire hazard management. London, Witherby & Co. Ltd., 2004. (ISBN 1-85609-265-8)
B191. SOCIETY OF INTERNATIONAL GAS TANKER AND TERMINAL OPERATORS (SIGTTO) - Liquefied gas carriers: Your personal safety guide. London, Witherby & Co. Ltd, 2002 (ISBN 1-85609-217-8)
B192. SOCIETY OF INTERNATIONAL GAS TANKER AND TERMINAL OPERATORS (SIGTTO) - LNG Operations in port areas: Essential best practices for the industry. London, Witherby & Co. ltd, 2004 (ISBN 1-85609-256-9)
B193. SPARKS, A.- Steel : Carriage by Sea. 4th ed. London, Lloyd's of London Press, 2003.
B194. Squairy W.H. - Modern chart work. 6th Ed. Glasgow (UK), Brown, Son & Ferguson Ltd, 1992. (ISBN 0-85174-548-2)
B195. Subramaniam, Capt. - Practical Navigation. 4th Edition. Nutshell Series Book 1. Vijaya Publications
B196. TANKER STRUCTURE CO-OPERATIVE FORUM - Guidance manual for tanker structures. London, Witherby & Co, Ltd, 1997. (ISBN 1-85609-093-0)
B197. TANKER STRUCTURE CO-OPERATIVE FORUM / INTERNATIONAL ASSOCIATION OF CLASSIFICATION SOCIETIES (IACS). - Guidelines for the inspection and maintenance of double hull tanker structures. London, Witherby & Co. Ltd., 1995. (ISBN 1-85609-080-9)
B198. TAYLOR, L. G. - Cargo work. 12th ed, Glasgow, Brown, Son & Ferguson Ltd. 1992. (ISBN 0-85174-605-5)
B199. TETLEY, W. - Maritime liens and claims. 2nd. ed. Montreal, International Shipping Publications, 1998. (ISBN 2-89451-227-9)
B200. The Standard. - A Master's Guide to Berthing. Witherby Seamanship International Ltd (ISBN 9781856092906)
B201. The Stationery Office. - Admiralty manual of seamanship. London HMSO, 1995. (ISBN 0-11-772695-8) Loose-leaf
B202. The Stationery Office. - The nautical almanac. London, HMSO. (Annual).
B203. THE TANKER STRUCTURE CO-OPERATIVE FORUM - Guidelines for ballast tank coating systems and surface preparation. London: Witherby & Co. Ltd., 2002. (ISBN : 1-85609-214-3)

B204. THOMAS, D.R. - Maritime liens. Andover (Hants, UK), Stevens, 1998. (ISBN 0-4216-0920-6)
B205. TODD, P. - Bills of lading and bankers' documentary credits. 3rd. ed. London, Lloyd's of London Press, 1998. (ISBN 1-85978-113-6)
B206. TUPPER, E.C. - Introduction to naval architecture. Butterworth-Heinemann, 1996. (ISBN 0-75062-529-5)
B207. UNITED NATIONS (UN) - United Nations Convention on the carriage of goods by sea, 1978 (Hamburg Rules). New York, 1994. (ISBN : 92-1-133494-2)
B208. Van Kluijven, P.C. et al - IMO standard marine communication phrases (Dutch-English). Alkmaar (The Netherlands) : De Alk & Heijnen bv, 2003 (ISBN : 90-5961-008-3)
B209. Various authors. Bridge Watchkeeping.2nd Ed. The Nautical Institute, 2003. (ISBN 1-8700-7717-0)
B210. Vervloesem, W. - Mooring and Anchoring Ships Vol 2 - Inspection and Maintenance. The Nautical Institute, 2009. (ISBN 1-8700-7794-1)
B211. VIDEOTEL MARINE INTERNATIONAL - Fighting pollution. (Book, video and posters), London, Videotel Marine International, 1991.
B212. Waugh, I. - The mariner's guide to marine communications.2nd Ed. London : The Nautical Institute, 2006 (ISBN : 1-870077-78-4) (http://www.nautinst.org)
B213. WILFORD, M. et al - Time charters. 5th ed. London, LLP Professional Publishing, 2003. (ISBN 1-84311-210-8)
B214. Williamson, P.R. - Ship manoeuvring principles and pilotage. London: Witherby & Co. Ltd., 2001. (ISBN : 1-85609-210-0)
B215. WITHERBY & CO. LTD. - Condition evaluation and maintenance of tanker structures. London, Witherby & Co. Ltd., 1992. (ISBN 1-85609-039-6)
B216. WITHERBY SEAMANSHIP INTERNATIONAL – Chemical tankers: A pocket safety guide. London, Witherbys Publishing Ltd., 2006 (ISBN – 1-85609-324-7)
B217. WITHERBY SEAMANSHIP INTERNATIONAL - LNG: Operational practice. London, Witherbys Publishing Ltd., 2006 (ISBN – 1-85609-321-7)
B218. Witherby Seamanship International Ltd - Macneil's Seamanship Examiner MATES/MASTERS Pocket Book, 2010. (ISBN 9781856094146)
B219. Witherby Seamanship International Ltd - Macneil's Seamanship Examiner COLREGS Pocket Book, 2010 (ISBN 9781 856094122)
B220. Witherby Seamanship International Ltd - Passage Planning Guide - English Channel and Dover Strait, 2010 (ISBN 1-9053-3194-0)
B221. Witherby Seamanship International Ltd - Passage Planning Guide – Malacca & Singapore Straits 2nd Ed, 2010 (ISBN 1905331940)
B222. Witherby Seamanship International Ltd - Regulatory Primer for Mates & Masters Covering Current and New Regulations, 2010 (ISBN 9781856094207)
B223. World Meteorological Organization (WMO) - Handbook on marine meteorological services. Geneva, WMO, 1991.
B224. World Meteorological Organization (WMO) - Manual on marine meteorological services. 2 Vols. Geneva, WMO, 1990.

Master and Chief Mate

Function 1:

Navigation at the Management Level

Master and Chief Mate
Function 1: Navigation at the Management Level

INDEX

Course Outline

■ Timetable

No formal example of a timetable is included in this model course.
Development of a detailed timetable depends on the level of skills of the officers entering the course and the amount of revision work of basic principles that may be required.

Lecturers must develop their own timetable depending on:

- the level of skills of trainees
- the numbers to be trained
- the number of instructors

and normal practices at the training establishment.

Preparation and planning constitute an important factor which makes a major contribution to the effective presentation of any course of instruction.

■ Lectures

As far as possible, lectures should be presented within a familiar context and should make use of practical examples. They should be well illustrated with diagrams, photographs and charts where appropriate, and be related to matter learned during seagoing time.

An effective manner of presentation is to develop a technique of giving information and then reinforcing it. For example, first tell the trainees briefly what you are going to present to them; then cover the topic in detail; and, finally, summarize what you have told them. The use of an overhead projector and the distribution of copies of the transparencies as trainees handouts contribute to the learning process.

■ Course Outline

The tables that follow list the competencies and areas of knowledge, understanding and proficiency, together with the estimated total hours required for lectures and practical exercises. Teaching staff should note that timings are suggestions only and should be adapted to suit individual groups of trainees depending on their experience, ability, equipment and staff available for training.

COURSE OUTLINE

Knowledge, understanding and proficiency			Total hours for each topic	Total hours for each subject area of Required performance
Competence:				
1.1	**PLAN A VOYAGE AND CONDUCT NAVIGATION**			
1.1.1	VOYAGE PLANNING AND NAVIGATION FOR ALL CONDITIONS			
	.1	Log Books	3	
	.2	Voyage planning and navigation for all conditions by acceptable methods of plotting ocean tracks	24	27
1.1.2	ROUTEING IN ACCORDANCE WITH THE GENERAL PROVISIONS ON SHIP'S ROUTEING			
	.1	Routeing	12	12
1.1.3	REPORTINGIN ACCORDANCE WITH THE GENERAL PRINCIPLES FOR SHIP REPORTING SYSTEMS AND WITH VTS PROCEDURES			
	.1	Ship reporting systems	1	1
1.2	**DETERMINE POSITION AND THE ACCURACY OF RESULTANT POSITION FIX BY ANY MEANS**			
1.2.1	POSITION DETERMINATION IN ALL CONDITIONS			
	.1	Celestial observations	24	
	.2	Terrestrial observations, including the ability to use appropriate charts, notices to mariners and other publications to assess the accuracy of the resulting fix	24	
	.3	Modern electronic navigational aids with specific knowledge of their operating principles, limitations, sources of error, detection of misrepresentation of information and methods of correction to obtain accurate position fixing	32	80

Knowledge, understanding and proficiency			Total hours for each topic	Total hours for each subject area of Required performance
1.3	**DETERMINE AND ALLOW FOR COMPASS ERRORS**			
1.3.1	MAGNETIC COMPASSES			
	.1	Parts of the magnetic compass and their function	3	3
1.3.2	THE PRINCIPLES AND ERRORS OF GYRO COMPASSES			
	.1	The Principles of gyro compasses	3	
	.2	Gyro compass errors and correction	7	10
1.3.3	SYSTEMS UNDER THE CONTROL OF THE MASTER GYRO AND THE OPERATION AND CARE OF THE MAIN TYPES OF GYRO-COMPASSES			
	.1	Systems under the control of the master gyro and the operation and care of the main types of gyro-compasses	2	2
1.4	**CO-ORDINATE SEARCH AND RESCUE OPERATIONS**			
	See IMO Model Course No. 1.08 and STCW Reg. I/12			
1.5	**ESTABLISH WATCH-KEEPING ARRANGEMENTS AND PROCEDURES**			
1.5.1	THE INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA			
	.1	Thorough knowledge of content, application and intent of the International Regulations for Preventing Collisions at Sea, 1972, as amended	30	30
1.5.2	PRINCIPLES TO BE OBSERVED IN KEEPING A NAVIGATIONAL WATCH			
	.1	Thorough knowledge of the content, application and intent of the Principles to be observed in keeping a navigational watch	6	6

Knowledge, understanding and proficiency		Total hours for each topic	Total hours for each subject area of Required performance
1.6	**MAINTAIN SAFE NAVIGATION THROUGH THE USE OF INFORMATION FROM NAVIGATION EQUIPMENT AND SYSTEMS TO ASSIST COMMAND DECISION-MAKING**		
	See IMO Model Course No. 1.08, 1.22, 1.27 and STCW Reg. I/12		
1.7	**MAINTAIN THE SAFETY OF NAVIGATION THROUGH THE USE OF ECDIS AND ASSOCIATED NAVIGATION SYSTEMS TO ASSIST COMMAND DECISION MAKING**		
	See IMO Model Course No. 1.27 Operational Use of Electronic Chart Display and Information Systems (ECDIS)and STCW Reg I/12		
1.8	**FORECAST WEATHER AND OCEANOGRAPHIC CONDITIONS**		
1.8.1	SYNOPTIC CHARTS AND WEATHER FORECASTING		
	.1 The planetary system of wind and pressure	2	
	.2 The weather associated with the principle air mass types	2	
	.3 Synoptic and prognostic charts and forecasts from any source	2	
	.4 The range of information available through fax transmission, internet and email	3	
	.5 The main types of floating ice, their origins and movements	2	
	.6 The guiding principles relating to the safety of navigation in the vicinity of ice	1	
	.7 Conditions leading to ice accretion on ship's superstructures, dangers and remedies available	2	14
1.8.2	CHARACTERISTICS OF VARIOUS WEATHER SYSTEMS		
	.1 The formation, structure and weather associated with the principle frontal systems	2	
	.2 The formation of, and weather associated with, frontal and non- frontal depressions	2	
	.3 The formation and weather characteristics of	2	

Knowledge, understanding and proficiency			Total hours for each topic	Total hours for each subject area of Required performance
		non-frontal weather systems		
	.4	Tropical revolving storms (TRS)	2	8
1.8.3	OCEAN CURRENT SYSTEMS			
	.1	Surface water circulation of the ocean and principal adjoining seas	3	
	.2	The principle of voyage planning with respect to weather conditions and wave height	2	
	.3	The formation of sea waves and swell waves	2	7
1.8.4	CALCULATION OF TIDAL CONDITIONS			
	.1	Ability to calculate tidal conditions	6	6
1.8.5	APPROPRIATE NAUTICAL PUBLICATIONS ON TIDES AND CURRENTS			
	.1	Nautical publications on tides and currents and information which can be obtained via internet and email	2	3
1.9	**RESPOND TO NAVIGATIONAL EMERGENCIES**			
1.9.1	PRECAUTIONS WHEN BEACHING A SHIP			
	.1	Precautions when beaching a ship	2	2
1.9.2	ACTION TO BE TAKEN IF GROUNDING IS IMMINENT AND AFTER GROUNDING			
	.1	Action to be taken if grounding is imminent and after grounding	2	2
1.9.3	RE-FLOATING A GROUNDED SHIP WITH AND WITHOUT ASSISTANCE			
	.1	Refloating a grounded ship with and without assistance	1	1
1.9.4	ACTION TO BE TAKEN IF COLLISION IS IMMINENT AND FOLLOWING A COLLISION OR IMPAIRMENT OF THE WATERTIGHT INTEGRITY OF THE HULL BY ANY CAUSE			
	.1	Action to be taken if collision is imminent and following a collision or impairment of the watertight integrity of the hull by any cause	2	2
1.9.5	ASSESSMENT OF DAMAGE CONTROL			
	.1	Assessment of damage control	1	1

Knowledge, understanding and proficiency			Total hours for each topic	Total hours for each subject area of Required performance
1.9.6	EMERGENCY STEERING			
	.1	Emergency steering	1	1
1.9.7	EMERGENCY TOWING ARRANGEMENTS AND TOWING PROCEDURES			
	.1	Emergency towing arrangements and towing procedure	2	2
1.10	**MANOEUVRE AND HANDLE A SHIP IN ALL CONDITIONS** *(Also refer to IMO Model Course No. 1.22 Ship Simulator and Bridge Teamwork and STCW Reg I/12)*			
1.10.1	MANOEUVRE AND HANDLING A SHIP IN ALL CONDITIONS			
	.1	Approaching pilot stations and embarking or disembarking pilots, with due regard to weather, tide, headreach and stopping distances	4	
	.2	Handling ship in rivers, estuaries and restricted waters, having regard to the effects of current, wind and restricted water on helm response	10	
	.3	Application of Constant rate of turn techniques	1	
	.4	Manoeuvring in shallow water including the reduction in under-keel clearance caused by squat, rolling and pitching	2	
	.5	Interaction between passing ships and between own ship and nearby banks (canal effect)	2	
	.6	Berthing and un-berthing under various conditions of wind, tide and current with and without tugs	12	
	.7	Ship and tug interaction	3	
	.8	Use of propulsion and manoeuvring systems including different types of Rudder	2	
	.9	Types of Anchors; choice of anchorage; anchoring with one or two anchors in limited anchorages and factors involved in determining the length of anchor cable to be used	6	
	.10	Procedures for anchoring in deep water and in shallow water	1	
	.11	Dragging anchor; clearing fouled anchors	1	
	.12	Dry-docking, both with and without damage	2	

Knowledge, understanding and proficiency		Total hours for each topic	Total hours for each subject area of Required performance
	.13 Management and Handling ships in heavy weather including assisting a ship or aircraft in distress; towing operations; means of keeping an unmanageable ship out of a sea trough, lessening lee drift and use of oil	6	
	.14 Precautions in manoeuvring to launch rescue boats or survival craft in bad weather	2	
	.15 Methods of taking on board survivors from rescue boats and survival craft	1	
	.16 Ability to determine the Manoeuvring and propulsion characteristics of common types of ships, with special reference to stopping distances and turning circles at various draughts and speeds	3	
	.17 Importance of navigating at reduced speed to avoid Damage caused due to own ship's bow and stern waves	1	
	.18 Practical measures to be taken when Navigating in or near ice or in conditions of ice accumulation on board	3	
	.19 Use of, and Manoeuvring in and near traffic separation schemes and in vessel traffic service (VTS) areas	2	64
1.11	**OPERATE REMOTE CONTROLS OF PROPULSION PLANT AND ENGINEERING SYSTEMS AND SERVICES**		
1.11.1	OPERATING PRINCIPLES OF MARINE POWER PLANTS	25	25
1.11.2	SHIPS' AUXILIARY MACHINERY	25	25
1.11.3	GENERAL KNOWLEDGE OF MARINE ENGINEERING TERMS		
	.1 Marine engineering terms and fuel consumption	4	4
1.10.4	ENGINE ROOM WATCHKEEPING		
	.1 Arrangements necessary for appropriate and effective engineering watches to be maintained for the purpose of safety under normal circumstances and UMS operations	2	
	.2 Arrangements necessary to ensure a safe	2	4

Knowledge, understanding and proficiency	Total hours for each topic	Total hours for each subject area of Required performance
engineering watch is maintained when carrying dangerous cargo		
Total for Function 1: Navigation at the Management Level		**342**

Teaching staff should note that the hours for lectures and exercises are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by lecturers to suit individual groups of trainees depending on their experience, ability, equipment and staff available for teaching.

Part C1: Detailed Teaching Syllabus

■ Introduction

The detailed teaching syllabus is presented as a series of learning objectives. The objective, therefore, describes what the trainee must do to demonstrate that the specified knowledge or skill has been transferred.

Thus each training outcome is supported by a number of related performance elements in which the trainee is required to be proficient. The teaching syllabus shows the *Required performance* expected of the trainee in the tables that follow.

In order to assist the instructor, references are shown to indicate IMO references and publications, textbooks and teaching aids that instructors may wish to use in preparing and presenting their lessons.

The material listed in the course framework has been used to structure the detailed teaching syllabus; in particular,

- o Teaching aids (indicated by A) which includes:
- o IMO references (indicated by R)
- o Textbooks (indicated by T) and
- o Bibliography (indicated by B)

will provide valuable information to instructors.

■ Explanation of Information Contained in the Syllabus Tables

The information on each table is systematically organised in the following way. The line at the head of the table describes the FUNCTION with which the training is concerned. A function means a group of tasks, duties and responsibilities as specified in the STCW Code. It describes related activities which make up a professional discipline or traditional departmental responsibility on board.[1]

In this Model Course there are three functions:

- o Navigation at the Management Level
- o Cargo Handling and Stowage at the Management Level
- o Controlling the Operation of the Ship and Care for Persons on Board at the Management Level.

The header of the first column denotes the **COMPETENCE** concerned. Each function comprises a number of competences. For example, the Function 1, Navigation at the Management Level, comprises a total of eleven COMPETENCES. Each competence is uniquely and consistently numbered in this model course.

1 Morrison, W.S.G. Competent crews = safer ships. Malmo, WMU Press, 1997 (ISBN 91-973372-0-X)

The first is **Plan a Voyage and Conduct Navigation.** It is numbered 1.1, that is the first competence in Function 1. The term competence should be understood as the application of knowledge, understanding, proficiency, skills, experience for an individual to perform a task, duty or responsibility on board in a safe, efficient and timely manner.

Shown next is the required TRAINING OUTCOME. The training outcomes are the areas of knowledge, understanding and proficiency in which the trainee must be able to demonstrate knowledge and understanding. Each COMPETENCE comprises a number of training outcomes. For example, the competence **Plan a Voyage and Conduct Navigation** comprises a total of seven training outcomes. The first is in VOYAGE PLANNING AND NAVIGATION FOR ALL CONDITIONS. Each training outcome is uniquely and consistently numbered in this model course. That concerned with Voyage Planning and Navigation for all Conditions is uniquely numbered 1.1.1. For clarity, training outcomes are printed in black on grey, for example TRAINING OUTCOME.

Finally, each training outcome embodies a variable number of required performances - as evidence of competence. The instruction, training and learning should lead to the trainee meeting the specified required performance. For the training outcome Voyage Planning and Navigation for all Conditions, there are two areas of performance. These are:

1.1.1.1 Log Books
1.1.1.2 Navigation Planning for all Conditions

Following each numbered area of Required performance there is a list of activities that the trainee should complete and which collectively specify the standard of competence that the trainee must meet. These are for the guidance of teachers and instructors in designing lessons, lectures, tests and exercises for use in the teaching process. For example, under the topic 1.1.1.2 Navigational Planning for all Conditions, to meet the Required performance, the trainee should be able to:

- o plan navigation in restricted waters by day, using terrestrial observations…
- o plan navigation in restricted waters by night…
- o plan navigation in restricted visibility…

and so on.

IMO references (Rx) are listed in the column to the right hand side. Teaching aids (Ax), videos and CBT’s (Vx) ,textbooks (Tx) and bibliography (Bx) relevant to the training outcome and required performances are placed immediately following the TRAINING OUTCOME title.

It is not intended that lessons are organised to follow the sequence of required performances listed in the Tables. The Syllabus Tables are organised to match with the competence in the STCW Code Table A-II/2. Lessons and teaching should follow college practices. It is not necessary, for example, for celestial navigation to be studied before tides. What is necessary is that all the material is covered and that teaching is effective to allow trainees to meet the standard of the required performance.

COMPETENCE 1.1 Plan a Voyage and Conduct Navigation	IMO Reference
TRAINING OUTCOMES:	STCW Code Table A-II/2
Demonstrates a knowledge and understanding of	
1.1.1 VOYAGE PLANNING AND NAVIGATION FOR ALL CONDITIONS	
1.1.2 ROUTEING IN ACCORDANCE WITH THE GENERAL PROVISIONS ON SHIP'S ROUTEING	
1.1.3 REPORTING IN ACCORDANCE WITH THE GENERAL PRINCIPLES FOR SHIP REPORTING	

COMPETENCE 1.1 Plan a Voyage and Conduct Navigation	IMO Reference

1.1.1 VOYAGE PLANNING AND NAVIGATION FOR ALL CONDITIONS

Textbooks / Bibliography: T2, T12, T38, T39, B7, B8, B12, B26, B36, B51, B57, B58, B60, B68, B69, B70, B86, B87, B105, B108, B119, B127, B134, B136, B138, B139, B140, B141, B142, B172, B173, B177, B194, B202, B209, B212, B220, B221

Teaching aids: A1, A2, A3, A8, A10, A13, A14, A15, A16, A17, A18, A19, A20, A21, A22, A23, A24, A25, A26, A27, V20, V21, V22, V23, V34, V40, V41, V125

Required performance:

1.1 Log Books (3 hours) — R1

- keeps a proper log in accordance with maritime shipping acts and other laws and regulations

1.2 Navigation Planning for all Conditions (24 hours) — R1, R3, R32, R33, R34, R48, R49

- plans navigation after analysing and evaluating current legislation (if applicable) with regard to Passage and Voyage Planning and as per the requirements of International Maritime Organisation resolution A.893
- plans navigation after utilising the principles of passage planning to make a complete appraisal of a proposed passage
- plans navigation taking into account restricted waters, en-route, in conjunction and utilising Navigational charts, Admiralty Routeing charts, Ocean Passages of the World, Admiralty Sailing Directions, Tide tables, to appraise a proposed ocean passage and a coastal or pilotage passage
- plans navigation using appropriate strategies and contingency plans in order to deal with various factors, such as:
  - encountering restricted visibility
  - expected meteorological conditions
  - navigational hazards and no go areas
  - making landfall
  - accuracy of position fixing required in critical areas
  - encountering or navigating in ice infested waters.
  - areas of restricted / confined waters
  - traffic separation schemes en-route
  - expected traffic density

COMPETENCE 1.1	Plan a Voyage and Conduct Navigation	IMO Reference

- areas of extensive tidal effects
- ship reporting requirements in vessel traffic service (VTS) areas
- approaching a port or anchorage

1.1.2 ROUTEING IN ACCORDING WITH THE GENERAL PROVISIONS ON SHIP'S ROUTEING

Textbooks/ Bibliography: T2, T3, B8, B57, B68, B177

Teaching aids: A1, A3, A11, A12, A13, A23, A24, V1

Required performance:

2.1 Routeing (12 hours) — R2, R3, R48, R49, R50

- uses Ocean Passages for the World
- uses pilot charts and other publications such as sailing directions, Notices to Mariners and the like to determine areas of ice and iceberg danger
- uses pilot charts and other information sources to determine areas in which visibility is likely to be reduced
- demonstrates an ability to choose select a route, taking into account distance, wind, sea states, current, ice, icebergs, bad visibility, the nature of the cargo, load lines, crew agreements etc.
- explains the principles of Weather Routeing

1.1.3 REPORTING IN ACCORDANCE WITH THE GENERAL PRINCIPLES FOR SHIP REPORTING SYSTEMS AND WITH VTS PROCEDURES

Textbooks/ Bibliography: T2

Teaching aids: A1, A3, A25, V27

Required performance:

3.1 Ship Reporting Systems (1 hour) — R1

- explains the general principles for various ship reporting systems — R2 Reg. V/8-1 R3, R14
- explains the general principles for reporting as per VTS procedures
- makes reports in accordance with published procedures and criteria

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

TRAINING OUTCOME: STCW Code Table A-II/2

Demonstrates a knowledge and understanding of:

1.2.1 POSITION DETERMINATION IN ALL CONDITIONS

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

1.2.1 POSITION DETERMINATION IN ALL CONDITIONS

Textbooks / Bibliography: T1, T2, T6, T7, T29, T38, T39, B7, B8, B12, B26, B27, B42, B50, B51, B57, B58, B119, B139, B140, B141, B150, B151, B172, B173, B195, B202

Teaching aids: A1, A2, A4, A5, A6, A7, A8, A9, A10, A16, A17, A18, A26, A28, A30, A32, A33, A34, A35, A36, A37, A38, A39, A40, V26, V40, V41, V42, V139, V150, V151

Required performance:

1.1 Celestial Navigation (24 hours) R1

- Using a celestial body determines the direction of a position line through an observer and a position through which it passes
- applies the calculated zenith distance to the true zenith distance of the body to find the intercept and the intercept terminal point through which to draw the position line (Marcq St. Hilaire also known as : Intercept method)
- obtains the longitude of the observer and the direction of the position line through an observer using a celestial body (Longitude by Chronometer Method)
- applies the true zenith distance of a celestial body when it is on the observer's meridian to the declination of the body, to obtain the observer's latitude (Latitude by Meridian Altitude)
- obtains the corrections, -1°+ a_0+ a_1 + a_2, from pole star tables in the nautical almanac and applies them to the altitude of Polaris to find the latitude of the observer
- finds the true azimuth of Polaris from the tables and the direction of the position line
- classifies stars by apparent magnitude
- chooses stars suitable for observation in the twilight period
- identifies stars by means of a star chart, a star finder and by calculation using Sidereal Hour Angle (SHA)and declination of the star
- finds the position of the observer at the time of the final observation, given two or more position lines with the courses and distances run between the observations using simultaneous / staggered observations

1.2 Terrestrial observations, including the ability to use R1

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

appropriate charts, notices to mariners and other publications to assess the accuracy of the resulting fix (24 hours)

- states the Mercator sailing formula
- uses the Mercator formula to calculate course and distance between two positions
- uses the Mercator formula to calculate the final position, given the initial position, course and distance
- calculates initial course and distance of a great-circle track
- calculates the position of the vertex
- calculates intermediate positions on the great circle and the course at these points
- calculates the distance and time to sail per 1^0 change of course
- calculates composite sailing
- demonstrates the use of gnomonic charts for plotting the great circle between two points
- transfers a great circle to a Mercator chart
- explains how errors may occur in position fixing, and explains how to minimize the probability of errors
- demonstrates how erroneous position lines influence the positions
- uses appropriate charts, notices to mariners and other publications to assess the accuracy of the resulting fix
- demonstrates the use of a chart catalogue
- demonstrates the correcting of charts using information from notices to mariners

1.3 Modern electronic navigational aids with specific knowledge of their operating principles, limitations, sources of error, detection of misrepresentation of information and methods of correction to obtain accurate position fixing (32 hours) — R1, R5, R36, R44, R45,

3.1 LORAN-C (2 hour)

- describes the operating principle of Loran-C
- state the importance of coding delay
- explains the meaning of Group Repetition Interval (GRI)
- describes the principles of time difference used in the Loran-C system
- lists and explains the errors of Loran-C, including
  - Ground wave propagation error
  - Sky wave error

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

- Lattice error
    - Synchronisation error
    - Envelope to cycle discrepancy
    - Receiver error
- explains and demonstrates how position fixing is achieved using Loran-C

3.2 Enhanced Loran (eLoran) (3 hours)

- describes the operating principles of eLoran and that it is a terrestrial navigation system
- states that eLoran is an independent, dissimilar, complement to Global Navigation Satellite Systems (GNSS)
- states that the principal difference between eLoran and traditional Loran-C is the addition of a data channel on the transmitted signal
- explains that the eLoran will allow GNSS users to retain the safety, security, and economic benefits of GNSS, even when their satellite services are disrupted
- explains that each user's eLoran receiver will be operable in all regions where an eLoran service is provided and eLoran receivers shall work automatically, with minimal user input
- describes that the core eLoran system comprises of modernized control centers, transmitting stations and monitoring sites
- explains that eLoran transmissions are synchronized to an identifiable, publicly-certified, source of Coordinated Universal Time (UTC) by a method wholly independent of GNSS
- explains that eLoran users' receivers operate in an all-in-view mode. That is, they acquire and track the signals of many Loran stations (the same way GNSS receivers acquire and track multiple satellites) and employ them to make the most accurate and reliable position and timing measurements
- states that an important bonus of using eLoran – something GNSS cannot provide – is the eLoran compass. How, when the receiver is used with an H-field (Magnetic Loop) antenna it can be employed as an automatic direction-finder taking bearings on the transmitting stations. From these, the receiver calculates the ship's heading, generally with an accuracy of better than 1°, and independent of the ship's movement
- describes the limitation of the eLoran system receiver

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

3.3 Global Positioning System (GPS) (3 hours)

- describes the principle on which the Global Positioning System (GPS) operates
- describes the configuration of satellite orbits and the periods of the satellite vehicles (SVs)
- states that at least four SVs at a usable elevation should be visible to the receiving antenna at any point on the earth's surface at any time
- states that SV positions are accurately controlled from the ground Master Control Station
- states that the Master Control Station also provides data which are sent to the SVs, stored and later transmitted as a data frame to receiving stations for use in calculating position
- explains what is meant by 'pseudo-random noise' codes (PRN codes) - describes briefly the two codes which are transmitted - explains why two frequencies are used
- states that civilian sets will probably work on one frequency, using the 'course and acquire' code (C/A code) only
- explains why an extremely stable clock is essential in the SV, while a less stable one is acceptable in the receiver
- describes briefly how pseudo-ranges are measured by matching the received code with the same locally generated code
- explains why the measurement is not a true range
- states that simultaneous pseudo-ranges to three SVs are sufficient to fix the position of the earth's surface and determine the receiver clock error from GPS time but four are required to obtain height
- lists and describes the main sources of error in the determined position
- states that the system is expected to have an accuracy of about 100 metres (95% probability)
- states that measured Doppler shifts can be processed to provide speed and direction outputs

3.4 Differential GPS (DGPS) including other satellite navigation systems (3 hours)

- explains the use of differential GPS
- describes the principle on which the Differential GPS work

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

- describes the two methods by which the DGPS station can transmit the corrections
- states that the system is expected to have an accuracy of 3 – 5 metres
- briefly describes the Regional Satellite Navigation Systems such as China's BeiDou (COMPASS) Navigation Satellite System, India's Indian Regional Navigational Satellite System (IRNSS), Japan's Quasi-Zenith Satellite System (QZSS) and France’s Doppler Orbitography and Radio positioning Integrated by Satellite (DORIS)
- describes the limitation of the DGPS receiver

3.5 Global Navigation Satellite System (GLONASS)
(3 hours)

- explains that GLONASS (Global Navigation Satellite System) is a space-based three-dimensional positioning, three-dimensional velocity and time system, which is managed for the Government of the Russian Federation by the Russian Space Agency
- describes the working principle of GLONASS
- explains the GLONASS 3 plane versus the GPS 6 plane satellite constellation and the differing inclinations of 65 degrees and 55 degrees respectively
- describe the advantage of the receiver capable of operating on both GLONASS and GPS - "combined GPS/GLONASS receiver equipment"
- explains that GLONASS system utilises a global datum based on the Soviet Geocentric Coordinate System 1990 (SGS 90)
- describes the limitation of the GLONASS system receiver

3.6 Galileo (3 hours)

- explains that Galileo is the European satellite navigation system, designed as a wholly civil system, operated under public control and is a 2nd generation Global Navigation Satellite System (GNSS)
- describes that Galileo comprises 30 medium earth orbit (MEO) satellites in 3 circular orbits.
- states that each orbit has an inclination of 56° and contains 9 operational satellites plus one operational spare
- states that this geometry ensures that a minimum of 6 satellites are in view to user world-wide with a position

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

dilution of precision (PDOP) ≤ 3.5
- states that Galileo transmits 10 navigation signals and 1 search and rescue (SAR) signal
- explains the concept of Galileo, where each satellite will have two types of atomic clocks, 4 in total (2 rubidium frequency stranded and 2 passive hydrogen maser) - critical to any sat-nav system and a number of other components
- states that the atomic clocks provide an accurate timing signal for a receiver to calculate the time that it takes the signal to reach the target
- explains that this information is used to calculate the position of the receiver by triangulating the difference in received signals from multiple satellites
- states that the Galileo receiver equipment provides a warning within 5 seconds of loss of position or if a new position based on the information provided by the Galileo constellation has not been calculated for more than 1 second for conventional craft and 0.5 seconds for high-speed craft
- states that the Galileo uses Galileo Terrestrial Frame System (GTRF) datum which is a realization of the International Terrestrial Frame Reference (ITRF) system and differs from WGS 84 by less than 5 cm worldwide
- states that some Galileo receiver equipment also has the capability to process the Galileo Safety of Life Service
- describes the limitation of the Galileo system receiver

3.7 Automatic Identification System (AIS)
(3 hours)

- explains that the Automatic Identification System (AIS) is a Very High Frequency (VHF) radio broadcasting system
- states that the international requirement for the carriage of AIS as ship-borne navigational equipment on vessels is detailed within Chapter V (Safety of Navigation) Regulation19, of the revised SOLAS Convention
- explains that the AIS transfers data over VHF, via a VHF data link (VDL), which enables AIS equipped vessels and shore-based stations to send and receive identification information
- states that the information received from the AIS can then be displayed on an electronic chart, computer

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

display or compatible radar and the information received can help situational awareness as well as provide a means to assist in collision avoidance
- explains that the principle of AIS is to allow automatic exchange of shipboard information from the vessel's sensors - inputted, static, dynamic and voyage related data - between one vessel and another and between a vessel and a shore station(s)
- lists that the principal functions of the AIS are to facilitate:
  - information exchange between vessels within VHF range of each other, increasing situational awareness
  - information exchange between a vessel and a shore station, such as a VTS, to improve traffic management in congested waterways
  - automatic reporting in areas of mandatory and voluntary reporting
  - exchange of safety related information between vessels, and between vessels and shore station(s)
- explains the two types Class A and Class B of AIS
- describes the working of the AIS, how the AIS uses a time-division multiple access (TDMA) scheme to share the VHF frequency, also known as the VHF Data Link (VDL)
- states that there are two dedicated frequencies used for AIS – AIS 1 (161.975 MHz) and AIS 2 (162.025 MHz)
- explains that the VHF Data Link (VDL) is divided into time slots that are repeated every 60 seconds and that each AIS unit sends a report to one of the time slots, while at the same time AIS units in range listen to all the timeslots and read the reported information
- state that the AIS should always be in operation and it is recommended that the AIS is not switched off during port stays because of the value of the ship information to port authorities whether at sea or in port; if the Master believes that the continued operation of AIS might compromise the ship's safety or security, the AIS may be switched off; however, the equipment should be reactivated as soon as the source of danger has disappeared
- explains that the Officer of the Watch (OOW) should always be aware that other ships and, in particular, pleasure craft, fishing boats and warships, and some shore stations including Vessel Traffic Service (VTS) centres, might not be fitted with AIS and the OOW

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

should always be aware that AIS fitted on other ships as a mandatory carriage requirement, might, under certain circumstances, be switched off, based on the Master's professional judgement

- describe that the AIS, once activated, will continuously and autonomously broadcast the vessel's position and all the static, dynamic and voyage related information as required by the IMO performance standards
- explains that the different information message types classified as "static", "dynamic" or "voyage related" are used as AIS messages and are valid for different time periods, thus requiring different update rates
- states that "Short safety related messages" are sent as required and are independent of timing
- explains that Ship's speed and manoeuvring status are used as the means of governing update rates for "dynamic" messages and ensuring the appropriate levels of positional accuracy for ship tracking
- explains that a similar process is applied to the content of ship information messages ("static" and "voyage related") to ensure that the more important message data being communicated is not encumbered with static or low priority information
- explain the information included in static data and the associated transmission intervals
- explains that "Static" information is entered into the AIS on installation and need only be changed if the ship changes its name or undergoes a major conversion from one ship type to another
- explains the information included in dynamic data and the associated transmission intervals
- explains that "Dynamic" information is automatically updated from the ship sensors connected to AIS
- explains the information included in voyage related data and the associated transmission intervals
- explains that the "Voyage related" information is manually entered and updated during the voyage
- explain the functionality of safety and security related messages
- explain the functionality of AIS aids to navigation
- states that the AIS aims to achieve positional accuracies of 'better than 10 metres' when associated with DGNSS correction signals and that this compares favourably with radar, which as a function of frequency, pulse repetition rate, and beam width, will often only achieve positional accuracy in the range 30 to 50 metres

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

- explain the integration of AIS with other navigational aids
- explain advantages of AIS, especially on radar shadow effects, however being aware that the very close proximity of buildings and bridges, sometimes known as the "urban canyon" effect, can cause difficulties for AIS transponders in heavily built-up areas
- explain the precautions to be exercised when AIS is used as an aid for collision avoidance
- explain disadvantages of AIS, such as, AIS information is ground-stabilized and if overlaid on sea stabilized display of radar the navigational information could differ
- explain that when using electronic chart to display AIS targets, the datum of electronic chart might be different from the datum of the AIS positioning

3.8 Long Range Identification and Tracking (LRIT)
(3 hours)

- explains that the purpose of LRIT is to improve maritime safety, security and assist with search and rescue (SAR) purposes
- describes that the LRIT system consists of the ship-borne LRIT information transmitting equipment, the Communication Service Provider(s), the Application Service Provider(s), the LRIT Data Centre(s), including any related Vessel Monitoring System(s), the LRIT Data Distribution Plan and the International LRIT Data Exchange
- states the Data transmitted from the LRIT are
  - ship's identity;
  - ship's position (Latitude and Longitude);
  - time and date of transmission (associated with the GNSS position)
- states that the following ships are required to transmit LRIT messages:
  - passenger ships (including high speed craft);
  - cargo ships (including high speed craft) of 300 gross tonnage and up;
  - mobile offshore drilling units
- explains that the availability of information from LRIT transmissions is restricted to contracting IMO member states and administrations and it is not available to third parties or other ships
- describes that the ship-borne LRIT equipment is:
  - capable of automatically transmitting the ship's

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

LRIT information at 6 hour intervals to an LRIT Data Centre without human intervention on board the ship;
- capable of being configured remotely to transmit LRIT information at variable intervals;
- capable of transmitting LRIT information following receipt of polling commands;
- interface directly to the ship-borne global navigation satellite system equipment, or has internal positioning capability;
- supplied with energy from main as well as emergency source of electrical Power;
- tested for electromagnetic compatibility taking into account the recommendations developed by International Maritime Organisation (IMO)

- describes that the position report from the ship is sent to a Data Centre via an Application Service Provider (ASP) utilizing a Communication Service Provider (CSP) and Position reports are automatically sent every six hours to the Data Centre and additional position reports may be requested by increasing the position reporting up to each 15 minutes or “polling” for an immediate position report by entitled Governments
- states that the ship-borne equipment should transmit the LRIT information using a communication system which provides coverage in all areas where the ship operates
- states that there is no interface between LRIT and AIS
- explains the difference between LRIT and AIS is that, whereas AIS is a broadcast system, data derived through LRIT will be available only to the recipients who are entitled to receive such information; regulatory provisions will include safeguards concerning the confidentiality of data
- states that SOLAS contracting Governments will be entitled to receive information about ships navigating within a distance not exceeding 1000 nautical miles off their coast
- describes the limitations of the LRIT system

3.9 Integrated Navigation system (INS) and Integrated Bridge system (IBS) (3 hours)

- briefly describe that Integrated Navigation system (INS) ‘supports safety of navigation by evaluating inputs from several independent and different sensors, combining them to provide information giving timely warnings of

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

potential dangers and degradation of integrity of this information'

- briefly explain the three categories of INS as defined by IMO, namely:
  - INS(A), which as a minimum provide the information of position, speed, heading and time, each clearly marked with an indication of integrity
  - INS(B), which automatically, continually and graphically indicates the ship's position, speed and heading and, where available, depth in relation to the planned route as well as to known and detected hazards
  - INS(C), which provides means to automatically control heading, track or speed and monitor the performance and status of these controls
- states that Integrity monitoring is an intrinsic function of the INS and that in the INS the integrity of information is verified by comparison of the data derived from two or more sources if available
- states that in Integrity monitoring by the INS, the integrity is verified before essential information is displayed or used and Information with doubtful integrity should be clearly marked by the INS and not used for automatic control systems
- explains that the Integrated Bridge Systems (IBS) is 'a combination of systems which are interconnected in order to allow centralised access to sensor information or command/control workstations, with the aim of increasing safe and efficient ship's management by suitably qualified personnel'
- states that IBS recommendation apply to a system performing two or more operations, namely: passage execution; communication; machinery control; loading, discharging and cargo control; and safety and security
- describes the limitations of the systems

3.10 Voyage Data Recorder (VDR) and Simplified Voyage Data Recorder (S-VDR) (3 hours)

- explains that Voyage data recorder (VDR) and Simplified Voyage Data Recorder (S-VDR) means a complete system, including any items required to interface with the sources of input data, for processing and encoding the data, the final recording medium in its capsule, the power supply and dedicated reserve power source
- explains that the purpose of a voyage data recorder

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

(VDR) and Simplified Voyage Data Recorder (S-VDR) is to maintain a store, in a secure and retrievable form, of information concerning the position, movement, physical status, command and control of a vessel over the period leading up to and following an incident having an impact thereon

- explains that the Information contained in a VDR and S-VDR is made available to both the Administration and the ship owner and this information is for use during any subsequent investigation to identify the cause(s) of the incident
- describe the operation of a VDR and S-VDR, that is it
  - continuously maintains sequential records of preselected data items relating to the status and output of the ship's equipment, and command and control of the ship
  - permits subsequent analysis of factors surrounding an incident, the method of recording ensures that the various data items are co-related in date and time during playback on suitable equipment. The final recording medium is installed in a protective capsule and in case of S-VDR of either a fixed or float-free type that meets all of the following requirements:
    1. is capable of being accessed following an incident but secure against tampering;
    2. for VDR - it maximizes the probability of survival and recovery of the final recorded data after any incident;
    3. for S-VDR – it maintains the recorded data for a period of at least 2 years following termination of recording;
    4. is of a highly visible colour and marked with retro-reflective materials; and
    5. is fitted with an appropriate device to aid location
- explains the requirements set out in MSC resolution A.861(20) on the fixed type protective capsule for S-VDR
- explains that the equipment is so designed that, as far as is practical, it is not possible to tamper with the selection of data being input to the equipment, the data itself nor that which has already been recorded, and any attempt to interfere with the integrity of the data or the recording is recorded
- explains that the recording method is such that each item of the recorded data is checked for integrity and

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

an alarm is given if a non-correctable error is detected
- describes the continuity of operation of VDR and S-VDR
- list and state the data items recorded in the VDR and S-VDR, which are:
    a) Date and time
    b) The ship's position
    c) The ship's speed
    d) Bridge audio
    e) Communications audio
    f) Radar data, post-display selection (or, for S-VDR only, AIS data if radar data is not available)

in addition to the above data sets, a VDR should also record:
    a) Depth under the keel
    b) Status of all mandatory bridge alarms
    c) Rudder order and rudder position
    d) Engine orders and engine response (rev/min or pitch), including any transverse thrusters.
    e) Status of hull openings
    f) Status of watertight doors and fire doors.
    g) Wind speed and direction
- explains the Data output interface of VDR and S-VDR, that they provide an interface for downloading the stored data and playbacks the information to an external computer. This interface is compatible with an internationally recognized format, such as Ethernet, USB, FireWire, or equivalent
- describes the software for data downloading and playback
- states that the ship owner, in all circumstances and at all times, owns the VDR and its information
- explains that in the event of an accident the owner of the ship makes all decoding instructions available as necessary to recover the recorded information and maintains the same
- explains the recovery and relevant information of VDR and S-VDR
- explains the custody, read-out and access to the VDR and S-VDR information
- describes the limitations of the receivers

3.11 Bridge Navigational watch alarm system (BNWAS)

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

(3 hours)

- explains that the carriage requirement of Bridge Navigational Watch Alarm Systems (BNWAS), is set out by SOLAS chapter V/19 and the requirements will be mandatory for new ships and phased-in for existing ships
- explains that the Phase-in is as follows:
  cargo ships >150 gt and passenger ships irrespective of size constructed on or after 1 July 2011;
  - passenger ships irrespective of size constructed before 1 July 2011, not later than the first survey after 1 July 2012;
  - cargo ships > 3,000 gt constructed before 1 July 2011, not later than the first survey after 1 July 2012;
  cargo ships > 500 gt but < 3,000 gt constructed before 1 July 2011, not later than the first survey* after 1 July 2013;
  - cargo ships > 150 gt but < 500 gt constructed before 1 July 2011, not later than the first survey after 1 July 2014
- explains that the purpose of BNWAS is to monitor bridge activity and detect operator disability, which could lead to marine accidents
- explains that this purpose is achieved by a series of indications and alarms to alert first the OOW and, if he/she is not responding, then to alert the Master or another qualified OOW
- explains that the system monitors the awareness of the officer-on-watch (OOW) and automatically alerts the Master or other qualified OOW if for any reason the OOW becomes incapable of performing watch duties
- explain that additionally, the BNWAS may provide the OOW with a means of calling for immediate assistance if required
- explain that the BNWAS should be operational whenever the ship's heading or track control system is engaged, unless inhibited by the Master
- explains that the system has the following operational modes: Automatic, Manual On and Manual Off
- list and explain the operational sequence of indications and alarms:
  - once operational, the alarm system remains dormant for a period of between 3 and 12 min (Td-selected dormant period)

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

- at the end of this dormant period, the alarm system initiates a visual indication on the bridge
- if not reset, the BNWAS additionally sounds a first stage audible alarm on the bridge 15sec after the visual indication is initiated
- if not reset, the BNWAS additionally sounds a second stage remote audible alarm in the back-up officer's and /or Master's location 15sec after the first stage audible alarm is initiated
- if not reset, the BNWAS additionally sounds a third stage remote alarm at locations of further crew members capable of taking corrective actions 90 seconds after the second stage remote audible alarm is initiated
- in vessels other than passenger vessels, the second or third stage remote audible alarms may sound in all the above locations at the same time. If the second stage audible alarm is sounded in this way, the third stage alarm may be omitted

- states that in larger vessels, the delay between the second stage and third stage may be set to a longer value on installation, up to a maximum of 3 min, to allow sufficient time for back-up officer and /or Master to reach the bridge
- list and explain the resetting function of the BNWAS, which are as follows;

  - it is not possible to initiate the reset or cancel any audible alarm from any device, equipment or system not physically located in areas of the bridge providing proper look out
  - the reset function does, by a single operator action, cancel the visual indication and all audible alarms and initiate a further dormant period. If the reset function is activated before the end of the dormant period, the period is re-initiated to run for its full duration from the time of reset
  - to initiate the reset function, an input representing a single operator action by the OOW is required. This input may be generated by reset devices forming an integral part of the BNWAS or by external inputs from other equipment capable of registering physical activity and mental alertness of the OOW
  - a continuous activation of any reset device does not prolong the dormant period or cause a suppression of the sequence of indications and alarms

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

- explains that the emergency call facility may be provided on the bridge to immediately activate the second, and subsequently third stage, remote audible alarms by means of an "Emergency Call" push button or similar
- explains that the means of selecting the operational mode and the duration of the dormant period (Td) is security protected so that access to these controls should be restricted to the Master only
- describes the limitation of the system

COMPETENCE 1.3 Determine and Allow for Compass Errors	IMO Reference
TRAINING OUTCOMES:	STCW Code Table A-II/2

Demonstrates a knowledge and understanding of:

1.3.1 THE PARTS OF THE MAGNETIC COMPASS AND THEIR FUNCTION

1.3.2 THE PRINCIPLE AND ERRORS OF GYRO COMPASSES

1.3.3 SYSTEMS UNDER THE CONTROL OF THE MASTER GYRO AND THE OPERATION AND CARE OF THE MAIN TYPES OF GYRO-COMPASSES

COMPETENCE 1.3	Determine and Allow for Compass Errors	IMO Reference

1.3.1 THE PARTS OF THE MAGNETIC COMPASS AND THEIR FUNCTION

Textbooks / Bibliography: T16, T22

Teaching Aids: A1, A27, A29, A30

Required performance:

1.1 The Parts of the Magnetic Compass and their Function (3 hours) — R2, Ch. V Reg. 19, R6, R39

- explains that SOLAS chapter V - Regulation 19, paragraphs 2.1.1, 2.1.2, 2.1.3 and 2.2.1 lay down the requirements for all ships (excluding fishing vessels and pleasure craft under 150 gt) to be fitted with a magnetic compass or other means to determine and display the vessel's heading independent of any power supply.
- explains that the ships must also be fitted with a pelorus, or other means, to take bearings over an arc of 360° of the horizon and a means for correcting heading and bearings to true at all times.
- describes the parts of the Magnetic compass and explains their function
- briefly explains the operating principle of Transmitting Magnetic Compass (TMC)
- outlines the performance standards for magnetic compasses
- explains that SOLAS Chapter V - Regulation 19 requires all ships of 150 GT and over, and all passenger ships to carry a spare magnetic compass (or equivalent.)
- explains the importance of keeping a record of observed deviations
- explains that the correction of the Magnetic Compasses are carried out by compass adjusters, certified by Competent Authorities

1.3.2 THE PRINCIPLES AND ERRORS OF GYRO COMPASSES

Textbooks / Bibliography: T16, T29

Teaching Aids: A1, A29, A31, V43, V44, V45
Required performance:

COMPETENCE 1.3	Determine and Allow for Compass Errors	IMO Reference

2.1 The Principles of Gyro-Compass (3 hours) — R1, R7, R38, R42

- explains the meaning of the term 'free gyroscope' and the properties 'gyroscopic inertia' and 'precession'
- states that in the absence of disturbing forces the spin axis of a free gyroscope maintains its direction in space
- explains how a free gyroscope is made north seeking under the influence of gravity control
- describes the use of damping in azimuth and damping in tilt to cause settling of the axis and thus produce a gyro-compass
- explains why a gyro-compass that is damped in tilt will settle with its spin axis at a small angle to the meridian, except when at the equator
- describes the precession resulting from a torque about axes perpendicular to the spin axis
- explains that friction at gimbal pivots produces torque which give rise to precession
- states that the rate of precession is proportional to the applied torque
- defines 'tilt' as movement of the spin axis in the vertical plane
- defines 'drift' as the apparent movement of the gyroscope in azimuth resulting from the earth's rotation
- describes non-mathematically the apparent movement of a free gyroscope on the earth's surface, given its position and initial attitude
- uses the apparent motion of a celestial body in the direction of the gyro-axis to aid the description in the above objective
- explains the operating principle of other types of gyro compasses such as Fiber Optic gyro-compass and ring laser gyro-compass and their advantages over the mechanical / ballistic gyro-compass

2.2 Gyro-Compass Errors and Corrections (7 hours)

- explains the meaning of the term 'free gyroscope' and the properties 'gyroscopic inertia' and 'precession'
- explains how a free gyroscope is made north seeking under the influence of gravity control
- explains why a gyro-compass that is damped in tilt will settle with its spin axis at a small angle to the meridian, except when at the equator
- states that the resulting error is known as latitude error or damping error and varies directly as the tangent of the latitude

COMPETENCE 1.3 Determine and Allow for Compass Errors IMO Reference

- states that latitude error can be removed by a manual setting that mechanically moves the lubber line and the follow-up system to show the correct heading
- states that course and speed error is caused by the tilting of the spin axis, resulting from the ship's motion over the surface of the earth
- states that the rate of tilting, in minutes of arc per hour, is equal to the north-south component of the ship's velocity
- explains how the tilt causes precession in azimuth to the west on northerly headings and to the east on southerly headings in compasses with liquid ballistic control
- states that the velocity error is removed by manual settings of latitude and speed to offset the lubber line and the follow-up system in liquid-controlled compasses
- explains how the correction is made in compasses that employ other methods of detecting tilt
- states that ballistic deflection results from changes in the ship's north-south component of velocity
- explains the behaviour of a liquid ballistic during a change of speed or an alteration of course
- explains that the precession resulting from ballistic deflection may be arranged to move the compass to the correct settling position, after allowance for the change in course and speed error, by choosing a suitable period for the compass
- explains that the pendulum of a tilt detector will be thrown out of the vertical during a change of course or speed, producing an error in its output
- explains that the method used in the above objective is not applicable for compasses without liquid ballistic control since course and speed error is fully corrected for all headings
- explains that errors are limited by damping the pendulum and limiting the applied torque for large deflections of the pendulum
- states that the sensitive element of a gyro-compass is made such that its moment of inertia about any axis is the same, thus preventing any tendency to turn when swinging pendulously as a result of rolling or pitching
- describes the effect of rolling on a liquid ballistic for various ship's headings
- explains why the movement of the liquid causes an error except on the cardinal headings
- explains how intercardinal rolling error is reduced to negligible proportions

COMPETENCE 1.3	Determine and Allow for Compass Errors	IMO Reference

- states that intercardinal rolling error does not occur in compasses having no gravitational control attachments to the gyroscope
- states that errors caused by acceleration of the compass during rolling and pitching can be reduced by sitting the master compass low down, near the rotational centre of the ship
- outlines the performance standards for gyro-compasses

1.3.3 SYSTEMS UNDER THE CONTROL OF THE MASTER GYRO AND THE OPERATION AND CARE OF THE MAIN TYPES OF GYRO-COMPASSES

Textbooks / Bibliography: T34, T59

Teaching Aids: A1, A29, A31

Required performance:

3.1 Systems Under the Control of the Master Gyro and the Operation and care of the Main Types of Gyro-Compasses in Use At Sea (2 hours) R1

- defines the main systems under the control of the master gyro
- defines the main types of gyro-compass in use at sea
- refers to manufacturers' manuals to determine necessary maintenance tasks

COMPETENCE 1.4 Co-ordinate Search and Rescue	IMO Reference
TRAINING OUTCOME:	STCW Code Table A-II/2
1.4.1 THE PROCEDURES CONTAINED IN INTERNATIONAL AERONAUTICAL AND MARITIME SEARCH AND RESCUE MANUAL (IAMSAR)	R24,R25, R 31, R37

Textbooks / Bibliography:

Teaching Aids: A1

Required performance:

1.1 As per IMO Model Course 1.08 for Radar Navigation - Management Level

COMPETENCE 1.5	Establish Watchkeeping Arrangements and Procedures	IMO Reference
TRAINING OUTCOMES:		STCW Code Table A-II/2

Demonstrates a knowledge and understanding of:

1.5.1 THE INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA

1.5.2 PRINCIPLES TO BE OBSERVED IN KEEPING A NAVIGATIONAL WATCH

COMPETENCE 1.5	Establish Watchkeeping Arrangements and Procedures	IMO Reference

1.5.1 THE INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA

Textbooks / Bibliography: T40, B17, B18, B142

Teaching Aids: A1, V134, V135

Required performance:

1.1 International Regulations for Preventing Collisions at Sea, 1972, as amended (30 hours) — R1, R8, R15, R16, R41

- demonstrates thorough knowledge of the content, application and intent of the International Regulations for Preventing Collisions at Sea, 1972, as amended
- describes the additional signals for fishing vessels fishing in close proximity
- identifies the lights and shapes by any type of vessel and their meaning
- demonstrates, with the use of models displaying proper signals or lights, a navigation light simulator or otherwise, the proper action to take to avoid collision with other vessels in sight
- demonstrates how to determine the risk of collision and the proper action to take to avoid collision in restricted visibility
- describes fully the use of, and manoeuvring in, traffic separation schemes

1.5.2 PRINCIPLES TO BE OBSERVED IN KEEPING A NAVIGATIONAL WATCH — STCW Code Section A-VIII/2 Part 3 – 1, R32, R33, R34,

Textbooks / Bibliography: T12, T27, B7, B8, B12, B13, B16, B17, B18, B19, B24, B25, B26, B27, B36, B42, B50, B51, B55, B57, B62, B63, B65, B69, B70, B86, B87, B105, B108, B112, B119, B134, B136, B138, B139, B140, B141, B142, B143, B150, B151, B172, B173, B177, B195, B202, B208, B209, B212
Teaching Aids: A1, V21, V22, V23, V26,V27, V28, V46
Required performance:

2.1 Thorough knowledge of the content, application and intent of the Principles to be observed in keeping a Navigational Watch (2 hours)

- states watch schedules must be posted and accessible

COMPETENCE 1.5	Establish Watchkeeping Arrangements and Procedures	IMO Reference

- writes standing orders for a deck watch at anchor and a navigational watch underway
- states the contents of the STCW CODE section A-VIII/2, Part 4-1 – Principles to be observed in keeping a navigational watch
- states that watch duties should be so arranged to comply with rest periods prescribed in the STCW CODE CHAPTER VIII Standards regarding watch keeping Section A-VIII/1 Fitness for duty
- states that the officer in charge of the navigational watch is the master's representative and is primarily responsible at all times for the safe navigation of the ship and for complying with the International Regulations for Preventing Collisions at Sea, 1972, as amended.
- states that the master of every ship should ensure that watch keeping arrangements are adequate for maintaining a safe watch or watches, taking into account the prevailing circumstances and conditions
- states that officers in charge of the navigational watch under the master's general direction are responsible for navigating the ship safely during their periods of duty, when they should be physically present on the navigating bridge or in a directly associated location such as the chartroom or bridge control room at all times
- states that the master, chief engineer officer and officer in charge of watch duties should maintain a proper watch, making the most effective use of the resources available, such as information, installations/equipment and other personnel
- states that the lookout must be able to give full attention to the keeping of a proper lookout and no other duties should be undertaken or assigned which could interfere with that task
- states that the duties of the lookout and helmsperson are separate and the helmsperson should not be considered to be the lookout while steering, except in small ships where an unobstructed all-round view is provided at the steering position and there is no impairment of night vision or other impediment to the keeping of a proper lookout
- lists all factors to be considered to decide if the officer in charge of the navigational watch can be the sole lookout in daylight
- lists all relevant factors to be taken into account by the Master in determining that the composition of the

COMPETENCE 1.5	Establish Watchkeeping Arrangements and Procedures	IMO Reference

navigational watch is adequate to ensure that a proper lookout can continuously be maintained, including those described in the STCW Code

- outlines all factors to be taken into account when deciding the composition of the watch on the bridge, which may include appropriately qualified ratings
- states that the officer in charge of the navigational watch should:
  1. keep the watch on the bridge;
  2. in no circumstances leave the bridge until properly relieved; and
  3. continue to be responsible for the safe navigation of the ship, despite the presence of the master on the bridge, until informed specifically that the master has assumed that responsibility and this is mutually understood
- states that the officer in charge of the navigational watch should not be assigned or undertake any duties which will interfere with the safe navigation of the ship
- states that **i**n cases of need, the officer in charge of the navigational watch should not hesitate to use the helm, engines and sound signalling apparatus. However, timely notice of intended variations of engine speed should be given where possible or effective use should be made of UMS engine controls provided on the bridge in accordance with the applicable procedures
- states that the officers of the navigational watch should know the handling characteristics of their ship, including its stopping distances, and should appreciate that other ships may have different handling characteristics
- states that the officer in charge of the navigational watch should make sure that a proper lookout is maintained at all times
- states that in a ship with a separate chartroom, the officer in charge of the navigational watch may visit the chartroom, when essential, for a short period for the necessary performance of navigational duties, but should first ensure that it is safe to do so and that proper lookout is maintained
- lists all the checks that should be carried out during the navigational watch by the officer in charge of the navigational watch
- states that the officers of the navigational watch should be thoroughly familiar with the use of all electronic navigational aids carried, including their capabilities and limitations, and should use each of these aids when appropriate and should bear in mind that the echo-

COMPETENCE 1.5	Establish Watchkeeping Arrangements and Procedures	IMO Reference

sounder is a valuable navigational aid

- states that whenever restricted visibility is encountered or expected, the officer in charge of the navigational watch should use the radar, and at all times in congested waters, having due regard to its limitations
- lists all the circumstances when the officer in charge of the navigational watch should notify the master immediately, which are;
  1. if restricted visibility is encountered or expected;
  2. if the traffic conditions or the movements of other ships are causing concern;
  3. if difficulty is experienced in maintaining course;
  4. on failure to sight land, or a navigation mark or to obtain soundings by the expected time;
  5. if, unexpectedly, land or a navigation mark is sighted or a change in soundings occurs;
  6. on breakdown of the engines, propulsion machinery remote control, steering gear or any essential navigational equipment, alarm or indicator;
  7. if the radio equipment malfunctions;
  8. in heavy weather, if in any doubt about the possibility of weather damage;
  9. if the ship meets any hazard to navigation, such as ice or a derelict; and
  10. in any other emergency or if in any doubt
- states that the officer in charge of the navigational watch, should not hesitate to take immediate action for the safety of the ship, where circumstances so require, despite notifying the master immediately in the circumstances considered important for his presence on the bridge
- states that the officer in charge of the navigational watch should give watch keeping personnel all appropriate instructions and information which will ensure the keeping of a safe watch, including a proper lookout
- states that in clear weather the officer in charge of the navigational watch should take frequent and accurate compass bearings of approaching ships as a means of early detection of risk of collision and should bear in mind that such risk may sometimes exist even when an appreciable bearing change is evident, particularly when approaching a very large ship or a tow or when approaching a ship at close range
- states that the officer in charge of the navigational watch should also take early and positive action in compliance with the applicable International

COMPETENCE 1.5	Establish Watchkeeping Arrangements and Procedures	IMO Reference

Regulations for Preventing Collisions at Sea, 1972, as amended and subsequently check that such action is having the desired effect

- states that when restricted visibility is encountered or expected, the first responsibility of the officer in charge of the navigational watch is to comply with the relevant rules of the International Regulations for Preventing Collisions at Sea, 1972, as amended with particular regard to the sounding of fog signals, proceeding at a safe speed and having the engines ready for immediate manoeuvre
- states that in addition to the above, the officer in charge of the navigational watch shall:
  1. inform the master;
  2. post a proper lookout;
  3. exhibit navigation lights; and
  4. operate and use the radar
- states that when arranging lookout duty, in hours of darkness, the master and the officer in charge of the navigational watch, should have due regard to the bridge equipment and navigational aids available for use, their limitations, procedures and safeguards implemented.
- states that in Coastal and congested waters the largest scale chart on board, suitable for the area and corrected with the latest available information, should be used
- states that fixes in Coastal and congested waters should be taken at frequent intervals, and should be carried out by more than one method whenever circumstances allow
- states that when using ECDIS, in coastal and congested waters, appropriate scale of electronic navigational charts should be used and the ship's position should be checked by an independent means of position fixing at appropriate intervals
- states that in coastal and congested waters the officer in charge of the navigational watch should positively identify all relevant navigation marks
- states that when navigating with pilot on board, despite the duties and obligations of pilots, their presence on board does not relieve the master or the officer in charge of the navigational watch from their duties and obligations for the safety of the ship
- states that when navigating with pilot on board, the master and the pilot should exchange information regarding navigation procedures, local conditions and

COMPETENCE 1.5	Establish Watchkeeping Arrangements and Procedures	IMO Reference
	the ship's characteristics - states that when navigating with pilot on board, the master and/or the officer in charge of the navigational watch should co-operate closely with the pilot and maintain an accurate check on the ship's position and movement - states that when navigating with pilot on board, if in any doubt as to the pilot's actions or intentions, the officer in charge of the navigational watch should seek clarification from the pilot and, if doubt still exists, should notify the master immediately and take whatever action is necessary before the master arrives	

COMPETENCE 1.6	**Maintain Safe Navigation Through the Use of information from Navigation Equipment and Systems to Assist Command Decision-making**	**IMO Reference**

TRAINING OUTCOMES: STCW Code Table A-II/2

Demonstrates a knowledge and understanding of:

1.6.1 SYSTEM ERRORS AND OPERATIONAL ASPECTS OF MODERN NAVIGATION SYSTEMS INCLUDING RADAR AND ARPA

1.6.2 BLIND PILOTAGE TECHNIQUES

1.6.3 EVALUATION OF NAVIGATIONAL INFORMATION TO AID IN COMMAND DECISIONS FOR AVOIDING COLLISION AND SAFE NAVIGATION OF THE SHIP

1.6.4 INTER-RELATIONSHIP AND OPTIMUM USE OF ALL NAVIGATIONAL DATA

See IMO Model Course 1.08 for Radar Navigation - Management Level, 1.22 Ship Simulator and Bridge Teamwork and 1.27 Operational Use of Electronic Chart Display and Information Systems (ECDIS)

COMPETENCE 1.7	Maintain Safe Navigation Through The Use Of ECDIS And Associated Navigation Systems To Assist Command Decision Making	IMO Reference
(See IMO Model Course No. 1.27 Operational Use of Electronic Chart Display and Information Systems (ECDIS)and STCW Reg I/12)		STCW Code Table A-II/2

COMPETENCE 1.8	**Forecast Weather and Oceanographic Conditions**	**IMO Reference**

TRAINING OUTCOMES: STCW Code Table A-II/2

Demonstrates a knowledge and understanding of:

1.8.1 SYNOPTIC CHARTS AND WEATHER FORECASTING

1.8.2 CHARACTERISTICS OF VARIOUS WEATHER SYSTEMS

1.8.3 OCEAN CURRENT SYSTEMS

1.8.4 CALCULATION OF TIDAL CONDITIONS

1.8.5 APPROPRIATE NAUTICAL PUBLICATIONS ON TIDES AND CURRENTS

COMPETENCE 1.8	Forecast Weather and Oceanographic Conditions	IMO Reference
1.8.1	SYNOPTIC CHARTS AND WEATHER FORECASTING	STCW Code Section A-VIII/2

Textbooks / Bibliography: T23, T24, B28, B41, B63, B138, B223, B224

Teaching Aids: A1, V36, V37, V38, V39, V114

Required performance:

SYNOPTIC METEOROLOGY

1.1 The Planetary System of Wind and Pressure (2 hours) — R1, R22, R35, R100

- explains, qualitatively with the aid of sketches, the circulation cells which would exist on a rotating earth, not inclined to its orbit of rotation about the sun, and with a homogeneous surface
- compares the actual wind and pressure distribution with the above
- draws the global mean surface pressure distribution together with the oceanic wind for January and July
- describes the characteristics and location of the doldrums, ITCZ, Trade Winds, Sub tropical oceanic highs, westerlies and polar easterlies
- defines the `Monsoon Regime'
- states the areas which experience a true monsoon regime
- applies previous concepts to a qualitative explanation of the causes of monsoon regimes
- applies previous concepts to a qualitative explanation of the weather associated with the January and July monsoons of the Indian Ocean, China sea, North Coast of Australia and West Coast of Africa
- explains qualitatively the monsoon type weather along the North East coast of Brazil

1.2 The Weather Associated with the Principal Air Mass Types (2 hours) — R1

- analyses qualitatively the formation of an air mass
- explains the significance of a Source Region
- describes the characteristics of a region acting as the source region for an air mass
- discriminates between the source region characteristics of Arctic Maritime and Continental Air, Polar Maritime and Continental Air, Tropical Maritime and Continental Air, and Equatorial Air

COMPETENCE 1.8	Forecast Weather and Oceanographic Conditions	IMO Reference
	- describes the subsequent modification of an air mass by the nature of the surface over which it travels - defines stable and unstable air masses - determines typical synoptic patterns associated with air mass types - interprets qualitatively the weather associated with air mass types	
1.3	**Synoptic and Prognostic Charts and Forecasts From Any Source** (2 hours) - interprets the isobaric patterns of a synoptic weather chart with interpolation and extrapolation as necessary - determines the geostrophic and approximate surface wind speeds from the chart by use of the geostrophic wind scale - determines the weather associated with specific places within the plots - applies the rules governing the movement of pressure systems, as given in Meteorology for Mariners to forecast the weather at specific places - evaluates the use of prognostic charts - evaluates the information given in shipping forecasts - evaluates the information received from internet and email	R1
1.4	**The Range of Information Available Through Fax Transmissions, Internet and Email** (3 hours) - lists the information available to the mariner in fax transmissions - discusses the source of information relating to radio stations, and their transmissions - evaluates the information given in surface synoptic and prognostic fax charts - interprets the information given in wave charts - evaluates the information given in ice charts - evaluates the use of 500 hPa charts in forecasting the progress of depressions - evaluates the value of personal observations of weather signs, in evaluating weather trends - lists the information available to the mariner via internet and email - evaluates the information received from internet and email	R1, R2 Ch.V, R100

COMPETENCE 1.8	Forecast Weather and Oceanographic Conditions	IMO Reference
1.5	**The Main Types of Floating Ice, Their Origins and Movements** (2 hours) - explains the formation of icebergs from floating glacier tongues and from ice shelves, and the characteristics of each - discusses the formation of sea ice - defines ice tongue, ice shelf - defines pack ice and fast ice - discusses the normal seasons and probable tracks of North Atlantic bergs from origin to decay - defines the outer limits of the area in which icebergs may be encountered in the North Atlantic - discusses the normal and extreme limits of iceberg travel in the southern oceans during summer and winter - explains the reasons for the decay of icebergs - describes the areas affected by sea ice in regions frequented by shipping - discusses the seasonal development and recession of sea ice on the coastlines of the northern oceans, and in the latitude of the normal trade routes	R1
1.6	**The Guiding Principles Relating to the Safety of Navigation in Ice** (1 hours) - states the signs which may indicate the proximity of ice on clear days and nights - defines the ranges at which observers may expect to detect ice visually in varying conditions of visibility, see T61 - discusses the limitations of radar as a means of detecting ice - states the precautions to be taken when navigating near ice, and when ice is suspected in the vicinity	R1, R2 Ch V
1.7	**Conditions Leading to Ice Accretion on Ship's Superstructures, Dangers and the Remedies Available** (2 hours) - describes the factors which may give rise to ice accretion - describes the use of data in the Mariner's Handbook, for estimating the rate of ice accretion - evaluates the methods of avoiding or reducing ice accretion - explains the reports to be made under International	R1

COMPETENCE 1.8	Forecast Weather and Oceanographic Conditions	IMO Reference

Conventions when ice is encountered
- lists the information to be given in radio messages reporting dangerous ice
- states the iceberg nomenclature in use by the International Ice Patrol
- lists the information to be given in radio messages reporting conditions leading to severe ice accretion on ship's superstructures

1.8.2 CHARACTERISTICS OF VARIOUS WEATHER SYSTEMS

Textbooks / Bibliography: T23, T24, B28, B41, B63, B138, B223, B224

Teaching Aids: A1, V36, V37, V38, V39

Required performance:

2.1 The Formation, Structure and Weather Associated with The Principal Frontal Systems (2 hours) — R1

- describes a front and a frontal zone
- sketches the structure of a typical frontal zone
- explains qualitatively the process of frontogenesis
- explains qualitatively the process of frontolysis
- explains with the aid of a diagram, the structure of an idealized cold front
- explains the sequence of weather associated with the passage of an idealized cold front
- explains with the aid of diagrams, the formation of, and weather associated with, a 'line squall'
- describes with the aid of diagrams, the structure of an idealized warm front
- describes the sequence of weather associated with the passage of an idealized warm front
- explains with the aid of diagrams, the orientation of isobars which cross a front
- describes with the aid of diagrams, the weather at the Inter Tropical Convergence Zone, both when it is close to, and more than 5° from, the equator

2.2 The Formation of, and Weather Associated with, Frontal and Non-Frontal Depressions (2 hours) — R1

- explains qualitatively why the polar front is a favourable breeding ground for frontal depressions
- describes, with the aid of diagrams, the formation,

COMPETENCE 1.8	Forecast Weather and Oceanographic Conditions	IMO Reference

development and decay of frontal depressions
- defines 'family of depressions'
- draws a typical synoptic pattern showing a family of frontal depressions and the associated pressure distribution
- explains qualitatively the process of the occlusion of a frontal depression
- describes with the aid of diagrams, the distribution of weather in a depression
- explains qualitatively the formation of frontal and non-frontal secondary depressions
- draws diagrams of frontal and non-frontal secondary depressions showing isobars and wind circulation
- describes the weather changes experienced during the passage of a secondary depression
- explains qualitatively, with the aid of diagrams, the formation of warm occlusions and cold occlusions
- draws cross sections through warm and cold occlusions showing temperature distribution, and cloud and precipitation areas
- describes the weather experienced during the passage of warm and cold occlusions with reference to objectives in the previous section
- compares alternative theories of cyclonic development since Bjerknes

2.3 The Formation and Weather Characteristics of Non-Frontal Weather Systems (2 hours) R1

- defines 'trough of low pressure', both frontal and non-frontal
- draws a synoptic pattern of frontal and non-frontal troughs, for both northern and southern hemispheres, showing isobars, wind circulation and, if applicable, front
- identifies a trough of low pressure on a surface synoptic or prognostic chart - explains the weather associated with the passage of a trough of low pressure
- defines an anticyclone
- draws a synoptic pattern of an anticyclone, for both northern and southern hemispheres, showing isobars and wind circulation
- identifies an anticyclone on a surface synoptic or prognostic chart - describes the general characteristics of an anticyclone - explains qualitatively the formation of warm and cold

COMPETENCE 1.8	Forecast Weather and Oceanographic Conditions	IMO Reference

anticyclones
- applies previous concepts to an explanation of the weather associated with an anticyclone, in summer and winter
- defines ridge of high pressure
- draws a synoptic pattern of a ridge which is an extension of an anticyclone, showing isobars and wind circulation for northern and southern hemispheres
- draws a synoptic pattern of a ridge contained between two lows, showing isobars and wind circulation, for northern and southern hemispheres
- identifies a ridge of high pressure on a surface synoptic or prognostic chart - explains the weather associated with both types of ridge of high pressure
- defines a col
- draws a synoptic pattern of a col showing isobars and wind circulation - explains the weather associated with a col
- draw synoptic patterns showing combination of various isobaric systems

2.4 Tropical Revolving Storms (TRS) (2 hours) — R1, R2

- states the definitions adopted by the WMO with respect to Tropical Storms
- states local nomenclature of TRS
- states regions and seasons of greatest frequency of TRS
- states the conditions associated with the formation of tropical revolving storms
- states the factors which affect the future movement of a TRS
- describes with the aid of diagrams typical and possible tracks of TRS
- explains the factors associated with the decay of TRS
- draws a plan of a TRS showing isobars, wind circulation, path, track, vortex or eye, trough line, dangerous semicircle, dangerous quadrant and navigable semicircle (for north and south hemispheres)
- explains the reasons for the naming of the dangerous semicircle
- draws a cross section through a TRS showing areas of cloud and precipitation
- describes the characteristics of a TRS, ie size, wind, pressure, eye, cloud and precipitation sequence
- describes the signs which give warning of the

COMPETENCE 1.8	Forecast Weather and Oceanographic Conditions	IMO Reference

approach for the TRS
- explains the methods of determining the approximate bearing of an approaching TRS
- explains the method of determining in which sector of a TRS the ship is situated
- states the correct avoidance procedure when in the vicinity of a TRS
- given the position and direction of travel of a TRS and ship's voyage information, describes appropriate measures to avoid the danger sector of a TRS
- describes the messages required to be sent in accordance with the requirements of SOLAS, when a TRS is encountered, or suspected to be in the vicinity
- describes the message required to be sent in accordance with the requirement of SOLAS when a wind of or above storm force 10 is encountered which has not previously been reported

1.8.3 OCEAN CURRENT SYSTEMS

Textbooks / Bibliography: T23, T24, T30, B28, B41, B63, B223, B224

Teaching Aids: A1, A12, A19, V36, V37, V38, V39

Required performance:

3.1 Surface Water Circulation of the Ocean and Principal Adjoining Seas (3 hours) R1

- defines qualitatively the effect of geostrophic force on surface currents
- discusses the generation of drift currents by prevailing winds
- discusses the generation of gradient currents from differences in water temperature and salinity
- discusses the generation of gradient currents resulting from the indirect effect of wind causing a piling up of water on windward coasts, as in the case of the Equatorial Counter Currents
- analyses the nature of currents formed by a combination of the above as experienced by western shores of large land masses
- relates the general pattern of surface water circulation to the atmospheric pressure distribution
- constructs a chart showing global surface water circulation applicable to the above

COMPETENCE 1.8	Forecast Weather and Oceanographic Conditions	IMO Reference

- describes the seasonal changes in the above in areas under the influence of the Asian monsoons
- identifies the principal individual currents by name
- analyses the causes of individual currents where explicitly stated in Meteorology for Mariners
- explains the classification of individual currents as warm or cold where appropriate
- describes the form in which surface current data is presented in current atlases and on routeing charts
- evaluates qualitatively the use of this data in passage planning
- explains the derivation of the current rose
- explains the derivation of the predominant current
- shows the meaning of the term constancy when applied to predominant currents
- explains the derivation of the vector mean current
- compares qualitatively the values of the information given by the current rose, the predominant current and the vector mean current as aids to passage planning

3.2 Voyage Planning Principles with Respect to Weather Conditions and Wave Height (2 hours) — R1, R2

- selects and uses data from Ocean Passages of the World
- describes climatological routeing
- defines significant wave height
- discusses the factors affecting wave height and direction
- describes the methods employed in forecasting wave heights
- describes optimum (least time) routeing
- evaluates the forms of routeing in the above objectives
- describes the methods of constructing a least time track
- appraises the relative merits of ship and shore based routeing, and their limitations
- describes the construction of ships' performance curves
- demonstrates the use on monthly Routeing Charts
- explains the construction and use of a Baillie wind rose
- demonstrates familiarity with the forms of climatological, meteorological and current data presented in the Sailing Directions (Pilot Books) and in the Mariner' Handbook

COMPETENCE 1.8	Forecast Weather and Oceanographic Conditions	IMO Reference

3.3 **The Formation of Sea Waves and Swell Waves** (2 hours) R1

- selects and uses data from Ocean Passages of the World
- explains the role of wind in wave formation
- explains the importance of wind force in wave formation
- explains the importance of duration of wind causing waves
- explains the importance of fetch in the growth of waves
- uses Dorrenstein's nomogram for forecasting
- significant wave heights
- states the relationship between sea waves and swell waves
- explains the decay of swell waves as they travel from the area of origin

1.8.4 CALCULATION OF TIDAL CONDITIONS

Textbooks / Bibliography : T1, B28, B41, B63, B138, B223, B224

Teaching Aids: A1, V36, V37, V38, V39

Required performance:

4.1 **Ability to calculate tidal conditions** (6 hours) R1

- explains the general theory of tides
- explains in basic terms the methods of predicting tides
- explains the non-astronomical component of sea level
- explains other irregularities of the tide
- states that the predicted tide level is not an accurate value
- demonstrates the use of tide tables
- determines height and time for high and low water in secondary ports
- determines the predicted height of water at a given time in a tabulated port
- determines the predicted time for a given tide level
- demonstrates the use of tidal stream charts
- defines the zero level of the charts
- evaluates qualitatively the effect of high or low atmospheric pressure on tide levels
- evaluates qualitatively the effect of persistent winds on tide levels and tidal times
- evaluates qualitatively the effect of abrupt changes of

COMPETENCE 1.8	Forecast Weather and Oceanographic Conditions	IMO Reference

weather conditions on tidal levels
- describes seismic waves, their origin and areas of prevalence
- demonstrates use of computer programmes to obtain tidal information
- explains briefly the use of harmonic constant method of tidal prediction
- explains the reliability of tidal predictions (awareness of the factors influencing the accuracy and reliability of predictions (e.g. local weather conditions, flooding, local area knowledge, etc)

1.8.5 APPROPRIATE NAUTICAL PUBLICATIONS ON TIDES AND CURRENTS

Textbooks / Bibliography: T1, B28, B41, B63, B138, B223, B224

Teaching Aids: A1, A16, A17

Required performance:

5.1 Nautical publications and information which can be obtained via internet and e-mail on tides and currents (3 hours) R1
- uses tidal height calculations in passage planning, with regard to limiting draughts and times of available depth of water
- uses tidal stream information in passage planning, with regard to effect on course made good, and effect on speed, timing of events
- uses current information in passage planning, with regard to effect on course made good, and effect on speed, timing of events
- uses information which can be obtained via internet and email on tides and currents in passage/voyage planning

COMPETENCE 1.9 Respond to Navigational Emergencies	**IMO Reference**
TRAINING OUTCOMES:	STCW Code Table A-II/2

Demonstrates a knowledge and understanding of:

1.9.1 PRECAUTIONS WHEN BEACHING A SHIP

1..92 ACTION TO BE TAKEN IF GROUNDING IS IMMINENT AND AFTER GROUNDING

1.9.3 REFLOATING A GROUNDED SHIP WITH AND WITHOUT ASSISTANCE

1.9.4 ACTIONS FOR IMMINENT COLLISION, AFTER COLLISION AND IMPAIRMENT OF THE WATERTIGHT INTEGRITY OF THE HULL BY ANY CAUSE

1.9.5 ASSESSMENT OF DAMAGE CONTROL

1.9.6 EMERGENCY STEERING

1.9.7 EMERGENCY TOWING ARRANGEMENTS AND TOWING PROCEDURES

COMPETENCE 1.9	Respond to Navigational Emergencies	IMO Reference

1.9.1 PRECAUTIONS WHEN BEACHING A SHIP

Textbooks / Bibliography: T3, B58, B59, B62

Teaching Aids: A1, V24, V25, V28, V29

Required performance:

1.1 Precautions When Beaching a Ship (2 hours) — R1

- describes the circumstances in which a vessel may be beached
- states that a gently shelving beach of mud, sand or gravel should be chosen if possible
- states that beaching should be at slow speed
- states that, when trimmed heavily by the head, beaching stern first may be advantageous
- compares the relative advantages of beaching broadside-on and at right-angles to the beach
- states that wind or tide along the shore will quickly swing the ship broadside-on to the beach
- describes measures which can be taken to prevent the ship driving further ashore and to assist with subsequent refloating
- states that ballast should be added or transferred to counteract a tendency to bump on the bottom
- states that all tanks and compartments should be sounded and an assessment made of damage to the ship
- states that soundings should be taken to establish the depth of water round the ship and the nature of the bottom

1.9.2 ACTIONS TO BE TAKEN IF GROUNDING IS IMMINENT AND AFTER GROUNDING

Textbooks / Bibliography: T10, T3, B58, B59, B62

Teaching Aids: A1, V24, V25, V28, V29, V113

Required performance:

2.1 Grounding (2 hours) — R1, R2

- states that, on stranding, the engines should be stopped, watertight doors closed, the general alarm sounded and, if on a falling tide, the engines should be put full astern to see if the ship will immediately refloat
- states that the engineers should be warned to change to high-level water intakes

COMPETENCE 1.9	Respond to Navigational Emergencies	IMO Reference

- states that a distress or urgency signal should be transmitted and survival craft prepared if necessary
- states that all tanks and compartments should be sounded and the ship should be inspected for damage
- states that any discharge or probable discharge of harmful substances should be reported to the nearest coast radio station
- states that soundings should be taken to establish the depth of water round the ship and the nature of the bottom

1.9.3 REFLOATING A GROUNDED SHIP WITH AND WITHOUT ASSISTANCE

Textbooks / Bibliography: T10, T3, B58, B59, B62

Teaching Aids: A1, V24, V25, V28, V29

Required performance:

3.1 Refloating (2 hours) R1

- describes measures which can be taken to prevent further damage to the ship and to assist with subsequent refloating
- explains how ballast or other weights may be moved, taken on or discharged to assist refloating
- describes the use of ground tackle for hauling off
- describes ways in which tugs may be used to assist in refloating
- describes the use of the main engine in attempting to refloat and the danger of building up silt from its use

1.9.4 ACTION TO BE TAKEN IF COLLISION IS IMMINENT, AFTER A COLLISION OR IMPAIRMENT OF THE WATERTIGHT INTEGRITY OF THE HULL BY ANY CAUSE

Textbooks / Bibliography: T3, T3, B58, B59, B62

Teaching Aids: A1, V24, V25, V28, V29

Required performance:

4.1 Action to be taken if collision is imminent and following a collision or impairment of the watertight integrity of the hull by any cause (2 hours)

- lists the duties of the master following a collision R1
- states that after impact the engines should be stopped, all R2

COMPETENCE 1.9	Respond to Navigational Emergencies	IMO Reference

watertight doors closed, the general alarm sounded and the crew informed of the situation
- states that in calm weather the colliding ship should generally remain embedded to allow the other ship time to assess the damage or prepare to abandon ship
- states that survival craft should be made ready for abandoning ship or assisting the crew of the other ship
- states that a distress or urgency signal should be made, as appropriate
- states that requests for information may be received from coastal States
- states that, if not in danger, own ship should stand by to render assistance to the other for as long as necessary
- states that any discharge or portable discharge of harmful substances should be reported to the nearest coast radio station
- states that the owners should be informed and all details of the collision and subsequent actions entered in the log-book

1.9.5 ASSESSMENT OF DAMAGE CONTROL

Textbooks / Bibliography: T3, T3, B58, B59, B62

Teaching Aids: A1, V24, V25, V28, V29

Required performance:

5.1 Assessment of Damage Control (2 hours) R1

- states that damage to own ship should be determined
- describes measures to attempt to limit damage and salve own ship

1.9.6 EMERGENCY STEERING

Textbooks / Bibliography: T3, T3, B58, B59, B62

Teaching Aids: A1, V24, V25, V28, V29

Required performance:

6.1 Emergency Steering (2 hours) R1

- describes typical arrangements of auxiliary steering gear
- describes how the auxiliary steering gear is brought into action R14
- describes how to change from bridge control to local

COMPETENCE 1.9	Respond to Navigational Emergencies	IMO Reference

control in the steering gear compartment
- states that, when appropriate, a disabled ship should report to a coastal State that it is a potential hazard to other ships or to the environment
- lists possible course of action which may be taken by a disabled ship
- states the navigational safety message to broadcast and signals to be displayed by a disabled vessel

1.9.7 EMERGENCY TOWING ARRANGEMENTS AND TOWING PROCEDURES

Textbooks / Bibliography: T3, T3, B58, B59, B62

Teaching Aids: A1, V128

Required performance:

7.1 Emergency Towing Arrangements (2 hours) R1

- states that permission from the owners or charterers is usually required before towing, except for the purpose of saving life
- states that a coastal State may intervene when a disabled ship presents a potential risk to the environment
- states that early communication should be established between the vessels to agree on the method of connecting the tow
- states that both vessels should have everything prepared and have agreed on communication before the arrival of the towing ship
- describes how to approach a disabled vessel and pass the first connection by line-throwing apparatus or other methods
- states that the tow normally passes a messenger followed by a wire messenger to the towing vessel to haul across the towing line
- describes how to pay out the towing wire under control
- describes methods of securing the towing wire at the towing ship
- explains why the wire is usually shackled to the anchor cable of the tow
- describes the preparations made by the disabled ship
- states that the towing wire should be protected from chafing at fairleads
- states that wires and cables should be inspected frequently and the nip freshened if any sign of wear or chafe is found

COMPETENCE 1.9	Respond to Navigational Emergencies	IMO Reference

- describes how to take the weight of the tow
- explains how the towing speed should be decided
- describes how to disconnect the tow on arrival at the destination
- describes the emergency towing arrangements for all tankers of not less than 20,000dwt

COMPETENCE 1.10	Manoeuvre and Handle a Ship in all Conditions	IMO Reference

TRAINING OUTCOME:

Demonstrates a knowledge and understanding of:	STCW Code Table A-II/2
1.10.1 MANOEUVRING AND HANDLING A SHIP IN ALL CONDITIONS	

COMPETENCE 1.10	Manoeuvre and Handle a Ship in all Conditions	IMO Reference

1.10.1 MANOEUVRING AND HANDLING A SHIP IN ALL CONDITIONS

Textbooks / Bibliography: T3, T8, T11, T18, T25, T3, B16, B24, B25, B58, B59, B60, B61, B62, B63, B99, B125, B163, B164, B165, B200, B214

Teaching Aids: A1, V3, V4, V5, V6, V7, V8, V9, V10, V11, V12, V13, V14, V15, V16, V17, V18, V19, V30, V31, V32, V33, V98,V140, V142, V152, V168

Required performance:

1.1 Approaching pilot stations and embarking or disembarking pilots, with due regard to Weather, tide, headreach and stopping distances (4 hours) — R1

- explains the importance and the procedure of making a passage plan from sea to berth — R2, R20
- describes the preparations for picking up a pilot — R2
- states that a second steering-gear power unit should be in operation where possible — R1
- states that steering should be changed to manual in ample time and tested
- states that anchors should be cleared and ready for letting go
- explains how to reduce speed when approaching the pilot station, taking account of wind and tidal set
- explains why the ship's speed should be reduced to a suitable speed for the pilot boat to come alongside
- describes how to make a lee for the pilot boat
- states that extra care should be taken after dropping the pilot until clear of inward ships manoeuvring to embark pilots

1.2 Handling ship in rivers, estuaries and restricted water having regard to the effects of current, wind and restricted water on helm response (4 hours) — **R1**

- defines shallow water as a depth of less than 2 times the ship's draught
- explains that shallow-water effects become more marked as the underkeel clearance decreases
- lists shallow-water effects as:
  - increased directional stability and sluggish response to helm
  - the speed falls less during turns

COMPETENCE 1.10	Manoeuvre and Handle a Ship in all Conditions	IMO Reference

- a large increase in turning radius
- a more pronounced effect from transverse propeller thrust
- a possibility that transverse thrust may act opposite to that expected
- the ship carries her way longer and responds slowly to changes in engine speed
- the trim changes, usually by the head for a full hull form
- an increase in squat

- defines squat as the reduction of under-keel clearance resulting from bodily sinkage and change of trim which occurs when a ship moves through the water
- calculates the approximate sinkage due to squat in deep water
- states that the squat in shallow water (ratio of water depth/draught = 2) may be double that in deep water
- uses a squat estimation diagram
- explains the meaning of 'blockage factor' in restricted channels
- explains how squat and trim effects increase with blockage factor
- describes the reduction in keel clearance resulting from rolling and pitching and heel or list
- states that speed should be moderate in rivers, estuaries, etc. to reduce shallow water effects and to provide reserve power for correcting a sheer
- describes how to round bends in a channel with a current in either direction, taking account of the effect of wind
- describes the use of an anchor to assist in rounding a bend
- describes how to turn short round in a narrow channel, with or without a wind
- describes the use of an anchor to assist turning in a channel
- explains the importance of navigating at reduced speed to avoid damage caused by own ship's bow wave or stern wave
- describes how a passing ship affects a moored ship

1.3 Application of Constant Rate of Turn Techniques R1
(1 hour)

- describes the circumstances in which a constant rate turn is appropriate

COMPETENCE 1.10	Manoeuvre and Handle a Ship in all Conditions	IMO Reference

- describes how to plan a constant rate turn
- describes how to judge the correct execution of a constant rate turn by visual means
- describes how radar can be used to assist in monitoring a constant rate turn
- describes how to determine the wheel over position bearing for a constant rate turn
- describes how a constant rate turn is effective in helping a vessel maintain its planned trail

1.4 Manoeuvring in Shallow Water including the reduction in under-keel clearance caused by squat, rolling and pitching (2 hours) — R1

- describes the use of the kick-ahead to control the speed and direction of the vessel
- explains how a ship will respond to helm before increasing speed when using a kickahead
- identifies the danger of taking a sheer in shallow water and what corrective action can be taken
- describes how tugs can be used to assist in maintaining slow speed control
- describes how anchors can be used to assist in manoeuvring a vessel in shallow water

1.5 Interaction between passing ships and between own ship and nearby banks (canal effect) (2 hours) — R1

- explains and describes the interaction between ship and shore
- explains and describes the interaction between ships when meeting end-on
- explains and describes the interaction between ships in an overtaking situation
- explains the particular dangers of interaction when working close by other craft such as tugs
- describes the pattern of pressure changes round the hull of a moving ship
- explains the interaction between a ship and nearby banks (bank cushion and bank suction)
- describes the interaction between passing ships
- describes how to pass or overtake another ship safely in a narrow channel
- explains that shoal patches may give rise to bank cushion or suction, resulting in an unexpected sheer

COMPETENCE 1.10	Manoeuvre and Handle a Ship in all Conditions	IMO Reference

1.6 **Berthing and Unberthing under various conditions of wind, tide and current with and without tugs** (12 hours) — R1

- describes the effects of right- and left-handed propellers on manoeuvring
- describes the use of twin screws for manoeuvring
- explains the advantages and disadvantages of controllable-pitch propellers with regard to ship handling
- describes the use of lateral thrusters
- states that lateral thrusters cease to be effective above a certain speed, which has to be determined by trial
- describes, with reference to ship type and trim, the likely effect of wind on a ship when moving ahead or astern and when stopped
- explains how an anchor or anchors may be used to assist in manoeuvring
- describes the use of anchors for stopping in an emergency
- describes the different ways in which tugs may be made fast and used
- explains fully how to use engine, helm, tugs, anchors and mooring lines to berth and unberth under various conditions of wind and tide at:
  - river berths
  - piers
  - locks
  - enclosed docks
  - a single buoy
  - two buoys
  - multibuoy berths
  - Mediterranean moorings
- describes the mooring lines to be used, their leads and methods of securing at the berths listed above
- explains that when wind blows against a ship, a force acts almost in the opposite direction to the relative wind direction and the magnitude is proportional to the square of the relative velocity of the wind.
- states that knowing the magnitude of the wind force and how it affects the ship is of great importance during berthing / unberthing
- explains that the knowledge of above mentioned magnitude, will assist the Master to ;
  - decide whether the available tugs have sufficient power to hold the ship against a cross wind or to move the ship against a crosswind
  - decide whether the thrusters have the necessary

COMPETENCE 1.10	Manoeuvre and Handle a Ship in all Conditions	IMO Reference

power to manoeuvre the ship safely under the prevailing wind conditions
- determine the effect of a longitudinal wind in respect of its effect on the ship's stopping distance

- explains that the wind force in tonnes may, with a certain approximation, be expressed by the formula:
  $K(wind) = k * A * V^2$
  Where K= wind force in tones
  k= Constant depending on the ship and direction of the wind
  (as an average figure for k, the following constants can be used: $k= 0.52 * 10^{-4}$ (for a beam wind) and $k= 0.39 * 10^{-4}$ (for a longitudinal wind)
  A= Windage area in sq.mtrs
  V= Relative velocity of the wind in m/sec
- explains that normally tugs cannot hold a ship against a cross current, as the power, which is necessary for such an operation, is enormous
- explains that the force (K) required to oppose a cross current in deep waters might be determined approximately by the formula: $K = k_{deep} * L * d * V^2$ (where K= Current force in tones, k= constant, 0.033 for deep water, L= Vessel length in meters, d= Vessel draft in meters and V = Current speed in m/sec)
- explains that the force (K) required to oppose a cross current in shallow waters might be determined approximately by the formula: $K = 0.033 * f * L * d * V^2$ (where K= Current force in tones, 0.033 is the constant, f = the shallow water constant modifier derived from a graph, L= Vessel length in meters, d= vessel draft in meters and V = Current speed in m/sec)

1.7 Ship and Tug Interaction (3 hours) — R1

- describes the type of tug, i.e. conventional single or twin-screw tugs fitted or not fitted with nozzles, tractor type tugs and the ASD (azimuth stern drive) tugs
- describes the main difference resulting from the location of tug's propulsion and towing point
- explains the dangers related to ship-tug interaction
- explains the dangers for relatively small tugs when compared with the size of assisted ships in relation to interaction phenomenon
- states the special attention to be paid by the master on the condition of own vessel, i.e. ships in ballast condition or for ships having particular overhanging stern, found generally on large container vessels, the

COMPETENCE 1.10	Manoeuvre and Handle a Ship in all Conditions	IMO Reference

danger of interaction which is created and the danger of damages that can be caused to the tug's hull and superstructure, during the ship-tug co-operation
- explains the tug bow-cushion effect
- explains the risk during the ship- tug co-operation of the tug getting sucked under the bow of the ship with risk of capsizing, and the importance of immediate action required by the tug master, by the application of rudder and the use of available power to go full astern, to avoid above
- explain why tractor type tugs are generally found to be less vulnerable in the above mentioned situation
- explains 'girting' and the dangers associated with it
- explains the dangers of ships high speed during ship-tug co-operation
- describes the meaning of 'gob rope', and how its use on conventional tugs can improve the situation of 'girting'
- explains how the use of such 'gob rope' limits the manoeuvrability of the towing tug
- explains the precaution needed to be exercised for the tug's safety, while using the tugs, in respect to;
  - the visibility of ship's bulbous bow
  - short towlines
  - excessive forward speed of the ship or sudden changes in a ship's heading and speed
  - experience and the ability of the crew in releasing tug's towline, when needed
  - underestimating wind and current forces
  - information exchange pilot-shipmaster-tug captain
  - operating bow-to-bow
- explains the importance of keeping the ship's speed and heading constant when passing or taking a towline
- explains the knowledge necessary for a master when ordering the number and total bollard pull of tugs
- explains the important criteria of ships' loading conditions when planning for the number of tugs and the tug position along the hull
- describes the effectiveness of Tug(s), during ship-tug co-operation, in relation to pivot point, leverage, and tendency of the ship to swing in a particular direction, in the following conditions;
  - when the Ship is stopped and making no way through the water (dead in the water)
  - when the Ship is making headway
  - when the ship is making sternway

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1.8 **Use of propulsion and manoeuvring systems including various types of rudder** (2 hours) — R1

- describes various types of udders, including;
  - Flap Rudder (commonly known as the "Becker rudder")
  - Rotor Rudder (commonly known as the "Jastram rudder")
  - T- shaped Rudder (commonly known as the "Single Schilling Rudder")
  - Twin Schilling Rudders and explain their advantages with regard to ship handling
- describes how the use of bow-thrust can be used to assist in manoeuvring
- describes how the use of stern-thrust can be used to assist in manoeuvring
- describes the use of high-lift rudder systems to improve ship manoeuvrability
- describes the use of dynamically positioned vessels and their control systems
- describes the use of rudder cycling to reduce head reach in an emergency
- compares the effectiveness of rudder cycling with a crash stop

1.9 **Choice of anchorage; Anchoring with one or two anchors in limited anchorages and factors involved in determining the length of anchor cable to be used** (6 hours) — R1

- explains how to choose an anchorage and lists the factors which influence the choice
- states that an anchoring plan should be prepared in advance, showing the direction and speed of approach and the dropping position(s), with check bearings
- explains how to judge that a ship is stopped ready for letting go
- explains that positions should be obtained on letting go and again when brought up
- describes the use of anchor buoys
- lists the factors to consider in determining the length of anchor cable to be used as:
  - the nature of the bottom
  - the strength of current or wind
  - the strength and direction of the tidal stream

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- the exposure of the anchorage to bad weather
- the amount of room to swing
- the expected length of stay at anchor

1.10 Procedures for anchoring in deep water and in shallow water (1 hour)

- describes holding powers of different Anchors
- describes the preparation of anchors, including walking the anchor back for anchoring in deep water
- explains that when lowering anchor under power, excessive load on the anchor cable could cause damage or wear of the windlass engine and gearing

1.11 Dragging anchor; clearing fouled anchors (1 hour) R1

- defines dragging and explains how to detect it
- describes the actions to be taken when the anchor starts to drag
- explains how excessive yawing may break the anchor out of its holding and describes measures to control yaw
- describes how to bring a ship to an open moor
- explains what is meant by 'foul hawse' and how it occurs
- describes how to clear a foul hawse
- describes how to clear a fouled anchor
- describes how to buoy and slip an anchor

1.12 Dry-Docking (2 hours) R1

- lists the information required by the dry-dock authorities as:
  - length, beam and rise of floor, if any
  - draughts and trim
  - position of bilge keels and appendages such as a bulbous bow
  - whether single or twin screw
  - the weight and disposition of any cargo on board
  - position of any hull damage for inspection or repair
- states that a plan showing the position of bulkheads, main structural members and drain plugs is required for the preparation of beds and shores when dry-docking in the loaded condition
- explains why a slight trim by the stern is the ideal condition for dry-docking
- explains the need for adequate statical stability and states when the most critical condition occurs

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- describes the use of bilge blocks, breast shores and bilge shores and their placement during pumping out
- states that all tanks should be sounded and the readings recorded when the ship takes the keel blocks
- explains why, as far as possible, tanks should be full or empty
- explains that tanks and movable weights should be restored to their original condition before flooding the dock to ensure the same trim and zero list on refloating
- explains why a ship may be left partially waterborne if damage is accessible
- explains how an adequate supply of water for fire fighting and a telephone for calling emergency services should be arranged
- lists the precautions to be taken and the preparations to be made before flooding the dock

1.10 Management and Handling Ships in Heavy Weather, including assisting a ship or aircraft in distress; towing operations; means of keeping an unmanageable ship out of trough of the sea; lessening drift and use of oil (6 hours) R1

- states that the use of weather routeing can reduce the number of occasions on which heavy weather is encountered
- explains that the most common reason for heavy weather damage is lack of proper route planning taking into consideration the 96 hrs, 72 hrs and 48 hrs forecasts during planning
- describes the precautions to be taken before the onset of heavy weather
- explains the importance of understanding the enormous stresses encountered by the ship in heavy weather conditions
- defines wavelength, period and period of encounter of waves and swell
- explains that high wave heights are one of the most common reasons for heavy weather damage
- describes the methods of observing the frequency of wave beating and the formula with which it can be calculated (for ships less than 250m in length and for ships whose length exceeds 250m)
- defines rolling period and synchronous rolling
- explains how synchronous rolling can be avoided by an alteration of speed or course to change the period of encounter

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- describes synchronous pitching and how to prevent it
- explains that Parametric rolling is caused due to changes in parameters of stability which are; Displacement W (constant), Righting lever GZ (variable), W x GZ = righting moment
- explains that Parametric roll motions with large and dangerous roll amplitudes in waves are due to the variation of stability between the position on the wave crest and the position in the wave trough
- explains that among the measures which the vessel can take to avoid parametric rolling and synchronous rolling are; Vessel must have adequate intact stability, the course and speed of the ship should be selected in a way to avoid conditions for which the encounter period is
    - close to the ship roll period or
    - the encounter period is close to one half of the ship roll period.
- describes how excessive speed into head seas can cause severe panting and slamming stresses
- states that excessive slamming may be almost unnoticed on the bridge of a very large ship
- explains that heavy pitching also gives rise to high longitudinal stresses, racing of the propeller and the shipping of water
- defines 'pooping' and describes the conditions in which it may occur
- defines 'broaching-to' and describes the conditions in which it may occur
- explains that a reduction in speed combined with an alteration of course can reduce the danger of broaching-to and of being pooped
- describes how to turn a ship in heavy seas
- states that a ship may be hove-to with the wind on the bow or on the quarter or stopped
- describes the circumstances in which each of the methods above may be used
- describes methods of turning a disabled ship's head to keep it out of a sea trough and of lessening lee drift
- explains that a ship may drift at an angle to the downwind direction and that its direction of drift will depend upon which side it has the wind
- describes how to use oil to reduce breaking seas when hove-to and when manoeuvring in heavy seas
- describes actions to prevent a ship being driven on to a lee shore
- describes how to assist a ship or aircraft in distress - describes towing operations

COMPETENCE 1.10	Manoeuvre and Handle a Ship in all Conditions	IMO Reference
1.14	**Precautions in manoeuvring to launch Rescue Boats and Survival Craft in bad weather** (2 hours) - explains how to make a lee for launching/recovering survival craft - describes the effect of speed and the effect of flowlines around the vessel	R1,Section A-VI/2
1.15	**Methods of taking on board survivors from rescue boats and survival craft** (1 hour) - describes the methods of manoeuvring the ship and the precautions needed to take on board survivors from rescue boats and survival craft	R1
1.16	**Ability to determine the Manoeuvring and Propulsion Characteristics of common types of ships; with special reference to stopping distances and turning circles at various draughts and speeds** (3 hours) - explains the IMO recommendations for ship manoeuvrability, which are: 1. standards for Ship Manoeuvrability, adopted by Resolution MSC.137 (76) on 4 Decemeber 2002 2. explanatory Notes to the Standards for Ship Manoeuvrability, adopted by MSC/Circ.1053 on 16 December 2002 3. provision and Display of Manoeuvring Information on Board Ships, adopted by Resolution A.601 (15) on 19 November 1987	R1, R2 Ch V Reg.23, R17, R18
	- states in particular to IMO's recommendation, with respect to the turning ability of the ship, that the advance should not exceed 4.5 ship lengths and the tactical diameter should not exceed 5 ship lengths in the turning circle manoeuvre - states in particular to IMO's recommendation, with respect to the stopping ability of the ship, that the track reach in the full astern stopping test should not exceed fifteen ships length and also keeping in mind, as guided by the recommendation, that this value may be modified by the administration where ships of large displacement make this criterion impracticable but in no case exceed twenty ships length - states that opportunity should be taken to check and	R1 Section B-V/a

COMPETENCE 1.10	Manoeuvre and Handle a Ship in all Conditions	IMO Reference

supplement the information in the ship's manoeuvring booklet for intermediate draughts and for various weather conditions
- states that turning circles in shallow water at various manoeuvring speeds should be recorded when possible
- states that details of an accelerated turn in shallow water should be obtained
- explains how trials of stopping ability under various conditions should be recorded
- states that the effect of wind on the behaviour of the ship should be recorded, in particular:
  - the drifting behaviour when stopped
  - the speed at which steerage is lost in various conditions of loading and wind
  - the behaviour of the ship when making stern way
- states why the minimum operating revolutions of the engine and the resulting speed should be checked
- states that any details of manoeuvring behaviour which would be useful to a pilot or future master should be recorded
- states that STCW Code recommends additional training for masters and chief mates Section B-V/a of large ships and ships with unusual manoeuvring characteristics

1.17 Importance of navigating at reduced speed to avoid Damage caused by Own Ship's Bow and Stern Waves (1 hours) — R1

- explains damage to shore due to excessive bow waves and stern waves
- explains the effects of passing ships on ships moored alongside
- states the precautions that should be taken by ships alongside to minimize the effect of passing traffic

1.18 Navigating in or Near Ice; Practical measures to be taken when navigating in or near ice or in conditions of ice accumulation on board (3 hours) — R1, R9, R19

- states that all possible information about ice located on or in the vicinity of the intended track should be obtained
- states that information is available from:
  - daily bulletins of the International Ice Patrol in the N. Atlantic
  - ice warnings from countries where ice is a regular problem

COMPETENCE 1.10	Manoeuvre and Handle a Ship in all Conditions	IMO Reference

- Hydrographic Office ice charts
- pilot books
- facsimile ice charts
- warnings from other ships in the vicinity

- defines the following terms used in ice warnings: R2
  - solid ice
  - soft ice
  - drift ice
  - pack ice
  - growler
  - iceberg
- states the master's obligation to report dangerous ice or sub-freezing air temperatures associated with gale-force winds causing severe ice accretion on superstructures
- states that, when ice is reported on or near the course, the master of every ship is bound to proceed at a moderate speed or to alter course so as to go well clear of the danger zone
- explains that radar may not detect small icebergs and growlers
- states that navigation marks may be removed without warning in coastal areas threatened by ice
- states that no attempt should be made to enter a region of thick ice in a ship not specially strengthened for navigation in ice
- lists precautions to take when entering ice as:
  - estimating the thickness and concentration of ice and assessing whether the ship can safely pass through it
  - avoiding entry to pressure areas (shown by hummocks and rafting)
  - following leads used by previous ships, where possible
  - entering on the lee side of the ice, if practicable
  - entering at right angles to the ice edge, to avoid damage to hull, propeller and rudder
  - approaching at as slow a speed as possible, and increasing the power to maintain headway when the bow contacts the ice
- explains that leads through the ice show well on radar when set to short range
- explains precautions to be taken to avoid damaging the propeller and rudder when manoeuvring in ice
- explains how to obtain assistance from an ice-breaker
- states that it is important to follow the ice-breaker's instructions regarding speed and manoeuvring
- states that fenders should be ready for use when negotiating sharp turns in leads

COMPETENCE 1.10	Manoeuvre and Handle a Ship in all Conditions	IMO Reference
	- describes the precautions which should be taken to prevent freezing up of tail-end shafts, deck machinery and services - describes how to heave-to in an ice field - describes the need to keep a look-out, when hove-to at night, for large ice drifting through the pack - states that soft ice may block seawater intakes - describes the conditions in which ice accumulates on decks and superstructures - explains the dangers resulting from heavy accumulation of ice - states that a change of course or speed should be made to reduce the shipping of freezing spray - states that accumulated ice and snow should be cleared away as quickly as possible - describes methods of clearing decks, rigging and superstructure of ice	
1.19	**Use of, and Manoeuvring in and near, traffic separation schemes (TSS) and in vessel traffic service (VTS)** (2 hours) - explains the requirements of the International Regulations for prevention of collisions at sea with respect to Traffic Separation Schemes and narrow channels - discusses the actions that can be taken to manoeuvre the vessel in case of emergency - describes the information that maybe required by VTS officers before entering leaving or manoeuvring within a VTS controlled area	R1, R2 Ch.V, R14

COMPETENCE 1.11	Operate Remote Controls of Propulsion Plant and Engineering Systems and Services	IMO Reference

TRAINING OUTCOMES:

Demonstrates a knowledge and understanding of		STCW Code Table A-II/2
1.11.1	OPERATING PRINCIPLES OF MARINE POWER PLANTS	
1.11.2	SHIPS' AUXILIARY MACHINERY	
1.11.3	GENERAL KNOWLEDGE OF MARINE ENGINEERING TERMS	

COMPETENCE 1.11	Operate Remote Controls of Propulsion Plant and Engineering Systems and Services	IMO Reference

1.11.1 OPERATING PRINCIPLES OF MARINE POWER PLANTS

Textbooks / Bibliography: T28, T41, B33, B34, B38

Teaching Aids: A1, V143

Required performance:

1.1 OPERATING PRINCIPLES OF MARINE POWER PLANTS (25 hours) R1

- Diesel Engines
  - uses generally accepted engineering terms
  - describes the 2-stroke diesel cycle
  - describes the 4-stroke diesel cycle
  - describes the operating principles of marine diesel engine propulsion plant
  - describes the advantages and disadvantages of a slow-speed diesel engine
  - explains the cause of scavenge fires and how they are dealt with
  - describes methods of supercharging
  - describes the fuel oil system from bunker tank to injection
  - describes the lubrication system
  - describes engine cooling-water systems
  - describes the advantages and disadvantages of a medium-speed diesel
  - explains the need for gearing with medium-speed diesels
  - describes the arrangement of clutch and turning gears
  - describes how a diesel engine is prepared for stand-by
  - describes the method of starting, stopping and reversing of a direct propulsion diesel engine
  - states that the number of starts is limited by the capacity of the starting air reservoir
  - describes the waste heat recovery system of the 2-stroke main propulsion engine

- Steam Turbine Systems
  - describes the turbine, the feed system and the boiler as a system
  - explains the working of an impulse turbine and a reaction turbine
  - describes a steam turbine installation and its gearing

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- distinguishes between and describes open and closed feed systems
- states that a steam turbine needs a large water-tube boiler
- describes the main features of a water-tube boiler
- describes in outline the procedure for raising steam
- describes the procedure for warming through a steam turbine ready for manoeuvring
- describes the procedures for manoeuvring when using a steam turbine

- Gas Turbine System
  - describes the gas turbine system
  - describes the compressor part of the gas turbine
  - describes the combustion chamber or combustor part of the gas turbine
  - describes the turbine part of the gas turbine
  - describes the two main types of compressors

- Propeller and Propeller Shaft
  - describes the arrangement of thrust shaft, intermediate shafts and tailshaft
  - explains how propeller thrust is transmitted to the hull
  - describes how the propeller shaft is supported between the thrust block and the stern tube
  - sketches and describes an oil-lubricated stern-tube bearing
  - describes how the propeller is secured to the tailshaft
  - defines pitch, slip and efficiency of a propeller
  - calculates the percentage apparent slip from given data
  - calculates the ship's speed, given the engine revolutions per minute, mean pitch and percentage slip
  - describes the arrangement and operation of a controllable-pitch propeller (CPP)
  - states the precautions to take with a CPP before:
    - starting the main engines
    - going to sea
    - entering harbour or confined waters
  - states that changing control positions and the use of emergency hand control pitch and engine revolutions should be exercised

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- Bridge Control[2]
  - describes a control system for the main engine, including control from bridge, machinery control room, engine control local and changeover controls
  - describes bridge control of controllable-pitch propellers
  - describes bridge control of slow speed diesel engines
  - describes bridge control of steam turbines with associated boilers
  - describes bridge control for gas turbines with associated gas generators
  - lists the indicators and alarms provided with bridge control
  - describes the arrangement and operations of lateral thrusters
  - describes the bridge control and indicators for lateral thrusters
  - describes the concept of control systems
  - describes the terminology used in control systems
  - explains when is the control system ‘fail-safe’
  - explains when is the control system ‘fail-run’
  - explains the meaning of safety interlocks in a control system
  - describes the types of controls (open and closed loop)

1.11.2 SHIP’S AUXILIARY MACHINERY

Textbooks / Bibliography: T28, B33, B34, B38

Teaching Aids: A1, V49, V116, V123, V124, V131, V132, V133, V144, V147, V149

Required performance:

2.1 Ships' Auxiliary Machinery (25 hours) R1

- distinguishes between water-tube and fire-tube boilers
- describes auxiliary boilers
- describes a waste-heat boiler
- describes exhaust-gas heat exchangers
- describes steam-to-steam generators and explains where

2 Administrations may wish to provide specialized training in bridge control systems for personnel who are to serve on higher technology ships fitted with complex bridge control systems

COMPETENCE 1.11	Operate Remote Controls of Propulsion Plant and Engineering Systems and Services	IMO Reference

and why they are used
- describes a boiler fuel oil supply system
- describes the effect of dissolved salts in the feedwater and how it is treated
- explains what is meant by 'priming'
- states that carry-over of water may cause serious damage to turbine blading and to steam cylinders

Distillation and Fresh-water Systems
- describes a distillation system
- explains the operation of a flash evaporator
- describes the treatment of fresh water intended for drinking
- describes a domestic water system

Pumps and Pumping Systems
- classifies pumps as displacement, axial-flow or centrifugal
- describes the operation of a reciprocating pump
- describes rotary displacement pumps and states typical applications
- describes a screw pump and states possible uses
- describes an axial-flow pump and states possible applications
- describes a centrifugal pump and states typical applications
- explains the need to prime a centrifugal pump
- describes the head losses in a pumping system and how they are expressed
- explains net positive suction head and its significance in pump operation
- describes a typical bilge system and ballast system for a dry cargo vessel
- states that the engine-room emergency bilge suction is connected to the main circulating pump in the engine-room

Steering Gear
- describes ram-type hydraulic steering gear
- describes rotary-vane steering gear
- explains how hydraulic power is provided by variable-delivery pumps
- describes the IMO requirements for auxiliary steering gear and how they are met by ram-type and rotary-vane steering gear
- describes a telemotor control system
- describes electric steering control
- explains how the change from remote to local control in the steering-gear compartment is made

COMPETENCE 1.11	Operate Remote Controls of Propulsion Plant and Engineering Systems and Services	IMO Reference

- describes the requirement for power supplies to electric and electrohydraulic steering gear
- describes the requirements for emergency control of the steering gear
- states the IMO requirements for testing steering gear and for drills

Generators, Alternators and Electrical Distribution
- describes the operation of a D.C. generator
- explains the functioning of shunt- and compound-wound D.C. motors
- describes the operation of an alternator
- explains the functioning of induction motors
- explains the relative advantages and disadvantages of generation and distribution of D.C. and A.C.
- describes D.C. and A.C. distribution systems
- describes the use of circuit-breakers and fuses
- describes and draws a navigation light circuit with indicators and alarm, showing an alternative power supply
- descries the use of rectifiers
- describes the characteristics of lead-acid batteries and of alkaline batteries
- describes the maintenance of batteries
- describes the safety precautions to be observed for battery compartments - outlines the starting requirements for emergency generating sets
- lists the services to be supplied from the emergency generator
- describes the supplementary emergency lighting for ro-ro passenger ships

Refrigeration, Air-conditioning and Ventilation
- describes a vapour-compression-cycle refrigeration plant
- states desirable properties of a refrigerant
- states the properties of commonly used refrigerants
- describes the use of secondary refrigerants for cooling compartments
- explains the co-efficient of performance of a refrigeration plant
- describes an air-conditioning plant
- describes a ventilation system for accommodation
- describes a mechanical ventilation system for ships' holds

Stabilizers
- describes the construction and operation of fin stabilizers
- describes the arrangement and operation of a flume

COMPETENCE 1.11	Operate Remote Controls of Propulsion Plant and Engineering Systems and Services	IMO Reference

stabilizer

Sewage Treatment Plants
- describes the operation of a chemical sewage treatment plant
- describes the operation of a biological sewage treatment plant

Oily-water Separators and Oil Filtering Equipment
- describes the operation of an oily-water separator (producing effluent that contains less than 100 ppm of oil)
- describes the operation of oil filtering equipment (producing effluent that contains not more than 15 ppm of oil)
- explains why oily-water separators, even if well maintained and correctly operated, may not function properly
- describes how an oil-content meter functions
- describes an oil discharge monitoring and control system

Incinerators
- describes the functioning of a waste incinerator

Deck Machinery
- states that the design and performance of anchor windlasses is subject to approval by a classification society
- sketches and describes a windlass driving two de-clutchable cable lifters and warping drums
- explains the gearing necessary between the prime mover and cable lifters
- states that both winches may be coupled mechanically to provide either a stand-by drive, in case one prime mover should fail, or the power of both prime movers on one windlass, if required
- describes the arrangement of vertical anchor capstans with driving machinery below deck
- describes a spooling device to distribute the wire evenly on the drum of a mooring winch
- explains the working of self-tensioning winches
- briefly explains the advantages and disadvantages of steam, electric and hydraulic drive for mooring winches and capstans
- describes a cargo winch
- sketches and describes a slewing deck crane, its motors and its controls
- describes the lubrication of deck machinery

COMPETENCE 1.11	Operate Remote Controls of Propulsion Plant and Engineering Systems and Services	IMO Reference

Hydraulic Systems

- states that a hydraulic system consists of an oil tank, pumps, control valves, hydraulic motors and pipework
- distinguishes between open- and closed-loop systems
- describes a live-line circuit supplied by a centralized hydraulic power system
- describes radial-piston and axial-piston variable-stroke pumps
- explains how the variable-stroke pump can act as controller and power supply
- sketches and describes a simple spool valve with shutoff and control of flow direction
- describes ram and rotary-vane actuators
- states that hydraulic systems can provide stepless control of speed for:
  - winches, cranes and other lifting devices
- describes a hydraulic accumulator and explains its purpose
- states that cooling of the hydraulic oil is necessary during operation to maintain the correct viscosity of the oil
- states that the oil may need to be heated before starting from cold
- states that cleanliness of the oil is essential for satisfactory operation and that all systems contain filters
- states that air in a system leads to erratic functioning

1.11.3 GENERAL KNOWLEDGE OF MARINE ENGINEERING TERMS

Textbooks / Bibliography: T28, T41, B33, B34, B38

Teaching Aids: A1

Required performance:

3.1 Marine Engineering Terms and Fuel Consumption (4 hours) R1

- uses the correct engineering terms when describing and explaining the operation of the machinery and equipment mentioned above
- defines mass, force, work, power, energy, pressure, stress, strain and heat and states the units in which each is measured
- explains what is meant by the efficiency of machine
- describes an indicator diagram and the information

COMPETENCE 1.11	Operate Remote Controls of Propulsion Plant and Engineering Systems and Services	IMO Reference

obtainable from it

- defines indicated power, shaft power, propeller power and thrust
- defines the Admiralty coefficient (AC) as:

  $$AC = \frac{(\text{displacement})^{2/3} \times (\text{speed})^3}{\text{engine power}}$$

- defines the fuel coefficient (FC) as:

  $$FC = \frac{(\text{displacement})^{2/3} \times (\text{speed})^3}{\text{daily fuel consumption}}$$

- explains that for a given period of time:

  $$\frac{\text{fuel consumption}^1}{\text{fuel consumption}^2} = \left[\frac{\text{displacement}^1}{\text{displacement}^2}\right]^{2/3} \times \left[\frac{\text{speed}^1}{\text{speed}^2}\right]^3$$

- explains that for a given distance:

  $$\frac{\text{fuel consumption}^1}{\text{fuel consumption}^2} = \left[\frac{\text{displacement}^1}{\text{displacement}^2}\right]^{2/3} \times \left[\frac{\text{speed}^1}{\text{speed}^2}\right]^2$$

- explains that:

  $$\frac{\text{Voyage consumption}^1}{\text{Voyage consumption}^2} =$$

  $$\left[\frac{\text{displacement}^1}{\text{displacement}^2}\right]^{2/3} \times \left[\frac{\text{speed}^1}{\text{speed}^2}\right]^2 = \frac{\text{Voyage distance}^1}{\text{Voyage distance}^2}$$

- given data from the previous performance, calculates:
  - the daily consumption at service speed
  - the bunker fuel required for a voyage
  - the speed for a given daily consumption
  - the reduced speed required to complete a voyage with a given consumption
- explains that, for fuel economy, the actual speed at any stage of a voyage should be as near as practicable to the required average speed
- explains how the condition of the hull affects the fuel coefficient and the fuel consumption
- explains that keeping the leading edges and tips of propeller blades dressed and polished improves propeller efficiency and reduces fuel consumption

COMPETENCE 1.11	Operate Remote Controls of Propulsion Plant and Engineering Systems and Services	IMO Reference

1.11.4 ENGINE ROOM WATCHKEEPING

Textbooks / Bibliography: T41, B33, B34, B38

Teaching Aids: A1, V153

Required performance:

4.1 Arrangements necessary for appropriate and effective engineering watches to be maintained for the purpose of safety under normal circumstances and ums operations. (2 hours)

- explains briefly the general engine room safety that should be observed at all given times
- describes the main dangers and sources of risk in an engine room
- explains the importance and implementation of risk assessment and risk management in an engine room
- describes the safe systems of work and permits to work that should be observed in an engine room
- explains the types and importance of wearing personal protective equipment (PPE) while working in an engine room
- describes the arrangements necessary for appropriate and effective engineering watches to be maintained for the purpose of safety under normal circumstances and UMS operations

4.2 Arrangements necessary to ensure a safe engineering watch is maintained when carrying dangerous cargo
(2 hours)

- describes the arrangements necessary to ensure a safe engineering watch is maintained when carrying dangerous cargo

Part D1: Instructor's Manual

Function 1: Navigation at the Management Level

■ Guidance Notes

The following notes are intended to highlight the main objectives or training outcomes of each part of the function. The notes also contain some material on topics which are not adequately covered in the quoted references.

This function covers the theoretical knowledge, understanding and proficiency for the safe navigation of a ship in coastal waters and in the open ocean.

Function 1: **Navigation at the Management Level**

On completion of training for this function, the officer should possess a thorough understanding and capability in navigation. This together with knowledge gained in other areas, will enable the officer to carry out passages independently in a proper and safe manner and to be able to solve those problems that may arise during a voyage.

The officer will be able to fix positions and analyse in a practical way the quality of the fix, make great circle calculations, read tide tables and predict times and heights of tides at different ports worldwide.

In voyage planning the officer will be able to:

- use appropriate means of navigation in coastal waters
- make use of publications and other information sources for safe voyage planning in coastal waters
- use pilot charts, *Ocean Passages for the World* and other publications to select a safe and economic 'best' route
- organize and manage the bridge team.

Officers will be thoroughly conversant with the content, application and intent of the International Regulations for Preventing Collisions at Sea (COLREG 1972), as amended.

The interpretations arising from court decisions should be used when teaching these rules. They will be able to apply them correctly in all situations as master of a ship.

Officers will be able to arrange and monitor the keeping of a safe navigational watch at sea and an effective deck watch in port taking account of the standards regarding watchkeeping in the STCW Code Chapter VIII. They will have a knowledge of all modern navigational aids, enabling them to navigate safely in all parts of the world. They will have specific knowledge of operating principles, limitations, sources of error, detection of misrepresentation of information and methods of correction to obtain accurate position fixing. Officers will appreciate the danger of exclusive reliance on information gained from instruments and the necessity for calibration and frequent checking of the instruments.

On completion of the function, officers will be able to identify the various parts of the Magnetic Compass and explain their functions. They will understand the reasons for the change of compass deviation with time and position and the need for routine checking of the ship's deviation. They will also be able to produce and analyse a deviation table. Officers will have a knowledge and understanding of gyro-compass errors and will be able to evaluate possible errors and appreciate the limitations of the instrument.

On completion of the function, officers will:

- possess a general understanding of the elements and processes which determine the weather:
- be able to draw conclusions on the basis of observations made on board and from information available;
- be able to utilize information from weather and wave charts; and
- have a basic knowledge of the elements of oceanography.

This knowledge will, as part of the training programme as a whole, enable the trainee to take into account climatic conditions, the weather prognosis, ocean currents and information on the presence of ice, for the safe operation of the ship.

The officer will understand and interpret a synoptic chart, predict area weather, have a knowledge of the characteristics of various weather systems and ocean current systems and be able to use all appropriate navigational publications.

Officers will also be aware of all of the factors affecting the manoeuvring and handling of ships. They will be able to plan berthing or anchoring procedures, taking account of prevailing conditions of wind and tide and their own ship's characteristics, and to make use of assisting tugs when necessary. They will, after having gained seagoing experience or training on a ship-handling simulator, also be able to handle a ship so as to minimize the risk of damage or stranding resulting from heavy weather. Officers will be aware of the dangers to be encountered when navigating in ice or conditions of ice accumulation on board and the precautions to take for the safety of the ship and crew.

Officers will know the procedures to use in VHF communications and be able to use radiotelephones, particularly with respect to distress, urgency, safety and navigational messages. They will also know the procedures for emergency distress signals by radiotelegraphy, as prescribed in the Radio Regulations, and will be able to send a distress call by using an automatic keying device and the emergency transmitter.

1.1 Plan a Voyage and Conduct Navigation

First of all, the officers should be well acquainted with publications which supply appropriate information for voyage planning. The officers should plan navigation after analysing and evaluating current legislations (if applicable) with regard to Passage and Voyage Planning and as per the requirements of International Maritime Organisation resolution A.893. Intelligent use of the information, together with professional ability and watchfulness, leads to a successful voyage. Proper safe working procedures are very important and should be stressed. Instructors will find T12 a valuable source of reference.

1.1.1 Voyage Planning and Navigation for all conditions

Log books **(3 hours)**

On board ship, various conditions need to be watched and taken care of. In a nautical context this means navigation, including watchkeeping, weather, shiphandling, handling of cargo, condition of ship as to stability, trim, stress, etc., personnel management and communications, which are the most important subjects. Proper and effective keeping of log-books is important as a record of the various circumstances. Special emphasis should be placed on conditions involving maritime shipping legislation and other regulations and on keeping log-books in normal circumstances.

Voyage Planning and navigation for all conditions by acceptable methods of plotting ocean tracks **(24 hours)**

The importance of preparing oneself and the vessel before setting off on a sea passage is irrefutable, especially on a coastal passage where the sheer number and proximity of hazards can quickly spell disaster for the unprepared. Navigation planning should be carried out after utilising the principles of passage planning to make a complete appraisal of a proposed passage also taking into account restricted waters, while enroute, in conjunction and utilising Navigational charts, Admiralty Routeing charts, Ocean Passages of the World, Admiralty Sailing Directions, Tide tables to appraise a proposed ocean passage and a coastal or pilotage passage. Appropriate strategies and contingency plans should also be used in order to deal with various factors, as mentioned in the detailed teaching syllabus.

Navigation Safety recommends that:

1) all of the ship's navigation is planned in adequate detail:
2) there is a systematic bridge organization that provides for:
    (a) comprehensive briefing of personnel
    (b) close monitoring of position
    (c) cross-checking.

1.1.2 Routeing in accordance with The General Provisions of Ship's Routeing

Routeing **(12 hours)**

The procedures for weather routeing by a shore-based service should be covered in this topic.

On-board routeing can be carried out by the master if the ship is equipped with a facsimile receiver and is in a region for which the necessary prognostic charts are available. The internet and email facility can also be used in order to obtain charts from various sources providing these facilities. This topic should be taught in conjunction with the voyage-planning.

Ocean voyage

Because traffic concentrations are low and navigational hazards are relatively few on an ocean crossing, the main data to be appraised are environmental, such as seasonal prevailing weather, local and actual weather, ocean currents, tides, ice, etc. In addition, data of the ship's characteristics, cargo and navigational/operational data need to be taken into account.

The main reason for selection of alternative routes is one of safety and economics. Route selection is to some extent regulated by insurance restrictions, load-line zones, IMO routeings and similar regulations.

A thorough analysis of all of the conditions relevant to passage planning should be covered in this subject area. Such an analysis may start with calculating distances of possible tracks and then evaluating weather conditions, current, characteristics of the ship and of its cargo, regulations, etc. Very often the "best" route is not the shortest.

1.1.3 Reporting in accordance with the general principles for ship reporting systems and with VTS procedures

Ship reporting systems **(1 hour)**

Instructors should note that ref R3 contains full information on ship's routeing and reporting.

Planning of navigation should be carried in accordance to the ships routeing as these systems contribute to safety of life at sea, safety and efficiency of navigation and/or protection of the marine environment. The Instructor should also refer to MSC/Circ.1060 Guidance Note on the Preparation of Proposals on Ships' Routeing Systems and Ship Reporting Systems, especially while appraising and preparing a coastal Navigation plan while teaching this topic.

They should also note that the measures mentioned on the ships routeing, that are described or defined in parts A and H of this publication are individually described in parts B (traffic separation schemes), C (deep-water routes), D (areas to be avoided), E (other routeing measures, such as recommended tracks, two-way routes and recommended directions of traffic flow), F (the rules and recommendations on navigation that are associated with particular traffic areas and straits), G (mandatory ship reporting systems, mandatory routeing systems and mandatory no anchoring areas) and H (archipelagic sea lanes).

Routeing measures were adopted on May 2010.

1.2 Determine Position And The Accuracy of Resultant Position Fix by Any Means

1.2.1 Position Determination in all conditions

The main objective of this subject area is that the officers shall gain knowledge and ability in position fixing in all conditions by celestial observations, terrestrial observations using appropriate charts, notices to mariners and other publications, which are required to assess the accuracy of position fixes and also using modern electronic navigational aids.

Celestial Navigation **(24 hours)**

The main objective of this subject area is that the trainee shall gain knowledge and ability in position fixing by using all celestial bodies.

To compute the altitude of the celestial body, three methods are available:

- the cosine formula and a pocket calculator
- the haversine formula
- pre-computed altitude and azimuth tables.

Which of these should be chosen is optional. After having introduced these methods, it is recommended to select one of them and specialize on that particular method. These days with universal access to inexpensive pocket calculators, the first method may be preferable.

The Longitude by chronometer method, to obtain the longitude (a position line) should be carried out before the body is on the observer's meridian.

The Marcq St. Hilaire method (also known as Intercept method) for obtaining a position line is universal and can be utilized for any celestial body in any direction, the body in the meridian included.

The Latitude by Meridian Altitude method should be used when the body is on the observer's meridian after applying the true zenith distance to the declination of the celestial body in order to obtain the observer's latitude.

The officers should also be able to obtain the corrections from pole star tables in the nautical almanac and apply them to the altitude of Polaris to find the latitude of the observer.

Finally the officers should be able to find the position of the observer at the time of the final observation, given two or more position lines with the courses and distances run between the observations

Fixing positions might be carried out as geometrical problems, using simultaneous or staggered observations of celestial bodies, preferably on an ocean plotting sheet which can then be transferred on to the navigational chart or on the navigation chart (if scale permits).

The examination of trainees in celestial navigation should be mainly limited to their demonstrating the ability to explain the most common definitions and, in a written examination, to the ability to carry out the calculations related to the various observations and obtain a fix from celestial bodies.

Terrestrial Navigation including the ability to use appropriate charts, notices to mariners and other publications to assess the accuracy of the resulting fix. (24 hours)

This subject area is intended to give the trainee sufficient knowledge and ability in:

1) sailing calculations, using the Mercator formula
2) Great circle and composite Great Circle calculation
3) simple analysis of errors that may occur in position fixing
4) Correct usage of appropriate charts, notices to mariners and other publications to assess the accuracy of the resulting fix
5) Correct usage of chart catalogue and correcting of charts using information from notices to mariners

The analysis of errors is a very important task. As far as mathematical knowledge permits, statistical methods may be used. A more practical approach to the problem may be more fruitful. The trainees' to make critical judgements and to adopt a critical attitude should be encouraged. In particular, the understanding of possible errors, limitations of accuracy and the need for repeated observations, must be stressed.

Calculation of the course, distance and intermediate positions should be practised by working a sufficient number of exercises. The choice of formulae and the method of calculation are optional. In the case of a pocket calculator being chosen, which these days is a natural choice, use of the cosine formula for the distance and of the cotangent formula for the course is convenient. The cotangent formula cannot be used close to the equator, where the great circle method is of little or no benefit. Except for this restriction, the formulae can be used in any position.

Despite great-circle sailing having the advantage over Mercator sailing, for a shorter distance, the method has certain disadvantages. In some cases, use of the method may lead to a latitude which is too high, and composite sailing has to be used. The latitude of vertex is important and if there are restrictions pertaining to weather or commercial aspects, composite sailing has to be used. Composite exercises, including various observation methods, dead reckoning and great-circle sailing, should be a part of the learning process.

Discussion of routes and the analysis of the optimum track may start in this subject area and continue in the subject area of voyage planning.

Modern electronic navigational aids (32 hours)

At the level of the training for chief mate and master there are two main areas of emphasis in this subject. First, there should be a more thorough treatment of principles, of the limitations of the systems, of the instruments and of the presentation of information than for the watch-keeping officer. Secondly, emphasis should be put on procedures for setting up the instruments, on sources of errors, detection of wrong information and on the use of corrections and estimation of accuracy.

In particular, methods of checking and calibration should be thoroughly covered.

New modern electronic aids have been added since the previous edition of the book, as many more are in operational use and the officers should be familiar with these electronic navigational aids.

Loran C, is covered in IMO model course 7.03, Officer in charge of a navigational watch – Operational level. Now overtaken by enhanced Loran (eLoran), little background knowledge is required to reinforce the knowledge gained previously, especially as it will benefit in understanding eLoran as Integrated GPS/DGPS/eLoran systems are already in use.

Enhanced Loran (eLoran), the officers should know that eLoran is an independent, dissimilar, complement to Global Navigation Satellite Systems (GNSS). Its operation limitation should also be covered.

Differential GPS (DGPS): The trainees should be able to explain the principle of the DGPS and its use, including the two working methods.

Global Navigation Satellite System (GLONASS): The Instructors should explain the principle on which GLONASS work and the advantage of the receiver capable of operating both GLONASS and GPS. Combined GPS/GLONASS receiver equipment utilises a global datum based on the Soviet Geocentric Coordinate System 1990 (SGS 90)

Galileo: The Instructor should explain that Galileo is the European satellite navigation system, designed as a wholly civil system, operated under public control and is a 2nd generation Global Navigation satellite System (GNSS).

Automatic Identification System (AIS): The international requirement for the carriage AIS as ship-borne navigational equipment on vessels is detailed within Chapter V (Safety of Navigation) Regulation19, of the revised SOLAS Convention. The information received from the AIS is displayed on an electronic chart, computer display or compatible radar and the information received can help situational awareness as well as assist in collision avoidance.

The precautions to be under taken when AIS is used as an aid for collision avoidance should be emphasized to the officers.

Long Range Identification and Tracking (LRIT): The purpose of LRIT is to improve maritime safety, security and assist in search and rescue (SAR)operation. The officers should have the knowledge that the Data transmitted from the LRIT, which ships are required to transmit LRIT messages. There is no interface between LRIT and AIS. AIS is a broadcast system and Data derived through LRIT will be available only to the parties entitled to receive such information; regulatory provisions will include safeguards concerning the confidentiality of data.

SOLAS contracting Governments will be entitled to receive information about ships navigating within a distance not exceeding 1000 nautical miles off their coast.

Integrated Navigation system (INS) and Integrated Bridge system (IBS): Integrated Navigation system (INS) ‘supports safety of navigation by evaluating inputs from several independent and different sensors, combining them to provide information giving timely warnings of potential dangers and degradation of integrity of this information’. The three categories of INS namely (A), (B) and (C) should be explained to the officers.

The Integrated Bridge Systems (IBS) is ‘a combination of systems which are interconnected in order to allow centralised access to sensor information or command / control workstations, with the aim of increasing safe and efficient ship’s management by suitably qualified personnel’. IBS recommendation apply to a system performing two or more operations, namely: passage execution; communication; machinery control; loading, discharging and cargo control; and safety and security. The Instructors should explain the limitations of these systems clearly to the officers.

Voyage Data Recorder (VDR) and Simplified Voyage Data Recorder (S-VDR): The purpose of a voyage data recorder (VDR) and Simplified Voyage Data Recorder (S-VDR) is to maintain and store, in a secure and retrievable form, information concerning the position, movement, physical status, command and control of a vessel over the period leading up to and following an incident having an impact thereon. The officers should know that the information contained in a VDR and S-VDR is made available to both the Administration and the ship owner and this information is for use during any subsequent investigation to identify the cause(s) of the incident. The equipment is so designed that, as far as is practical, it is not possible to tamper with the selection of data being input to the equipment, the data itself nor that which has already been recorded and any attempt to interfere with the integrity of the data or the recording is recorded. The various data items recorded in the VDR and S-VDR should be explained to the officers. The officers should know that the ship owner, in all circumstances and at all times, owns the VDR and its information and in the event of an accident the owner of the ship makes all decoding instructions available as necessary to recover the recorded information and maintains the same.

Bridge Navigational watch alarm system (BNWAS): The carriage requirement of Bridge Navigational Watch Alarm Systems (BNWAS), is set out by SOLAS chapter V/19 and the requirements will be mandatory for new ships and phased-in for existing ships. The instructors should explain the purpose of BNWAS is to monitor bridge activity and detect operator disability, which could lead to marine accidents and this purpose is achieved by a series of indications and alarms to alert first the OOW and, if he/she is not responding, then to alert the master or another qualified OOW. The system monitors the awareness of the officer-on-watch (OOW) and automatically alerts the master or other qualified OOW if for any reason the OOW becomes incapable of performing watch duties. The officers should be able to list and explain the operational sequence of indications and alarms of the system.

Officers should be fully conversant with the limitations of all the equipments.

Exercises in the use and calibration of instruments are suitable for group activities.

1.3 Determine and Allow for Compass Errors

1.3.1 Magnetic Compasses

Parts of the magnetic compass and their function **(3 hours)**

The officers should be able to identify the various parts of the Magnetic Compass and explain their functions. Resolution A.382(X) details the performance standards for magnetic compasses and Resolution MSC.86(70), annex 2 for Transmitting magnetic heading devices.

Since correction of Magnetic Compasses are carried out by compass adjusters, certified by Competent Authorities, the errors and method of correcting the Magnetic compass is not required from the officers.

Although the magnetic compass is mainly used only as a stand-by for the gyro compass, its errors should be regularly checked and recorded.

1.3.2 The Principles and Errors of Gyro Compasses

Gyro compass errors and corrections (10 hours)

The instructor should remind trainees that the meridian-seeking property and damping both depend upon detection and measurement of the tilt of the spin axis of the gyroscope resulting from the earth's rotation. That applies equally to compasses controlled by liquid-ballistic attachments and those controlled by electrical signals to torque motors. Any tilt, other than that resulting from the earth's rotation, and any apparent tilt resulting from horizontal acceleration of the compass is a source of error.

The errors and the methods of correcting or limiting them should be treated non-mathematically.

The various errors may be referred to the performance standards for gyro-compasses to give trainees an indication of the limits of the accuracy that can be expected.

1.4 Co-Ordinate Search and Rescue Operations

See IMO Model Course No. 1.08 Radar Navigation - Management Level and STCW Reg. I/1 2

Instructors should note that the International Aeronautical and Maritime Search and Rescue Manual, R31 published jointly by IMO and the International Civil Aviation Organization (ICAO) in three volumes provides guidelines for a common approach to organizing and providing SAR services.

Volume III, Mobile Facilities, is intended to be carried aboard rescue units, aircraft and vessels to help with performance of a search, rescue or on-scene co-ordination function, and with aspects of SAR that pertain to their own emergencies.

1.5 Establish Watch keeping Arrangement and Procedures

1.5.1 The International Regulations for Preventing Collisions at Sea

Thorough knowledge of content, application and intent of the International Regulations for Preventing Collisions at Sea, 1972, as amended (30 hours)

This section will be dealt with mainly by question-and-answer sessions, using models or magnetic boards. Trainees should already be thoroughly familiar with COLREGS and their application, so these sessions will be for the purposes of revision and

consolidation. The response "call the master" will, of course, no longer be available to them.
The attention of trainees should be drawn to collision cases and court judgements when discussing their answers and the actions they propose.

When dealing with the use of and manoeuvring in traffic separation schemes, particular attention should be drawn to the proper use of inshore traffic zones where they exist.
Exercises should involve planning passages during which it would be necessary to join or to leave lanes, including cases which involve crossing the other lane.

The use of radar for collision avoidance in restricted visibility is covered in IMO Model Course 1.08 Radar Navigation, but some attention should be paid to the posting of lookouts, the proper use of sound signals, the actions to take on hearing the fog signal of another ship and other matters which do not lend themselves to simulation.

1.5.2 Principles to be observed in keeping a Navigational Watch

Thorough knowledge of the content, application and intent of the Principles to be observed in keeping a navigational watch (6 hours)

This is based on ensuring that the requirements of STCW regulations and recommendations are complied with. The regulations are contained in the STCW Code Section A-VIII/2.

The references provide examples of strandings which became the subject of official investigations. In most cases, a failure to keep an adequate navigational watch caused or contributed to the accident. A criticism made in a number of cases was the absence of master's standing or special orders and the lack of any routine regarding effective navigational and watchkeeping procedures, such as the planning of passages in confined waters and the checking of courses and positions on the chart. In other cases there was uncertainty about calling the master and confusion about who was conning the ship after the master had come to the bridge.

1.6 Maintain Safe Navigation Through the Use of information from Navigation equipment and systems to Assist in Command Decision-Making

***See IMO Model Course 1.08 Radar Navigation - Mana**gement Level, 1.22 Ship Simulator and Bridge Teamwork, 1.27 Operational Use of Electronic Chart Display and Information Systems (ECDIS) and STCW Reg 1/12*

1.7 Maintain The Safety Of Navigation Through The Use Of ECDIS And Associated Navigation Systems To Assist Command Decision Making

See IMO Model Course No. 1.27 Operational Use of Electronic Chart Display and Information Systems (ECDIS)and STCW Reg I/12

1.8 Forecast Weather and Oceanographic Conditions

1.8.2 Synoptic Charts and Weather Forecasting (14 Hours)

The planetary system of wind and pressure

Reference should be made to the way in which the stability of the atmosphere determines the type of cloud, the height at which it forms and its thickness. The stability of the different air masses and how it is modified as they move should be related to the weather associated with them.

A qualitative treatment of the various forces which give rise to surface winds is intended.

Climatology

Trainees should have a general idea of the climate of the oceans and the seasonal changes to be expected. The Mariner's Handbook (T30) contains world climatic charts.

1.8.3 Characteristics of Various Weather Systems (8 hours)

Tropical revolving storms

The instructor should make use of drawings of the structure of a tropical storm, graphical representations of temperature, pressure and wind speed, satellite pictures and charts showing actual storm tracks.

Trainees should be fully conversant with the means of avoiding tropical storms, where to find details of radio storm warnings and the information which should be transmitted if the master has good reason to believe that a tropical storm is developing or exists in the neighbourhood.

Weather forecasting

If a facsimile receiver, internet and email facility is available, receiving and interpreting the weather chart of the day should be part of the training process.

1.8.4 Ocean Current Systems (7 hours)

Ocean currents

Trainees should possess sufficient knowledge of ocean currents and sources of information on currents to enable them to select an optimal route for a sea passage and season. As an aid to the Instructors, there are; sample Lesson plan for Ocean Current Systems, sample participants handout, sample power point presentation and activities, included in this model course. The Instructors may find them useful when preparing for lectures. These samples are given as guidance only to demonstrate the use of extensive research and pedagogy.

Waves

The dangers of crossing areas of shallow water in heavy weather should be stressed.

If facsimile wave charts of the area are available, trainees should make use of them in weather forecasting.

Ice on the sea

Trainees should know where information on ice reports can be found and understand the terms and descriptions used in them. The Marine Observer's Handbook (T23) and The Handbook (T30) contain the Ice Nomenclature drawn up by the World Meteorological Organization.

Trainees should also recognize the conditions which may give rise to severe Accumulation of ice on the ship.

1.9 Respond to Navigational Emergencies

1.9.1 Precautions When Beaching a Ship

Precautions to be taken when beaching a vessel (2 hours)

Although a gently shelving beach of sand or gravel is ideal, in many cases the urgency of the operation will dictate that the nearest beach is used regardless of the nature of the bottom. Similarly, the state of the tide can seldom be chosen.

A loss of stability similar to that experienced on taking the blocks in dry-dock will occur. If the ship has a large trim or the slope of the bottom is large, a heavy list may develop as the tide falls. The ship will list similarly when one end lifts again on the rising tide. Transfer of ballast or flooding a compartment may be necessary to prevent the list becoming excessive.

Beaching with the ship parallel to the beach may avoid that problem; the ship will settle with a list equal to the slope of the beach. If boats are to be used to transfer passengers or non-essential crew members ashore, the broadside-on position will provide a lee from onshore waves and surf for the boatwork.

On the other hand, a ship end-on to the beach with ground tackle laid out to keep, the stern in place would be better able to withstand heavy onshore weather and would be easier to haul off eventually.

1.9.2 Actions to be Taken if Grounding is Imminent and After Grounding

Grounding (2 hours)

Many of the actions to take after beaching a ship apply also to stranding.

When planning an attempt at refloating, consideration should be given to the extent of damage, the height of the tide, the assistance available and whether the ship can be lightened by discharging ballast or cargo. Soundings, taken from a boat, will give an indication of the most favourable direction in which to try to move the ship during refloating.

The release or probable release of oil or other harmful substances should be reported at once to the nearest coast radio station. Where a serious threat of pollution exists, the coastal State involved may intervene in the salvage operations.

1.9.3 Action to be taken if Collision is imminent, after a Collision or Impairment of the Watertight Integrity of the Hull

Collision **(2 hours)**

The duties of the master following a collision are set out in the appropriate regulations and annexes.

There may also be national requirements regarding the recording and notification of collision accidents. In any case, full details of the collision, engine and helm orders prior to impact, estimates of the heading and speed at the time of impact and the angle of contact with the other ship should be entered in the log-book for future reference. The trace from the course recorder should be appended to the log-book.

1.9.4 Assessment of Damage Control (1 hour)

Even a small hole in the shell plating below the waterline will admit water faster than the capacity of bilge pumps to deal with it. A rapid assessment is needed of the tonnage of water in the space, the lost buoyancy and change of trim and the effect of these factors on stability. Cross-flooding may be needed to reduce the list in certain ships, if only to aid abandonment.

The release or probable release of oil or other harmful substances should be reported to the nearest coast radio station at the first opportunity.

1.9.5 Emergency Steering (1 hour)

When a ship in a coastal region or area of high traffic density has become disabled as a result of engine or steering failure which cannot readily be repaired, she should report her situation to the coastal State concerned.

It is unlikely that jury steering can be arranged for a large deeply loaded ship, such as a VLCC or a bulk carrier, which would be effective in conditions of strong wind. Recognizing that, the most prudent course of action would be to call for tug assistance at an early stage, before a dangerous situation has developed.

1.9.6 Emergency Towing Arrangements and Towing Procedures (2hours)

Before undertaking a tow, the master should check that he is permitted to do so by the terms of the charter-party or bills of lading. In any case, he should contact the owners for their agreement. They will have to arrange additional insurance.

Towing for the purpose of saving life is always permitted. For example, towing a disabled vessel away from a lee shore may be the safest way of saving the crew in some circumstances.

The master should also be satisfied that the towing operation has a reasonable chance of successful completion. He should consider the relative sizes of the ships, the power of the engines, fuel reserves, equipment available and distance to a safe port.

The towing wires used by salvage tugs are much longer than the towing wires carried by merchant ships, which do not have sufficient weight on their own to provide a catenary to absorb shock loadings. To provide the extra weight it is usual to shackle the towing wire to the anchor cable of the towed ship and to walk back the cable sufficiently to keep the towing wire submerged throughout the towing operation.

When starting to tow, the weight should be taken up gradually, the speed being slowly increased until towing speed is reached. Care should be taken to avoid jerking the tow wire on first taking the weight. The towing speed is adjusted so that the tow wire remains submerged. If the tow wire shows signs of clearing the water and straightening, the engine revolutions should be reduced until a catenary has been restored.

A method of slipping the tow in an emergency (such as the foundering of the towed vessel, for example) should be decided and known to all of the watchkeepers.

Disconnecting the tow, particularly in confined waters at a port approach, can be a critical operation and should be planned and agreed between the two vessels. Speed will have to be reduced gradually over a long distance. As the depth of water decreases, the towed ship should shorten the tow by heaving in cable, to prevent the tow line fouling on the bottom. Harbour tugs should be arranged to assist with manoeuvring during disconnection and to take the tow into a berth. Alternatively, both ships may be brought to anchor before disconnecting.

1.10 Manoeuvre and Handle a Ship in all Conditions

1.10.1 Manoeuvring and Handling a Ship in all conditions

(V3, V4, V5, V6, V7, V8, V9, V10, V11, V12, V13, V14, V15, V16, V17, V18, V19,V30, V31, V32, V33, V98,V140, V142, V152, V168)

Approaching pilot stations and embarking or disembarking pilots, with due regard to weather, tide, head reach and stopping distances (4 hours)

This section can largely be dealt with by discussion led by the instructor. Trainees should be encouraged to contribute, from their own experiences, cases of difficult approaches, problems with embarking a pilot in heavy weather and the slowing of very large ships.

The instructor should impress on trainees that the passage plan should extend to the berth and not finish at the pilot station. The officer in charge of the navigational watch will need the plan to monitor the ship's progress to the berth, (T25).

Handling ship in rivers, estuaries and restricted waters having regard to the effects of current, wind and restricted water on helm response (10 hours)

The approximate mean squat can be calculated by using formulae. Trainees should be reminded that values obtained from the formula or from squat diagrams are theoretical and that the actual squat and trim of their vessels may differ somewhat, (T18, T25, V4, V7).

Application of Constant rate of turn techniques (1 hour)

Such techniques may be demonstrated and practised using a radar simulator. Radar Navigation - Management Level is covered in IMO Model Course 1.08.

Berthing and unberthing under various conditions of wind, tide and current with and without tugs (12 hours)

Trainees should demonstrate, with the use of models on a large table, how to berth and unberth at given port facilities, under various conditions of wind and current, detailing the helm and engine orders, anchors, mooring lines and instructions to tugs that they would use. Instructors should also emphasize on the knowledge of the magnitude of wind and current force and how it affects the ship during berthing or unberthing. This knowledge will assist a master, to decide whether the available tugs have to hold the ship against a cross wind or to move the ship against a crosswind. Normally tugs cannot hold a ship against a cross current, as the power, which is necessary for such an operation, is enormous. The class should be asked to evaluate and criticize the actions taken and suggest alternative methods where applicable (V5).

Ship and tug interaction (3 hours)

Different types of tugs and the main difference resulting from the location of tug's propulsion and towing point should be pointed out. The dangers related to ship-tug interaction and the precautions which the trainee, when acting as master should take is of importance.

Use of propulsion and manoeuvring systems including various types of rudder (2 hours)

Various types of Rudders and their advantages with regard to ship-handling should be pointed out to the trainees. Knowledge on the appropriate use of bow and stern thrusters is also important. Trainees should also have adequate knowledge on the use of rudder cycling and its effectiveness.

Anchoring (6 hours)

Exercises in anchoring are particularly suitable for practice with a training vessel where one is available. Trainees should be required to produce a plan for anchoring in a given position and then carry out the plan, acting as a bridge team. Their roles in the bridge team would be rotated in subsequent exercises. Mention should be made of the importance of checking lateral as well as fore-and-aft movement when anchoring very large ships.

Procedures for anchoring in deep water and in shallow water (1 hour)

Many ships reportedly have experienced large damage to ships and its ancillary equipments, as the required knowledge on anchoring ships in deep or shallow waters were found inadequate. The procedures and precautions when anchoring in these waters should be explained to the trainees.

Dry-docking (2 hours)

Stability during dry-docking and the practical implications should be pointed out to trainees.

Management and handling the ship in heavy weather (6 hours)

Full use should be made of trainee's personal experiences when covering this section. When dealing with methods of keeping a disabled vessel out of a sea trough and lessening lee drift, trainees should be restricted to using materials which are available aboard their ships. The importance of understanding the enormous stresses encountered by the ship in heavy weather conditions is vital. Dangers and precautions to be exercised when the ships experience synchronous rolling / pitching, parametric rolling to be pointed out to the trainees. (V5, V8, V9).

Ability to determine the Manoeuvring and propulsion characteristics of common types of ships, with special reference to stopping distances and turning circles at various draughts and speeds (3 hours)

Draw attention to the warning in the manoeuvring booklet and the wheelhouse poster that the performance of the ship may differ from that shown, due to environmental, hull and loading conditions. Also point out that much of the information is estimated; for example, the manoeuvring characteristics in wind. Records of actual behaviour, together with the conditions in which they were observed, form a valuable addition to the manoeuvring booklet. IMO’s recommendation, with respect to the turning ability of the ship, that the advance should not exceed 4.5 ship lengths and the tactical diameter should not exceed 5 ship lengths in the turning circle manoeuvre should be pointed out to the trainees. Opportunities for determining characteristics arise, for example, when approaching pilot stations or anchoring to await a tide or berth (R17).

Practical measures to be taken when navigating in or near ice, ice or in conditions of ice accumulation on board (3 hours)

The Mariner's Handbook (T30) contains a full treatment of ice conditions, well illustrated with photographs

1.11 Operate Remote Controls of Propulsion Plant and Engineering Systems and Services

1.11.1 Operating Principles of Marine Power Plants

Marine power plants (25 hours)

Diesel engines

The principles of the working of 2-stroke and 4-stroke diesels should be covered, together with their essential services such as fuel, lubricating and cooling systems. Details of particular makes of engines are not required. Trainees should be aware of the procedures for preparing the engine for use and the change-over from full sea speed to manoeuvring, with the likely times involved. They should also know what is involved in starting and controlling the engine.

The rules regarding the capacity of the starting air reservoir are laid down by the classification societies.

Steam turbine systems

The boiler, feed system and turbine should be treated as a single main propulsion system. Trainees should be able to produce schematic drawings of the complete system and explain the purpose of the various parts. Details of particular makes of equipment are not required. Trainees should be aware of those faults which lead to automatic shut-down. The procedures and time taken to raise steam and prepare the engine for manoeuvring and the procedures for controlling a steam turbine engine should be known.

Propeller and propeller shaft

The bridge control for controllable-pitch propellers is usually arranged to give about 60 to 70 per cent of engine full speed when set for zero pitch. Movement of the lever forward or aft initially affects the pitch only. Full pitch is usually reached by moving the control lever through half of its travel, further movement increasing the engine revolutions. There may also be a means of adjusting the maximum pitch available. The engine and CPP can be controlled from the machinery control room and facilities may be provided for overriding all remote controls. Standing orders should lay down the procedure for informing the bridge if this has to be done.

Before starting the main engine, the propeller pumps should be running and a check made that control is possible from all control positions. During starting, control will be from the machinery control room. The propeller should be set for zero thrust and a check made that it is all clear to start the propeller turning. After starting, control is transferred to the bridge.

Before letting go or weighing anchor, the officer of the watch should check which position has control, and that it is effective, by making a small movement of the pitch control and observing the result. Before entering harbour or restricted waters, a check should be made on the control of engine speed and propeller pitch while sea room is still available.

Throughout this section instructors should keep in mind that officers should be able to explain the principles of operating and maintaining marine power plants. Officers should be familiar with the correct and commonly used engineering terminology in this context. The officer must have sufficient knowledge to be able to understand and manage the issues – he therefore does not need to have a detailed engineering knowledge. It is important that he understands the consequences of any malfunctioning and the actions to be taken to restore proper operations, or avoid problems if the machinery cannot be restored.

Bridge control

Technical details are not required. Trainees should be able to draw block diagrams of the systems, showing the information paths between the various components. The requirements for bridge indicators and alarms and the emergency stop are set out in SOLAS Regulations.

1.11.2 Ships' Auxiliary Machinery (25 hours)

This section deals with machinery and equipment other than the main propulsion, although some of the equipment would be necessary to keep the main engine running; for example, pumps.

Trainees should be able to draw simple line drawings of boilers and heat exchangers. Today, when most ships are equipped with diesel main engines, their use is restricted to providing ship's services. In tankers, the use of steam is important for heating cargo and for the driving of cargo pumps.

Instructors should keep in mind that officers should be able to explain the principles of operating and maintaining auxiliary machinery. Officers should be familiar with the correct and commonly used engineering terminology in this context. The officer must have sufficient knowledge to be able to understand and manage the issues - he therefore does not need a detailed engineering knowledge. It is important that he understands the consequences of any malfunctioning and the actions to be taken to restore proper operations, or avoid problems if the machinery cannot be restored.

Distillation and fresh-water systems

The production of fresh water from seawater in sufficient quantities enables a ship to carry a larger deadweight of cargo and ensures a supply of water free from dissolved salts for the boiler feed. The temperature at which flash evaporators work is not high enough to sterilize water for drinking purposes. Evaporators should not be run for the production of drinking water in coastal areas because of the risk of biological contamination. In any case, water from distillers or evaporators must be treated before it is safe to drink.

As an alternative to traditional distillation methods, reverse osmosis process may be used for generating fresh water at sea and should be mentioned.

Pumps and pumping systems

Trainees should have a qualitative knowledge of the losses in a pumping system and the characteristic curve for centrifugal pumps. They should also understand net positive suction head and realize that, when it approaches zero, gassing will occur at the pump, leading to cavitation which may cause damage to the impellers of centrifugal pumps.

Steering gears

The operation of ram and rotary-vane hydraulic steering gears and how the power required is supplied by variable-delivery pumps should be known. Trainees should also be able to explain how the SOLAS requirements for auxiliary steering and emergency control of steering gear are met. They should also be aware of the requirements for testing the steering gear and having drills in the change-over to auxiliary steering gear. Records of the tests and drills should be entered in the log-book.

Generators, alternators and electrical distribution

Trainees should have a qualitative understanding of electrical generation and distribution, including the connection between the main and emergency switchboard during normal operation. The treatment of A.C. motors is confined to the induction motor, which is the only type found aboard most ships.

The considerations in loading generators and parallel operations may be covered.

During charging, lead-acid batteries evolve hydrogen, which is easily ignited over a wide range of concentration. The electrolytes of both acid and alkaline batteries are highly corrosive to many materials and to the person. In addition, there is a risk of electric shock from large installations such as the traditional sources of electrical power.

Refrigeration, air-conditioning and ventilation

Trainees should be able to sketch a vapour-compression-cycle refrigeration system and explain what happens at the various components. The coefficient of performance is defined as the rate of heat extraction at the evaporator divided by the power used to circulate the refrigerant. It is a measure of the plant efficiency but, since its value is greater than one, the term 'coefficient of performance' is used instead of 'efficiency'. Trainees should deal with refrigerated cargo systems. The arrangements can be considered in three parts; the central primary refrigeration plant, the brine circulating system and the air circulating system for cooling the holds.

Mechanical ventilation systems for ships' holds often incorporate remote-reading dewpoint sensors and drying units for the circulated air to maintain the dewpoint in the hold below the temperature of the cargo and of its steelwork, so as to prevent condensation damage.

Stabilizers

The quantity of water and the setting of the control valves of flume stabilizers need to be adjusted to the ship's condition of loading, which determines its natural rolling period.

Adjustment may be necessary after an alteration of course which produces a large change in wave encounter period.

Sewage treatment plants

The discharge of untreated sewage into coastal waters is prohibited by some countries and most port authorities. Ships will then either have to retain sewage aboard for subsequent discharge to shore facilities or more than 12 miles from the nearest land, or be equipped with an approved sewage plant producing an effluent which can be discharged anywhere. The latter would require a biological treatment plant. Discharges from an approved chemical treatment plant would be permitted when more than four miles from the nearest land.

Oily-water separators and oil filtering equipment

The term 'separator', as used in the regulations for preventing pollution by oil, means equipment which reduces the oil content below 100 ppm even if it uses filters to achieve that level. 'Oil filtering equipment' refers to equipment which reduces the oil content to 15 ppm or less.

The approval for an oily-water separator includes the pump supplying it. No other pump should be used with it. Even when used correctly, a separator may fail to reduce the oil content to the required limits if the oil is emulsified or the water contains a lot of particulate matter to which the oil adheres.

Incinerators

An incinerator can be used to burn residual oil and sludge collected from oil purifiers and the oily-water separator. It can also be used for the disposal of sewage sludge and rubbish. Ships fitted with an incinerator may not be dependent on the availability of shore reception facilities.

Deck machinery

The requirements for windlasses vary between the classification societies, but, basically, require that:

- the windlass brakes are able to control the running anchor and cable when letting go;
- the windlass can heave a specified weight of cable and anchor at a specified speed, typically between 4 and *6* times the weight of one anchor at a speed of between 0.12 and 0.2 m/s.

Hydraulic systems

The majority of marine hydraulic systems are medium-pressure systems and may be either open- or closed-circuit.

Accumulators damp out fluctuations in pressure which may occur in the pressure line. They may also be used to provide a small store of pressurized fluid which can be used in an emergency. One example is for the closing of watertight doors after power to the hydraulic pump has been lost.

Hydraulic systems also contain nonreturn valves, to prevent reverse flow, and pressure-control valves, including pressure-relief valves.

Hydraulic steering gear provides an example of a variable-stroke pump acting as controller and power supply.

Dirt or sediment in a system causes abrasion of moving parts and blockage of control valves, leading to a failure of the machinery. Filters are fitted at pump suctions and upstream of control valves. When any part of the system is disconnected for repair or replacement, it is important to cover and seal openings through which dust or water could enter. Hydraulic systems should not be opened up or reassembled when other work in the vicinity is creating dirty conditions.

1.11.3 General Knowledge of Marine Engineering Terms (4 hours)

Some of the terms listed in the syllabus may already have been covered in the teaching of Physical Science.

Marine engineering terms and fuel consumption

When using the fuel coefficient to estimate fuel requirements for a passage, it should be remembered that the value of the constant depends to some extent on the roughness of the hull.

A ship lying in water of high temperature for some time may attract considerable fouling of the hull and propeller, resulting in increased fuel consumption during the subsequent passages. Generally, performance falls off with time since the previous dry-docking. Clearly, the state of maintenance of the engine also affects fuel consumption.

When it is known that the ship cannot be berthed or is not required before a certain time at the next port, fuel may be saved by reducing speed, to arrive shortly before the required time, rather than proceeding at full speed and waiting at anchor.

1.11.4 Engine Room Watchkeeping

Arrangements necessary for appropriate and effective engineering watches to be maintained for the purpose of safety under normal circumstances and UMS operations. (2 hours)

Main dangers and sources of risk in an engine room should be pointed out. The importance of and implementation of risk assessment and risk management in an engine room should be highlighted to the trainees.

Master and Chief Mate

Function 2:

Cargo Handling and Stowage at the Management Level

Master and Chief Mate
Function 2: Cargo Handling and Stowage at the Management Level

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Part B2: Course Outline

■ Timetable

No formal example of a timetable is included in this model course.
Development of a detailed timetable depends on the level of skills of the officers entering the course and the amount of revision work of basic principles that may be required.

Lecturers must develop their own timetable depending on:

- the level of skills of trainees
- the numbers to be trained
- the number of instructors

and normal practices at the training establishment.

Preparation and planning constitute an important factor which makes a major contribution to the effective presentation of any course of instruction.

■ Lectures

As far as possible, lectures should be presented within a familiar context and should make use of practical examples. They should be well illustrated with diagrams, photographs and charts where appropriate, and be related to matter learned during seagoing time.

An effective manner of presentation is to develop a technique of giving information and then reinforcing it. For example, first tell the trainees briefly what you are going to present to them; then cover the topic in detail; and, finally, summarize what you have told them. The use of an overhead projector and the distribution of copies of the transparencies as trainees handouts contribute to the learning process.

■ Course Outline

The tables that follow list the competencies and areas of knowledge, understanding and proficiency, together with the estimated total hours required for lectures and practical exercises. Teaching staff should note that timings are suggestions only and should be adapted to suit individual groups of trainees depending on their experience, ability, equipment and staff available for training.

COURSE OUTLINE

Knowledge, understanding and proficiency			Total hours for each topic	Total hours for each subject area of Required performance
Competence:				
2.1	**PLAN AND ENSURE SAFE LOADING, STOWAGE, SECURING, CARE DURING VOYAGE AND UNLOADING OF CARGOES**			
2.1.1	APPLICATION OF INTERNATIONAL REGULATIONS, CODES, AND STANDARDS CONCERNING THE SAFE HANDLING, STOWAGE, SECURING AND TRANSPORT OF CARGOES			
	.1	Plans and actions conform with international regulations	6	6
2.1.2	EFFECT ON TRIM AND STABILITY OF CARGOES AND CARGO OPERATIONS			
	.1	Draft, trim and stability	20	20
2.1.3	STABILITY AND TRIM DIAGRAMS AND STRESS-CALCULATING EQUIPMENT			
	.1	Shear forces, bending moments and torsional moments	8	
	.2	Compliance with minimum freeboard requirements of the load-line regulations	6	
	.3	Use of automatic data-based (ADB)equipment	2	
	.4	Knowledge of loading cargoes and ballasting in order to keep hull stress within acceptable limits	6	22
2.1.4	STOWAGE AND SECURING OF CARGOES ON-BOARD SHIP, CARGO-HANDLING GEAR AND SECURING AND LASHING EQUIPMENT			
	.1	Timber deck cargoes	3	
	.2	Procedures for receiving and delivering cargo	3	
	.3	Care of cargo during carriage	4	
	.4	Requirements applicable to cargo-handling gear	4	
	.5	Maintenance of cargo gear	3	
	.6	Maintenance of hatch covers	2	19

Knowledge, understanding and proficiency			Total hours for each topic	Total hours for each subject area of Required performance
2.1.5	LOADING AND UNLOADING OPERATIONS, WITH SPECIAL REGARD TO THE TRANSPORT OF CARGOES IDENTIFIED IN THE CODE OF SAFE PRACTICE FOR CARGO STOWAGE AND SECURING			
	.1	Loading, Stowage and discharge of heavy weights	3	
	.2	Care of cargo during carriage	1	
	.3	Methods and safeguards when fumigating holds	2	6
2.1.6	GENERAL KNOWLEDGE OF TANKERS AND TANKER OPERATIONS			
	.1	Terms and definitions	1	
	.2	Contents and application of ISGOTT	2	
	.3	Oil tanker operations and related pollution-prevention regulations	3	
	.4	Chemical tankers	3	
	.5	Tanker cleaning and control of pollution in chemical tankers	2	
	.6	Gas tankers	3	
	.7	Cargo operations in gas tankers	2	16
2.1.7	KNOWLEDGE OF THE OPERATIONAL AND DESIGN LIMITATIONS OF BULK CARRIERS			
	.1	Operational and design limitations of Bulk carriers	3	
	.2	SOLAS Chapter XII Additional Safety Measures for Bulk Carriers	1	
	.3	CSR Bulk	1	5
2.1.8	LOADING, CARE AND UNLOADING OF BULK CARGOES			
	.1	Application of all available shipboard data related to loading, care and unloading of bulk cargoes	5	
	.2	Code of practice for the safe loading and unloading of bulk carriers (BLU code)	1	6

Knowledge, understanding and proficiency	Total hours for each topic	Total hours for each subject area of Required performance
2.1.9 SAFE CARGO HANDLING IN ACCORDANCE WITH THE PROVISIONS OF THE RELEVANT INSTRUMENTS		
.1 Establish Procedures for safe cargo handling in accordance with the provisions of the relevant instruments such as; - IMDG Code - IMSBC Code - MARPOL 73/78, Annexes III and V	3	3
2.1.10 EFFECTIVE COMMUNICATIONS AND IMPROVING WORKING RELATIONSHIP		
.1 Basic principles for establishing effective communications and improving working relationship between ship and terminal personnel	1	1
2.2 **ASSESS REPORTED DEFECTS AND DAMAGE TO CARGO SPACES, HATCH COVERS AND BALLAST TANKS AND TAKE APPROPRIATE ACTION**		
2.2.1 LIMITATIONS ON STRENGTH OF THE VITAL CONSTRUCTIONAL PARTS OF A STANDARD BULK CARRIER AND INTERPRET GIVEN FIGURES FOR BENDING MOMENTS AND SHEAR FORCES	3	3
2.2.2 METHODS TO AVOID THE DETRIMENTAL EFFECTS ON BULK CARRIERS OF CORROSION, FATIGUE AND INADEQUATE CARGO HANDLING	3	3
2.3 **CARRIAGE OF DANGEROUS GOODS**		
2.3.1 INTERNATIONAL REGULATIONS, STANDARDS, CODES AND RECOMMENDATIONS ON CARRIAGE OF DANGEROUS CARGOES		

Knowledge, understanding and proficiency		Total hours for each topic	Total hours for each subject area of Required performance
.1	International regulations and codes including the International Maritime Dangerous Goods (IMDG) Code and the International Maritime Solid Bulk Cargoes (IMSBC) Code	3	3
2.3.2	CARRIAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES, PRECAUTIONS DURING LOADING AND UNLOADING AND CARE DURING THE VOYAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES		
.1	Dangerous goods in packages	10	
.2	Solid bulk cargoes	9	
.3	The International Code for the Safe Carriage of Grain in Bulk (International Grain Code)	7	26
Total for Function 2: Cargo Handling and Stowage at the Management Level			**139**

Teaching staff should note that the hours for lectures and exercises are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by lecturers to suit individual groups of trainees depending on their experience, ability, equipment and staff available for teaching.

Part C2: Detailed Teaching Syllabus

Introduction

The detailed teaching syllabus is presented as a series of learning objectives. The objective, therefore, describes what the trainee must do to demonstrate that the specified knowledge or skill has been transferred.

Thus each training outcome is supported by a number of related performance elements in which the trainee is required to be proficient. The teaching syllabus shows the Required performance expected of the trainee in the tables that follow.

In order to assist the instructor, references are shown to indicate IMO references and publications, textbooks and teaching aids that instructors may wish to use in preparing and presenting their lessons.

The material listed in the course framework has been used to structure the detailed teaching syllabus; in particular,

Teaching aids (indicated by A)
IMO references (indicated by R)
Textbooks (indicated by T) and
Bibliography (indicated by B)

will provide valuable information to instructors.

Explanation of Information Contained in the Syllabus Tables

The information on each table is systematically organised in the following way. The line at the head of the table describes the FUNCTION with which the training is concerned. A function means a group of tasks, duties and responsibilities as specified in the STCW Code. It describes related activities which make up a professional discipline or traditional departmental responsibility on board.

In this model course there are three functions:

- Navigation at the Management Level
- Cargo Handling and Stowage at the Management Level
- Controlling the Operation of the Ship and Care for Persons on Board at the Management Level.

The header of the first column denotes the **COMPETENCE** concerned, Each function comprises a number of competences. For example, the Function 2, Cargo Handling and Stowage at the Management Level, comprises three COMPETENCES. Each competence is uniquely and consistently numbered in this model course.

The first is **Plan and Ensure Safe Loading, Stowage and Securing, Care During the Voyage and Unloading of Cargoes**. It is numbered 2.1 that is the first competence in Function 2. The term competence should be understood as the application of knowledge, understanding, proficiency, skills, experience for an individual to perform a task, duty or responsibility on board in a safe, efficient and timely manner.

Shown next is the required TRAINING OUTCOME. The training outcomes are the areas of knowledge, understanding and proficiency in which the trainee must be able to demonstrate knowledge and understanding. Each COMPETENCE comprises a number of training outcomes. For example the above competence comprises a total of ten outcomes. The first is in APPLICATION OF INTERNATIONAL REGULATIONS, CODES AND STANDARDS.
Each training outcome is uniquely and consistently numbered in this model course. That concerned with application of international regulations, codes and standards concerning safe handling, stowage, securing and transport of cargoes is uniquely numbered

2.1.1 For clarity training outcomes are printed in black on grey, for example TRAINING OUTCOME.

Finally, each training outcome embodies a variable number of Required performances — as evidence of competence. The instruction, training and learning should lead to the trainee meeting the specified Required performance. For the training outcome concerned with international regulations, codes and standards concerning safe handling, stowage, securing and transport of cargoes, there is a single area of performance. This is:

2.1.1.1 Plans and actions conform with international regulations

Following each numbered area of Required performance there is a list of activities that the trainee should complete and which collectively specify the standard of competence that the trainee must meet. These are for the guidance of teachers and instructors in designing lessons, lectures, tests and exercises for use in the teaching process. For example, under the topic 2.1.1.1 Plans and actions conform with international regulations, to meet the Required performance, the trainee should be able to:

- plan passage to comply with Loadline Convention correctly conforming with:
- vessel loading
- seasonal restrictions, etc
- plan cargo stowage and carriage in compliance with the Code of Safe Practice for cargo stowage and securing
- state that an approved cargo securing manual is required to be carried on board all ships except those engaged solely in the carriage of bulk cargoes

and so on.

IMO references (Rx) are listed in the column to the right hand side. Teaching aids (Ax), videos and CBT's (Vx) textbooks (Tx) and bibliography (Bx) relevant to the training outcome and required performances are placed immediately following the TRAINING OUTCOME title.

The columns to the right hand side list the IMO references relevant to the competence, outcome and required performance.

Note, it is not intended that lessons are organised to follow the sequence of Required performances listed in the Tables. The Syllabus Tables are organised to match with the competence in the STCW Code Table A-II/2. Lessons and teaching should follow college practices. It is not necessary, for example, for celestial navigation to be studied before terrestrial and coastal navigation. What is necessary is that all the material is covered and that teaching is effective to allow trainees to meet the standard of the required performance.

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

TRAINING OUTCOMES:

STCW Code
Table A-II/2

Demonstrates a knowledge and understanding of:

2.1.1 APPLICATION OF INTERNATIONAL REGULATIONS, CODES AND STANDARDS CONCERNING SAFE HANDLING, STOWAGE, SECURING AND TRANSPORT OF CARGOES

2.1.2 EFFECT ON TRIM AND STABILITY OF CARGOES AND CARGO OPERATIONS

2.1.3 STABILITY AND TRIM DIAGRAMS AND STRESS-CALCULATING EQUIPMENT

2.1.4 STOWAGE AND SECURING OF CARGOES ON BOARD SHIP, CARGO-HANDLING GEAR AND SECURING AND LASHING EQUIPMENT

2.1.5 LOADING AND UNLOADING OPERATIONS, WITH SPECIAL REGARD TO THE TRANSPORT OF CARGOES IDENTIFIED IN THE CODE OF SAFE PRACTICE FOR CARGO STOWAGE AND SECURING

2.1.6 GENERAL KNOWLEDGE OF TANKERS AND TANKER OPERATIONS

2.1.7 KNOWLEDGE OF THE OPERATIONAL AND DESIGN LIMITATIONS OF BULK CARRIERS

2.1.8 LOADING, CARE AND UNLOADING OF BULK CARGOES

2.1.9 SAFE CARGO HANDLING IN ACCORDANCE WITH THE PROVISIONS OF THE RELEVANT INSTRUMENTS

2.1.10 EFFECTIVE COMMUNICATIONS AND IMPROVING WORKING RELATIONSHIP

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

2.1.1 APPLICATION OF INTERNATIONAL REGULATIONS, CODES AND STANDARDS CONCERNING SAFE HANDLING, STOWAGE, SECURING AND TRANSPORT OF CARGOES — R2, R55, R56, R57, R58, R59, R60, R61, R62, R64, R64, R66, R67, R68, R69, R82, R83

Textbooks / Bibliography: T15

Teaching aids: A1

Required performance:

1.1 Plans and Actions Conform with International Regulations (6 hours) — R1

- plans passage to comply with Loadline Convention correctly conforming with:
  - vessel loading
  - seasonal restrictions
  - zones
  - bunker requirements

  expected weather patterns
- plans cargo stowage and carriage in compliance with the Code of Safe Practice for cargo stowage and securing — R2, Res A.714(17)
- states that an approved cargo securing manual is required to be carried on board all ships except those engaged solely in the carriage of bulk cargoes
- lists the information provided in the cargo securing manual
- uses data from the cargo securing manual to plan securing a range of cargo types
- lists the certificates required for inspection by port state control officers

2.1.2 EFFECT ON TRIM AND STABILITY OF CARGOES AND CARGO OPERATIONS

Textbooks / Bibliography: T4, T14, T15, T21, T34, B3, B198

Teaching aids: A1

Required performance:

2.1 Draught, Trim and Stability (20 hours)

- given the draughts forward, aft and amidships, calculates

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

the draught to use with the deadweight scale, making allowance for trim, deflection and density of the water
- given a ship's hydrostatic data, the weight and the intended disposition of cargo, stores, fuel and water, calculates the draughts, allowing for trim, deflection and water density
- calculates changes of draught resulting from change in distribution of masses
- calculates changes of draught resulting from change in water density
- calculates the quantity of cargo to move between given locations to produce a required trim or maximum draught
- calculates how to divide a given mass between two given locations to produce a required trim or maximum draught after loading
- calculates the locations at which to load a given mass so as to leave the after draught unchanged
- given a ship's hydrostatic data and the disposition of cargo, fuel and water, calculates the metacentric height (GM)
- calculates the arrival GM from the conditions at departure and the consumption of fuel and water
- identities when the ship will have the worst stability conditions during the passage
- calculates the maximum weight which can be loaded at a given height above the keel to ensure a given minimum GM
- constructs a GZ curve for a given displacement and KG and checks that the ship meets the minimum intact stability requirements
- determines the list resulting from a change in distribution of masses
- determines the expected maximum heel during the loading or discharging of a heavy lift with the ship's gear
- calculates the increased draught resulting from the heel

2.1.3 STABILITY AND TRIM DIAGRAMS AND STRESS-CALCULATING EQUIPMENT

Textbooks / Bibliography: T4, T14, T15, T21, T34, B3, B198

Teaching Aids: A1

Required performance:

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

3.1 **Shear Forces, Bending Moments and Torsional Moments** (8 hours) — R1

- states that the carriage of loading calculators in large ships carrying dry or liquid cargo in bulk is a requirement of the classification societies
- states that the maximum permissible values of shear force and bending moment in harbour and at sea are laid down by the classification societies
- states that maximum torsional moments are also laid down for some container ships
- describes the use of typical cargo loading instruments and lists the information obtainable from them
- explains that harbour stress limits should not be exceeded during loading, discharging or ballasting operations and that it is not sufficient just to finish within the limits
- explains that sufficient information to arrange for the loading and ballasting of the ship in such a way as to avoid the creation of unacceptable stresses should be on board, unless the Administration considers it unnecessary for that ship

3.2 **Compliance with the Minimum Freeboard Requirements of the Load Line Regulations** (6 hours) — R1, R4, R5

- uses the chart of zones and seasonal areas to determine the load lines which apply for a particular passage
- given the ship's hydrostatic data and the daily consumption of fuel and water, determines the minimum departure freeboard and quantity to load, taking into account the zones, seasonal zones and areas through which the ship will pass
- calculates the maximum quantity to load, taking account of loading, discharging and bunkering at an intermediate port or ports, so as to comply throughout with the load line regulations

3.3 **Use of Automatic Data Based (ADB) Equipment** (2 hours)

- provides an understanding of information obtained from ship stress indicators and loading programmes
- use of stress indicators and loading programmes in planning for the safe carriage of dry and liquid cargoes
- advantages and limitations of analogue and digital

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

stability and loading programmes

3.4 Knowledge of loading cargoes and ballasting in order to keep hull stress within acceptable limits (6 hours) — R64, R65

- explains the importance of devising a cargo stowage plan and loading / unloading plan
- states that the officer in charge should always refer to the loading manual to ascertain an appropriate cargo load distribution, satisfying the imposed limits on structural loading
- explains the stages of development of a safe cargo loading or unloading plan
- explains that in any event if the cargo needs to be distributed differently from that described in the loading manual, calculations must always be made to determine, for any part of the voyage, that still water shear force (SWSF), still water bending moments (SWBM) and local loading limits are not exceeded
- explains the reason to keep the hull stress levels below the permissible limits by the greatest possible margin
- explains that when making a plan for cargo operations, the officer in charge must consider the ballasting operation, to ensure:
  - correct synchronisation is maintained with the cargo operations
  - that the de-ballasting/ballasting rate is specially considered against the loading rate and the imposed structural and operational limits
  - that ballasting and de-ballasting of each pair of symmetrical port and starboard tanks is carried out simultaneously
- explains the importance to know the exact pumping rates achieved on board their ship to ascertain and ensure the plan are devised and modified accordingly
- demonstrates the knowledge gained of above by preparing a loading/de-ballasting plan keeping the fore mentioned points in mind
- demonstrates the knowledge gained of above by preparing a discharging/ballasting plan keeping the fore mentioned points in mind

2.1.4 STOWAGE AND SECURING OF CARGOES ON BOARD SHIP, CARGO-HANDLING GEAR AND SECURING AND LASHING EQUIPMENT

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

Textbooks / Bibliography : T36, B21,B71, B72, B73, B74, B75, B76, B77, B78, B80, B81, B82, B83, B88, B89, B90, B91, B92, B93, B94, B95, B97, B98, B101, B102, B104, B106, B109, B110, B113, B117, B128, B129, B130, B146, B152, B153, B156, B158, B159, B161, B162, B167, B182, B189, B190, B191, B192, B193, B196, B197, B198, B215, B216, B217

Teaching Aids: A1, V60, V86, V170, V172, V173, V174, V175

Required performances:

4.1 Timber Deck Cargoes (3 hours) R57

- outlines the contents of the Code of Safe Practice for Ships Carrying Timber Deck Cargoes with respect to:
  - stowage of sawn timber, logs, cants and wood pulp
  - fitting of uprights
  - lashings and the arrangements for tightening them, including the use of a wiggle wire
- states that vibration and movement of the ship in a seaway compacts the stow and slackens the lashings
- states that lashings should be inspected regularly and tightened as necessary
- states that inspections of lashings should be entered in the log-book
- explains the dangers of heavy seas breaking aboard and how to minimize that risk
- states the action to take if cargo is lost overboard or jettisoned
- states the maximum height of cargo permitted on deck in a seasonal winter zone in winter
- describes the controlling factors for height of cargo at other times
- describes the requirements for fencing, for provision of walk-ways and for access to the top of the cargo
- describes the requirements when loading to timber load lines
- lists the stability information that should be available to the master
- explains when the worst stability conditions during a voyage are likely to occur
- describes the rolling period test for the approximate determination of a ship's stability and the limitations of the method

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- explains the actions to take in the event of the ship developing an angle of loll

4.2 Procedures for Receiving, and Delivering Cargo (3 hours) R1

- states that the master is responsible for goods from the time of their passing the rail during loading to passing the rail at discharging
- states that damaged packages should be rejected, for re-coopering or checking of contents
- explains that bills of lading are drawn up from mate's receipts and the importance of endorsing mate's receipts for the condition of goods and packages
- describes the endorsement of mate's receipts for goods in dispute
- describes the endorsement of mate's receipts for cargoes where the weight and quality are not known to the ship
- explains the actions to take when a clean mate's receipt or bill of lading is demanded for cargo which is not in apparent good condition
- explains why letters of indemnity offered in return for clean bills of lading should be refused
- describes the documentation which should accompany dangerous goods and is required before loading
- states that containers should have their seals and locks in place when loaded
- states that, if damage to cargo is suspected, protest should be noted before commencing discharging
- explains the procedure for noting protest and extending protest
- states that an independent cargo survey should be arranged when cargo damage is suspected or found on opening hatches
- states that broken or broached packages should be placed in a locker until the contents can be checked and agreed with a representative of the receiver and a receipt obtained for them
- explains how to deal with empty bags or packages, sweepings and other loose goods
- states that cargo spaces should be searched at the completion of discharging to prevent the over carriage of cargo
- describes the procedure for claiming for damage done to the ship during loading or discharging
- explains to whom cargo should be delivered

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

4.3 **Care of Cargo During Carriage** (4 hours) R1

- given a cargo list, uses reference books to plan the stowage of a hold or holds, taking account of the carriage requirements of the various cargoes
- describes the precautions to avoid crushing and chafing damage and states which cargoes are most liable to be affected
- explains how cargo may be damaged by residues of previous cargo, dirty dunnage or leaking fuel oil tanks
- describes how cargo can be damaged by dust and the precautions to take when carrying commodities giving rise to dust
- states which cargoes are particularly liable to damage by ship or cargo sweat and explains how to minimize the risk of sweat damage
- explains that any goods containing liquids are liable to leak and describes the stowage required to prevent any leakage damaging other goods
- states that many goods can be spoiled by extremes of temperature
- explains that overheating may occur in cargo stowed against engine-room bulkheads, heated double-bottom tanks and deep tanks carrying heated cargoes
- states that high temperatures also occur on the underside of steel decks exposed to tropical sunshine
- describes how to protect cargoes which must be kept from freezing
- describes the measures to take to prevent pilferage of cargo during loading, discharging and carriage
- describes the damage to cargo which can result from the use of fork-lift trucks and similar machinery in cargo spaces and methods of preventing it

4.4 **Requirements Applicable to Cargo-handling Gear** (4 hours)

- outlines the requirements of ILO Convention 152, the Occupational Safety and Health (Dock Work) Convention, 1 97g, which apply to ships
- defines the terms:
  - competent person
  - responsible person
  - authorized person

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

lifting appliance loose gear

- states that national laws or regulations should prescribe measures to cover, amongst others:
  - safe means of access to ships, holds, staging, equipment and lifting
  - appliances
  - opening and closing of hatches, protection of hatchways and work in holds
  - construction, maintenance and use of lifting and other cargo- handling appliances
  - rigging and use of ship's derricks
  - testing, examination, inspection and certification, as appropriate, of lifting
  - appliances, of loose gear (including chains and ropes) and of slings and other
  - lifting devices which form an integral part of the load
  - handling different types of cargo
  - dangerous substances and other hazards in the working environment
- describes the requirements for guarding dangerous parts of machinery
- states that machinery includes mechanized hatch covers and lifting appliances
- states the requirements for the marking of beams and portable hatch covers
- states that only an authorized person, preferably a member of the ship's crew, should be permitted to open or close power-operated hatch covers and equipment such as doors in hull, ramps and car decks
- describes the requirements for fencing of openings
- describes the requirements for the testing of lifting appliances and loose gear before they are used for the first time
- describes the requirements for periodic thorough examination and inspection of lifting appliances and loose gear
- explains what is meant by a thorough examination
- describes the records and certificates which should be kept in respect of tests, thorough examinations and inspections of lifting appliances and loose gear
- describes the marking of safe working loads required on lifting appliances and loose gear
- states that every ship must have a rigging plan and relevant information necessary for the safe rigging of derricks and accessory gear

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

4.5 Maintenance of Cargo Gear (3 hours) R1

- states that the plan should be amended when any changes to the attached gear are made
- describes the maintenance of wire ropes used with lifting appliances
- lists the points to look for when inspecting wire ropes
- describes the amendments to be made to the rigging plan when a wire rope is renewed
- describes the care of fibre guy ropes
- lists the points to look for when inspecting fibre ropes
- describes the maintenance of cargo blocks
- lists the points to look for during inspection or maintenance of cargo blocks
- explains that blocks should be lubricated daily while in use for cargo handling
- states that loose gear should be checked to see that there is no distortion to such items as chain links or shackles
- states that shackles should be checked to ensure that they are fitted with the correct pins
- states that all gear should be checked to ensure that the safe working load and, where appropriate, identification marks are readable
- states the requirements for the annealing of wrought iron loose gear
- describes the precautions to be taken when working aloft for the overhaul of cargo gear

4.6 Maintenance of Hatch Covers (3 hours)

- states that trackways should be cleaned of loose material before closing hatches
- states that the tension of draw chains should be adjusted as required
- states that wheels, gears, racks and pinions and other moving parts should be kept lubricated
- states that side cleats and cross-joint wedge mechanisms should be kept greased
- explains that hydraulic systems should be checked for leakage, especially in ‘tween-decks where leaked fluid may damage cargo
- states that drainage channels should be cleaned out and drainage holes checked on weather-deck hatches

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- describes how to check that compression bars are making complete contact with sealing gaskets
- explains that tightness may be checked by hose-testing the covers before loading

2.1.5 LOADING AND UNLOADING OPERATIONS, WITH SPECIAL REGARD TO THE TRANSPORT OF CARGOES IDENTIFIED IN THE CODE OF SAFE PRACTICE FOR CARGO STOWAGE AND SECURING — R61

Textbooks / Bibliography: B21, B71, B72, B73, B74, B75, B76, B77, B78, B80, B81, B82, B83, B88, B89, B90, B91, B92, B93, B94, B95, B97, B98, B101, B102, B104, B106, B109, B110, B113, B117, B128, B129, B130, B146, B152, B153, B156, B158, B159, B161, B162, B167, B182, B189, B190, B191, B192, B193, B196, B197, B198, B215, B216, B217

Teaching Aids: A1, V53, V57, V58, V59, V69, V70, V71, V72, V74, V75, V76

Required performances:

5.1 Loading, Stowage and Discharge of Heavy Weights (3 hours)

- explains how a load should be spread over an area of deck or tank top by the use of dunnage to avoid heavy point loading between beams and floors
- states that special supports or cradles will need to be built for awkwardly shaped lifts
- explains the use of shoring in a tween-deck to spread the load over a larger part of the ship’s structure
- states that the ship’s stability should be checked to ensure that the resulting list will be acceptable
- states that the weight of the lifting gear should be included in the weight of the lift, both for stability calculations and during consideration of safe working loads
- explains why double-bottom tanks should be full or empty and the ship upright before starting to load or to discharge
- states that additional stays may need setting up to a mast or kingpost
- states that only experienced winch drivers should be allowed to handle heavy lifts

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

– states that all movements should be controlled and steady, avoiding rapid stops and starts
– describes methods of securing heavy lifts in the hold or on deck

5.2 Care of Cargo During Carriage (1 hour) — R1, R61

– outlines the content of the Code of Safe Practice for Cargo Stowage and Securing — R66, R61, R69, R60, R61
– describes how to stow and secure containers on deck on vessels which are not specially designed and fitted for the purpose of carrying containers
– describes the stowage and securing of containers and other cargo units in ships other than cellular container ships
– describes the contents of the cargo-securing manual and its use
– lists the elements to be considered by the master when accepting cargo units or vehicles for shipment
– states that cargo spaces should be regularly inspected to ensure that the cargo, cargo units and vehicles remain safely secured throughout the voyage
– describes the stowage and securing of road vehicles on ro-ro ships
– describes recommended methods for the safe stowage and securing of:
  - portable tanks
  - portable receptacles
  - wheel-based (rolling) cargoes
  - coiled sheet steel
  - heavy metal products
  - anchor chains
  - metal scrap in bulk
  - flexible intermediate bulk containers
  - unit loads
– summarizes the guidelines for the under-deck stowage of logs
– describes actions which may be taken in heavy weather to reduce stresses on securing arrangements induced by excessive accelerations
– describes actions which may be taken once cargo has shifted

5.3 Methods and Safeguards When Fumigating Holds (2 hours) — R1, R56, R19

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- Explains recommendations given in MSC.1/Circ.1264 - Recommendations on the Safe Use of Pesticides in Ships Applicable to the Fumigation of Cargo Holds, contained in the added supplement of the IMSBC code.
- explains the reasons for the control of pests
- states that the control of rodents is required by the International Health Regulations
- describes the methods for the prevention of insect infestation and states the areas to which particular attention should be given
- explains how contact insecticides in the form of sprays, smokes or lacquers may be used by the crew for dealing with local infestation
- states that all persons not directly involved in the application should be evacuated from the areas being treated for a period not less than that recommended by the manufacturer of the pesticide
- states that extensive or hazardous treatments, including fumigation and spraying near human or animal food, should only be undertaken by expert operators
- states that a fumigator-in-charge should be designated by the fumigation company or appropriate authority
- lists the information about the fumigation which should be supplied to the master
- states that fumigation of empty cargo spaces should always be carried out in port
- states that crew should remain ashore until the ship is certified gas-free, in writing, by the fumigator-in-charge
- states that a watchman should be posted to prevent unauthorised boarding and warning notices should be displayed
- lists the precautions to be taken if essential crew members are permitted to return before aeration (ventilation) of the ship
- states that entry to spaces under fumigation should never take place except in case of extreme urgency and lists the precautions to be taken if entry is imperative
- states that fumigation in transit should only be carried out in ships approved for such process by the flag State Administration and that the application should be with the agreement of the port State Administration
- states that fumigation in transit may be:
  - treatment continued during the voyage in a sealed space in which no aeration

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

  - has taken place before sailing
  - continuation of in-port fumigation where some aeration has taken place but
  - clearance cannot be issued because of residual gas and the cargo space has been re-sealed before sailing
- states that precautions are the same in both cases
- states that at least two members of the crew, including one officer, who have received appropriate training, should be designated as the trained representative of the master responsible for ensuring safe conditions after the fumigator-in-charge has handed over that responsibility to the master
- states that the trained representative should brief the crew before a fumigation
- lists the training which the designated representatives should have
- lists the items which the ship should carry
- describes the procedures for the fumigation and the handing over of responsibility from the fumigator in-charge to the master
- describes the safety checks on gas concentration that should be made throughout the voyage and states that the readings should be entered in the log-book
- describes the procedures to follow prior to and on arrival at the discharging port
- describes the precautions to be taken during the discharge of cargo until the ship is certified free of fumigants
- describes the procedures for the carriage of fumigated freight containers, barges and transport units that are loaded after fumigation without ventilation
- states that the master should be informed prior to loading such freight containers, barges and transport units and that they should be identified with suitable warning labels showing the identity of the fumigant and the date and time of fumigation
- describes the methods which may be used for the control of rodents
- describes the use of baits by the ship's crew and the precautions to observe
- explains that the use of pesticides is regulated by Governments, and their use may be limited by the regulations and requirements of:
  - the country where the cargo is loaded or treated

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- the country of destination
- the country of registration of the ship

– describes the use of pesticides by the ship's crew and the precautions to observe
– describes the measures to be taken if clothing becomes contaminated
– states that, if contact insecticides are to be applied to grain during loading, the master should be provided with written instructions on the type and amount of insecticide to be used and on the precautions to be taken
– states the actions to be taken in the event of exposure to insecticides resulting in illness

2.1.6 GENERAL KNOWLEDGE OF TANKERS AND TANKER OPERATIONS — R70

Textbooks / Bibliography: T14, T19, B81, B82, B83, B90, B91, B92, B93, B94, B97, B98, B100, B101, B102, B104, B106, B109, B110, B113, B117, B152, B153, B156, B157, B158, B159, B161, B162, B167, B189, B190, B191, B192, B196, B197, B198, B203, B215, B216, B217

Teaching Aids: A1, V50, V51, V52, V54, V55, V56, V61, V62, V63, V64, V65, V66, V68, V73, V78, V83, V84, V129, V137, V138, V174, V175

Required performances:

6.1 Terms and definition (3 hours)

– defines petroleum as crude oil and liquid hydrocarbon products derived from it
– states that petroleum gases, principally methane, are extracted from crude oils before shipment
– explains that 'spiked crude' has additional petroleum gas, usually butane, dissolved in it before shipment
– states that 'sour crude' contains appreciable amounts of hydrogen sulphide or organic sulphur compounds
– states that products derived from crude oil include naphtha (gasolines), kerosine, gas oil, diesel oils, lubricating oils, waxes and residual oils such as fuel oil and bitumen
– explains that vapour pressure of any liquid increases with increasing temperature
– defines Reid Vapour Pressure (RVP)

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- explains why the pressure in a tank is not necessarily the same as the RVP of the oil it contains, even at the standard temperature
- states that the flashpoint of a liquid is the lowest temperature at which it gives off sufficient gas to form a flammable mixture in a flashpoint apparatus
- explains why flashpoint cannot be used as an absolute measure of safety
- states that 'flammable' means 'capable of being ignited and of burning'
- defines 'upper flammable limit', 'lower flammable limit' and 'flammable range' and states approximate values for petroleum products
- defines the auto-ignition temperature as the temperature at which a flammable material will ignite without initiation by a spark or flame and will continue to burn
- describes the viscosity of a fluid as a measure of its resistance to flow
- states that viscosity increases as the temperature decreases
- defines 'pour point' as the lowest temperature at which an oil is observed to flow
- appreciates that crude carriers in particular have significant residues in tanks which must be accounted for in order to calculate the cargo loaded
- calculates the volume of dry residue as a uniform layer on the tank bottom
- calculates the volume of liquid residues as a wedge on the tank bottom
- knows the limitation of application of wedge calculation

6.2 Contents and Application of the International Safety Guide for Oil Tankers and Terminals (ISGOTT) (2 hours) — R1, R28

- explains that ISGOTT provides operational advice to directly assist personnel involved in tanker and terminal operations, including guidance on, and examples of, certain aspects of tanker and terminal operations and how they may be managed
- states that ISGOTT is divide into 4 parts
- states that Part 1deals with General Information Part 2contains Tanker information, part 3 contains Terminal information and Part 4 contains Management of the tanker and terminal interface.
- states that terminal, local or national regulations may also

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be applicable and should be known by those concerned

- outlines the general precautions to be taken on tankers regarding:
  - smoking, matches and cigarette lighters
  - naked lights
  - the galley
  - electrical equipment
  - use of tools
  - entry to enclosed spaces and pump-rooms
- lists the information which should be exchanged between the ship and the terminal before arrival
- states that safety procedures are agreed between the tanker and the terminal and include:
  - means of summoning emergency services
  - availability and use of fire-fighting and other emergency equipment
  - actions to be taken in case of fire or other emergency
  - emergency evacuation of the berth
- states that fire-fighting equipment should be ready for immediate use
- states that main engines and other equipment essential for manoeuvring should be ready for use at short notice and the written agreement of the terminal and port authority should be obtained for any work or repairs which would immobilize the ship
- states that detailed loading or discharging plans are agreed between the ship and the terminal
- explains that safety measures against pollution and actions to take in case of an accident are agreed before transfer of cargo commences
- states that, before starting cargo transfer, the responsible officer and the terminal representative must formally agree that they are ready to do so safely
- states that the terminal should be notified of the intention to use crude oil washing (COW) at least 24 hours in advance
- explains that tanks should be maintained in an inert condition throughout all operations except when entry to tanks for inspection or repair is necessary
- explains that the inert gas should have an oxygen content not exceeding 5% by volume
- states that the oxygen content of cargo tanks should not exceed 8% by volume
- explains that the inert-gas plant will be used to:
  - inert empty cargo tanks

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- supply inert gas during cargo discharging, deballasting, crude oil washing
- and tank cleaning
- purge tanks prior to gas-freeing
- top-up the pressure when necessary during a voyage

– explains that, in the event of a failure of the inert gas system, discharge of cargo or ballast or tank cleaning should be stopped, to prevent air being drawn into the tanks, and operations should only be resumed when a supply of inert gas has been restored
– describes the hold and tank arrangements of combination carriers
– describes the safety aspects relating to the operation of double hull tankers
– outlines the change-over from oil to dry bulk cargo and from dry bulk cargo to oil

6.3 Oil Tanker Operations and Related Pollution-prevention Regulations (3 hours) — R1, R28

– defines ‘segregated ballast’, ‘clean ballast, ‘dirty ballast’, ‘slop tank’
– briefly describes an inert gas system (IGS) and sketches the distribution of inert gas to tanks
– explains the reasons for ballasting
– states that the capacity and arrangement of segregated ballast tanks is intended to provide sufficient weight, to provide a satisfactory trim and to ensure full immersion of the propeller for normal conditions of sea passages
– states that on rare occasions weather conditions may be so severe that additional ballast is needed for the safety of the ship
– states that in crude oil tankers equipped with COW the additional ballast would be carried in tanks that have been washed with crude oil
– states that the additional ballast must be treated as dirty ballast
– explains why a ship may have only clean or segregated ballast on board upon arrival at a loading port
– states the criteria for the discharge of oil from cargo-tank areas of oil tankers
– outlines the procedures for changing ballast at sea
– states that, before loading clean ballast, cargo pumps and lines to be used are flushed with clean water into a dirty ballast or slop tank

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- describes how to dispose of dirty ballast
- describes how to decant the water contents of the slop tank
- states that a final flushing of cargo pumps and lines to be used for discharge of clean ballast is made to the sea through the oil monitoring and control system
- explains that the operation of discharging dirty ballast, decanting the slop tanks and flushing lines must be done when more than 50 nautical miles from the nearest land and outside a special area
- states that only segregated or clean ballast may be discharged within 50 nautical miles of land or inside a special area
- explains the reasons for tank cleaning
- briefly describes the use of fixed and portable machines for tank cleaning
- describes the use of slop tanks during tank cleaning
- states that an inert atmosphere should be maintained in tanks during tank cleaning in ships fitted with IGS
- briefly describes crude oil washing and the reasons for requiring it in crude oil tankers of 20000 dwt and above
- states that crude oil washing can only be carried out with fixed washing machines in inerted tanks
- states that the oil residues in the slop tank resulting from tank cleaning and disposal of dirty ballast may be:
  - pumped ashore at the loading terminal
  - retained on board and segregated from the next cargo
  - retained on board and the new cargo loaded on top of them
- states that the process of tank cleaning, changing ballast, decanting the water from slop tanks and loading the next cargo over the retained oil is known as the load-on-top procedure
- states that details of cargo operations, ballasting and deballasting, tank cleaning, discharge of water from slop tanks and disposal of residues are entered in the ship's Oil Record Book
- defines gas-freeing as the replacement of hydrocarbon vapours or inert gas by air
- lists the reasons for gas-freeing
- explains why inert gas is used to purge the tanks of hydrocarbon vapours before introducing air on suitably equipped ships
- states that a mechanical fixed system is used or portable

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fans are used
- states that checks are made during gas-freeing with combustible-gas indicators, oxygen meters and toxic-gas detectors
- states that the supply of inert gas to the tank is shut off
- explains the need to maintain ventilation and to check the atmosphere frequently when persons are working in a tank
- appreciates that the change of volume with temperature of oils is not linear
- states that cargo calculation is carried out as if the oil were at a standard temperature
- understands that the volume of the oil must be corrected from its actual temperature when measured to the standard temperature
- states that the cargo calculation is carried out as if the density of the oil was that at the standard temperature
- explains that the density of oil must be corrected from its actual density to that at the standard temperature
- appreciates that different types of oils have different coefficients of expansion and that there are separate Petroleum Measurement Tables for Crude Oils, Products and Lubricating Oils
- understands the difference between mass and weight in air and that one or the other may be required by different administrations

6.4 Chemical Tankers (3 hours)

- states that modem chemical tankers have evolved from oil product tankers to take account of special carriage requirements and associated hazards
- explains that dedicated service usually means that the tanker is designed for the carriage of a particular type of chemical and transports the same type of cargo on each voyage
- explains that a chemical tanker engaged in parcel trade moves a variety of relatively small lots of chemicals between a number of ports
- lists the most important of the rules governing chemical tankers as:
  - international rules and regulations
  - national rules and regulations
  - classification society rules
- states that the sea transport of liquid chemicals in bulk is

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

internationally regulated, as regards safety and pollution aspects, through Conventions adopted by the International Maritime Organization (IMO)

– explains that the Convention requirements are supplemented by recommendations, specifications and Codes adopted by IMO
– states that the IMO Conventions covering the carriage of chemicals in bulk are:
  - the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, Chapter VII
  - the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the 1978 Protocol (MARPOL 73)78), as amended, Annex II
– states that the most important Codes and standards covering the transport of liquid chemicals are:
  - the Bulk Chemical Codes
  - Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (BCH Code)
  - International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC) Code
  - Standards for Procedures and Arrangements for the discharge of Noxious Liquid Substances (P and A Standards)
– defines a chemical tanker as a cargo ship constructed or adapted and used for the carriage in bulk of any liquid product listed in Chapter 17 of the IBC Code
– explains that products are included in the list in Chapter 17 because of their safety hazards or because of their pollution hazards or both
– states that safety hazards may be one or more of the following:
  - fire hazard in excess of that of petroleum products
  - toxicity
– corrosivity
  - reactivity with water, air or other chemicals or self-reaction (polymerization, decomposition)
– states that, in addition to the survey requirements for any ship, chemical tankers must undergo surveys of the cargo-containment and handling arrangements for the issue of an International Certificate Fitness for the Carriage of Dangerous Chemicals in Bulk
– explains that the Bulk Chemical Codes divide tankers into three ship types, Type 1, Type 2 and Type 3, which reflect the hazard ratings of the cargoes which may be

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

carried

- states that a Type 1 ship is intended for the transportation of products considered to present the greatest overall hazards and Type 2 or Type 3 for products of progressively lesser hazards
- states that the division into ship types is based on the ship's capability to survive specified damage caused by collision or stranding and the location of the cargo tanks in relation to such damage
- illustrates, by means of sketches, the location of tanks for each type of ship
- explains the following descriptions of tanks:
  - independent
  - Integral
  - gravity
  - pressure
- states that all materials used for tank construction and associated piping, valves and pumps must be resistant to the cargo carried
- states that some ships have stainless-steel tanks for the carriage of cargoes which cannot be contained in mild steel
- explains that mild-steel tanks are normally coated, to protect cargoes from contamination by steel and to make cleaning, gas-freeing and inspection easier
- states that no single coating is suitable for all cargoes and that the coating manufacturers compatibility data must be used when planning a cargo
- explains that cofferdams and other void spaces may be included in the cargo- tank area to provide segregation of groups of tanks
- illustrates typical tank arrangements by means of simple sketches
- states that the heating medium may be steam, water or thermal oils
- explains that the heating system may use coils fitted inside the tank or a heat exchanger placed outside the tank
- describes, with the aid of a drawing, a cargo heating system that uses a heat exchanger placed outside the tank
- states that there is suitable protective clothing on board which must be worn by all personnel engaged in loading or discharging operations
- states that, for certain cargoes, there must be respiratory

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and eye-protection equipment for every person on board for emergency escape

- states that equipment for evaluation of atmospheres in tanks and other enclosed spaces is provided for
  - detection of flammable gases
  - measurement of oxygen content
  - measurement of concentration of toxic gas
- describes how to use an absorption tube gas detector for measuring the concentration of a gas
- explains what is meant by:
  - the threshold limit value (TLV) of a product
  - the odour threshold
- states that the atmosphere in tanks and enclosed spaces must be considered dangerous unless appropriate checks prove otherwise
- states that information about cargoes to be handled is essential to the safety of the vessel and crew
- states that information for each product may be found on cargo data sheets contained in safety guides or provided by the manufacturer or shipper
- states that, if sufficient information necessary for the safe handling and carriage of a cargo is not available, the cargo must not be loaded
- states that information necessary for the safe carriage of a cargo includes:
  - a full description of the physical and chemical properties, including reactivity,
  - necessary for its safe containment
  - action to take in the event of spills or leaks
  - countermeasures against accidental personal contact
  - fire-fighting procedures and fire-fighting media
  - procedures for cargo transfer, tank cleaning, gas-freeing and ballasting
  - details of the stabilizer or inhibitor added to those cargoes, which require one (on the manufacturer's certificate, in the absence of which the cargo should be refused)
- First Aid procedures, including the use of specific antidotes for poisons
- states that tanks are normally subject to thorough inspection and testing for cleanliness before loading
- explains, with the aid of a simple drawing, how cargo is routed from the manifold to tanks on a chemical tanker with separate lines for each tank
- explains, with the aid of a simple drawing, a 'closed

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

circuit' loading operation using a vapour-return line
- states that samples are taken from the lines and tanks during loading for purposes of quality control
- states that visual and audible high-level alarms and a tank overflow control system are required for many chemicals
- states that personnel involved in unloading should check the information in the relevant data sheets and take all necessary precautions, including the wearing of appropriate protective clothing
- states that, prior to discharging, samples from tanks and lines are analysed to check if the product has been contaminated on board during the passage
- explains, with the aid of a simple drawing, how cargo is routed from tank to the manifold on a tanker with deepwell pumps and separate lines from each tank
- states that, in tanks containing cargoes that present a major fire hazard, inert gas or nitrogen is used to maintain a small positive pressure during unloading, to prevent air from entering the tanks

6.5 Tank Cleaning and Control of Pollution in Chemical Tankers (2 hours)

- states that different cargoes require different tank-cleaning procedures
- states that most tank cleaning can be done with hot or cold seawater or fresh water, or by ventilation alone, although a few cargoes require special solvents
- states that fixed or portable tank-washing machines are used
- lists phases in a tank-cleaning operation as:
  - prewash
  - main wash
  - fresh water rinse
  - gas-freeing
  - drying
  - inspection and testing
- explains the use of slop tanks to hold cargo residues and tank washings
- explains, with the aid of a simple drawing, the cycle of a tank-washing system from the seawater inlet to the slop tank
- states that Annex II of the MARPOL 73/78 Convention contains regulations for the control of pollution by noxious

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liquid cargoes carried in bulk or tank washings from such cargoes

- states that as per the amendments of Annex II of MARPOL, which entered into force on 1 January 2007, a revised annex a new four-category pollution category system for noxious liquid substances; the previous A, B, C and D category system has become X,Y Z and OS.
- states that every chemical tanker is required to have a Certificate of Fitness (CoF) indicating that it is certified to carry certain products. The issuance of a CoF will also require a revised Procedures and Arrangements (P&A) Manual.
- states that each ship which is certified for the carriage of noxious liquid substances in bulk must be provided with a Procedures and Arrangements (P and A) Manual that has been approved by the Administration and a Cargo Record Book
- states that the master must ensure that no discharges into the sea of cargo residues or residue/water mixtures containing substances of Category X, Y, Z or OS take place unless they are made in full compliance with the P and A Manual
- states that carrying out operations in accordance with the ship’s P and A Manual ensures that the pollution regulations are complied with
- states that pollution-prevention procedures during cargo transfer, ballasting and tank cleaning should include keeping a watch on:
  - levels in cargo, slop or ballast tanks
  - hoses or loading arms
  - pumps, valves, gaskets, connections and hatches
  - spill pans and scuppers
  - alarms and instrumentation
  - co-ordination of operational signals
  - water around vessel
- states that personnel on watch should be present at all times during operations and regularly carry out the inspections mentioned in the above
- states that entries should be made in the Cargo Record Book, on a tank-to- tank basis, of:
  - loading
  - internal transfer of cargo
  - unloading
  - mandatory prewash in accordance with P and A Manual

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- cleaning of cargo tanks
- discharge into the sea of tank washings
- ballasting of cargo tanks
- discharge of ballast water from cargo tanks
- accidental or other exceptional discharge control by authorized surveyors

6.6 Gas Tankers (3 hours)

- states that the transport by sea of liquid gases in bulk is internationally regulated with regard to safety, through standards laid down by IMO
- states that Chapter VII of the IMO International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, makes the provisions of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) mandatory
- states that a liquefied gas is the liquid form of a substance that at normal atmospheric temperatures and pressures would be a gas
- states that liquefied gas products transported by gas tankers are listed in Chapter 19 of the IGC Code
- states that some of those substances are also covered by the IBC Code
- divides gas cargoes into four groups as:
  - liquefied natural gas (LNG)
  - liquefied petroleum gas (LPG)
  - liquefied ethylene gas (LEG)
  - chemical gases
- states that LNG is natural gas from which impurities have been removed, and consists mainly of methane
- states that LPG is the common name for petroleum gases consisting mainly of butane and propane
- lists chlorine, ammonia and vinyl chloride monomer as examples of chemical gases
- states that, in addition .to the surveys required for all ships, gas tankers must undergo surveys of the cargo-containment equipment and cargo-handling arrangements for the issue of an International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk
- states that the Certificate of Fitness lists the cargoes which may be carried by the ship and may also stipulate conditions for carriage
- explains the following terms used in the IGC Code:
  - boiling point

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    - cargo area
    - cargo containment system
    - gas carrier
    - gas-dangerous space or zone
    - gas-safe space
    - hold space
    - interbarrier space
    - MAR VS
    - primary barrier
    - secondary barrier tank dome
- explains that the IGC divides ships into four types, IG, 2G, 2PG and 3G
- states that a Type 1 G ship is intended for the transportation of products considered to present the greatest overall hazard and Types 2G/2PG and 3G for products of progressively lesser hazards
- states that the division into ship types is based on the ship's capability to survive specified damage caused by collision or stranding and the location of the cargo tanks in relation to such damage
- describes, in simple terms:
    - integral tank
    - membrane tank
    - semi-membrane tank
    - independent tank
    - internally insulated tank
- explains, in simple terms, the division of independent tanks into:
    - Type A, generally a self-supporting prismatic tank
    - Type B, generally a self-supporting spherical tank
    - Type C, generally a self-supporting cylindrical pressure tank
- states that a cargo tank has shut off valves located as close to the tank as possible for all liquid and vapour connections except for safety relief valves
- states that regulations require remotely operated emergency shutdown (ESD) valves in the cargo piping system
- states that the operation of the ESD system also stops pumps and compressors
- states that all cargo tanks must be provided with a pressure-relief system
- states that all equipment and piping which can be isolated when full of liquid must be provided with a pressure-relief system

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- states that cargo pumps are usually centrifugal, either deepwell pumps or submerged electric pumps, in the tanks with deck-mounted booster pumps, if required
- describes the uses of cargo heaters and vaporizers
- explains the effect of transfer of heat to the cargo on cargo temperature and tank pressure
- states that, except for fully pressurized vessels, means for controlling the pressure must be provided
- states that pressure in cargo tanks may be controlled by:
  - insulation of tanks, to reduce heat transfer
  - leading cargo boil-off to the ship's boilers or main engine as fuel (ONLY with LNG)
  - leading cargo boil-off to the ship's reliquefaction plant, where vapour is liquefied and returned to the tank
  - cooling the liquid in a heat exchanger (indirect system)
- describes the single-stage direct liquefaction cycle
- states that the indirect system is only used for those products which cannot be compressed for safety reasons
- states that inert gas is used to inert hold spaces and inter barrier spaces and to purge tanks
- states that most gas tankers are fined with an inert-gas generator
- states that the liquid level in cargo tanks is commonly measured by means of float gauges
- states that each cargo tank is fitted with a high-level alarm and automatic shutoff valves to prevent overflow
- states that each cargo tank is fitted with means for indicating the temperature and pressure
- explains how cargo leakage through the primary barrier can be detected
- states that gas tankers have a fixed gas-detection system that gives audible and visual alarms of the accumulation of gas in enclosed spaces such as cargo pump-rooms, compressor rooms, hold spaces and interbarrier spaces
- describes briefly the arrangements for fire fighting on deck in the cargo area describes the water-spray system for ships carrying flammable or toxic products

6.7 Cargo Operations in Gas Tankers (2 hours)

- states that information for each product may be found on cargo data sheets contained in safety guides or obtained from the shipper

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- states that information needed before loading includes:
  - a full description of the physical and chemical properties that are necessary for the safe containment of the cargo
  - action to be taken in the event of spills or leaks
  - counter-measures against accidental personal contact
  - fire-fighting procedures and fire-fighting media
  - procedures for cargo transfer, gas-freeing, ballasting, tank cleaning and changing cargoes
  - special equipment for particular cargoes
  - minimum temperatures of the inner hull steel
  - emergency procedures
- states that products that react when mixed should only be loaded if the complete cargo systems are separated
- states that personnel should be made aware of the hazards and be required to use the appropriate protective equipment provided
- states that the master should ensure proper liaison between the ship and the terminal before and throughout cargo-transfer operations
- describes briefly the following cargo operations:
  - drying
  - inerting
  - purging
  - cooling down
  - loading
  - cargo conditioning on passage
  - discharging
  - changing cargoes
  - gas-freeing
  - preparing for tank inspection
- states that all operations involving cargo, ballast and bunkers should be carried out in accordance with the applicable international and local pollution regulations
- states that some gas cargoes are subject to the regulations of Annex II of MARPOL 73/78
- explains that a gas tanker requires an International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk (NLS Certificate) to carry such products
- states that such cargoes must be handled in accordance with the Procedures and Arrangements Manual
- understands that the mass of vapour present in the ullage space is included in the calculation of liquefied

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

gasses
– calculates the vapour mass

2.1.7 KNOWLEDGE OF THE OPERATIONAL AND DESIGN LIMITATIONS OF BULK CARRIERS — R56, R64

Textbooks / Bibliography: T35, B71, B72, B73, B74, B76, B77, B78, B88, B89, B95, B104, B106, B109, B110, B113, B117, B128, B129, B130, B146, B182, B193, B198

Teaching Aids: A1, V59, V172

Required performances:

7.1 Operational and design limitations of Bulk carriers
(3 hours)

– explains that the problems that are generally considered to be associated with bulk carriers includes, but is not limited to;
  - high density cargoes, leading to loss of buoyancy or structural failure, if holds are flooded in the loaded condition
  - high loading rate, leading to possible loss of control of load condition; with consequent high stresses
  - vulnerability to internal damage during cargo loading and discharging operations, leading to protective coating damage, accelerated corrosion, and local structural failure.
  - low freeboard, leading to high green sea loads on deck structures
  - vulnerability to flooding of forward holds
  - rapid corrosion caused by corrosive cargo
– minor damage to single sided ship structures or hatch covers can lead to hold flooding
– explain why the nature of bulk cargoes can give rise to a number of problems
– explains that cargoes such as coal produces gas and acidic conditions, high density cargoes produce large void spaces, and other cargoes can produce stability problems due to shifting or liquefaction
– explains that loaded bulk carriers tend to have a low freeboard making forward hatches vulnerable to heavy seas
– explains that a single hold flooding on a bulk carrier,

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

particularly when loaded with high density cargoes, can have a severe adverse affect on stability and hull stresses
- explains that the corrosive effects of some cargoes accelerate the rate of deterioration of internal structures
- describes that ships can be more heavily stressed during ballast passage compared to loaded passage because the use of one or two ballast tanks leads to uneven weight distribution along the hull
- states that hold cleaning, ballasting at sea and ballast exchange carried out at sea are vulnerable aspects of a ballast voyage for a bulk carrier
- describes that improper cleaning during hold cleaning leads to accelerated corrosion and structural faults going unnoticed
- states that additional hull stresses due to redistribution of ballast are imposed on the ship carrying out ballasting at sea and ballast water exchange which is required for operational and environmental reasons
- explains that there is also a possibility of hull damage from ‘sloshing’ when ballasting at sea
- states that this is also one of the reasons why some ships have been fitted with hull stress monitoring systems
- explains why at shallow drafts ships in ballast are vulnerable to slamming with the consequent risk of bottom damage
- explains why loading operation of a bulk carrier has been identified as an area of operations that can have immediate and long term affects on the structural integrity of the ship
- describes that loading of bulk carriers requires the careful consideration of the loads imparted to the ship structure
- explains that high density cargoes bring high local stresses, particularly in shear, if the vessel is block loaded and can also cause local damage and fatigue when being loaded
- explains that loading at excessive speeds can cause high local stresses
- describes that high loading rates make it difficult to monitor the amount of cargo being loaded
- explains that continued over stressing has a cumulative effect with respect to fatigue
- explains that discharging the cargoes causes similar problems to that of loading
- describes that in addition to the problems associated with

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discharging, mechanical grabs, bulldozers, hydraulic hammers, and other machinery produce local damage and loading that can weaken the ship's structure

- explains that ballasting operations during discharge can also add to the stresses on the ship if not planned and executed properly
- explains as with loading, the need of good coordination at the time of discharge and ballasting of the ship
- explains the reason why maintenance and inspection play an important part in the safety of bulk carriers
- explains that all ships are designed with limits deliberately imposed on their operations to ensure that structural integrity is maintained
- explains that exceeding these limits may over-stress the structure and lead to catastrophic failure
- explains that the ship's hull structure is designed to withstand the static loads of the ship's weight and sea water pressure on the hull and the dynamic loads on the hull due to waves and ship's motion
- explains that overloading in any one cargo hold space will increase static stress in the hull structure and reduce the capability of the hull structure to withstand dynamic loads when the ship is at sea
- explains that many bulk carriers are fitted with very large hatch openings to facilitate cargo loading and unloading and these openings may represent points of weakness in the hull since they reduce the torsional resistance of the hull
- explains that when bulk carriers are loaded with dense and heavy cargoes such as iron, dense ores or steel products they rely on large empty spaces in holds, ballast tanks, voids and forward tanks as reserve buoyancy to stay afloat and if seawater enters any of these spaces due to damaged hull, hatches, accesses, ventilators or air pipes, the vessel can lose buoyancy and sink very quickly
- explains the need for all crew on the ship to be aware that any loss of buoyancy in forward spaces due to flooding will reduce the freeboard forward and dramatically increase the forces of extreme weather on hull structures and hatches
- explains why there is an urgent need for action if a ship takes on an unusual trim or heel, or if her motions become changed

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7.2 SOLAS Chapter XII Additional Safety Measures for Bulk Carriers (1 hours)

- explains Chapter XII of the SOLAS convention which contains regulations of Additional Safety Measures for Bulk Carriers
- states chapter XII Additional Safety Measures for Bulk Carriers was adopted by Conference held in November 1997 and it entered into force on 1 July 1999
- describes that this regulations relate to bulk carriers of 150m in length and upwards, carrying high density dry bulk cargoes, and introduce standards for damage stability and flotation, structure of bulkheads and double bottoms, overall longitudinal strength in the flooded state, hold loading, cargo density declarations, provision of a loading instrument, Hold, ballast and dry space water ingress alarms, Availability of pumping systems and Restrictions from sailing with any hold empty
- describes that the regulations states that all new bulk carriers 150 metres or more in length (built after 1 July 1999) carrying cargoes with a density of 1,000 kg/m3 and above should have sufficient strength to withstand flooding of any one cargo hold, taking into account dynamic effects resulting from presence of water in the hold and taking into account the recommendations adopted by IMO
- explains that the regulations states for existing ships (built before 1 July 1999) carrying bulk cargoes with a density of 1,780 kg/m3 and above, the transverse watertight bulkhead between the two foremost cargo holds and the double bottom of the foremost cargo hold should have sufficient strength to withstand flooding and the related dynamic effects in the foremost cargo hold.
- explains that Cargoes with a density of 1,780 kg/m3 and above (heavy cargoes) include iron ore, pig iron, steel, bauxite and cement, Lighter cargoes, but with a density of more than 1,000 kg/m3, include grains such as wheat and rice, and timber
- explains that as per the research carried out by the International Association of Classification Societies (IACS) at the request of IMO it was found that if a ship is flooded in the forward hold, the bulkhead between the two foremost holds may not be able to withstand the

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pressure that results from the sloshing mixture of cargo and water, especially if the ship is loaded in alternate holds with high density cargoes (such as iron ore) and if the bulkhead between one hold and the next collapses, progressive flooding could rapidly occur throughout the length of the ship and the vessel would sink in a matter of minutes.

- states that the most vulnerable areas of the bulk carrier are the bulkhead between numbers one and two holds at the forward end of the vessel and the double bottom of the ship at this location
- explains that no bulk carrier over ten years old can carry a high density bulk cargo unless she has undergone either a periodical survey or a survey of her cargo holds to an equivalent extent, as required by regulation XII/7
- explains that as per SOLAS Regulation XII/8 - Documentation of Compliance, the cargo loading manual, required by SOLAS Regulation VI-7.2 should be endorsed by the certifying authority to indicate which of the SOLAS regulations are complied with
- states that Under Chapter XII, surveyors can take into account restrictions on the cargo carried in considering the need for, and the extent of, strengthening of the transverse watertight bulkhead or double bottom and if the restrictions on cargoes are imposed, then as per SOLAS Regulation XII/8.3 ,the bulk carrier shall be permanently marked on the side shell at midships, port and starboard, with a solid equilateral triangle having sides of 500 mm and its apex 300 mm below the deck line, and painted a contrasting colour to that of the hull.
- explains that such operating restrictions is only imposed for solid bulk cargoes having a density of 1,780 kg/m3 and above, and this applies at all times when solid bulk cargoes having a density of 1,780 kg/m3 and above are carried
- states that the permanently marking of a solid triangle on its side shell is required when a ship's loading booklet restricts the ship to carry solid bulk cargoes having a density of less than 1,780 kg/m3, a triangle mark is not required, provided that all reference to carriage of solid bulk cargoes having a density of 1,780 kg/m3 and above are removed from the loading booklet.
- states that in the above case the loading booklet is to clearly specify that the ship is prohibited from carrying solid bulk cargoes having a density of 1,780 kg/m3 and

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above
- states that the permanently marking of a solid triangle on its side shell is also required when a ship's deadweight is restricted, but the load line assignment permits deeper draughts, and operating restrictions in the form of draught or deadweight limits are imposed on the ship to obtain compliance with the requirements and the loading booklet is to clearly specify the operating restrictions
- explains that if the ship's load line and loading booklet are revised to limit the ship's draught at all times, operating restrictions and the triangle marks are not required
- states that the permanently marking of a solid triangle on its side shell is also required where restrictions, other than a general restriction to homogeneous loading, are imposed on the distribution of cargo in the two foremost cargo holds as a condition of compliance and the loading booklet is to clearly specify the applicable operating restrictions
- states that the permanently marking of a solid triangle on its side shell is not required where restrictions are imposed on the maximum mass of packaged cargoes to be carried in the foremost cargo hold as a condition of compliance with the Standards for the evaluation of allowable hold loading of the foremost cargo hold, as contained in annex 2 to 1997 SOLAS Conference resolution 4 but the loading booklet is to clearly state these limits
- states that the permanently marking of a solid triangle on its side shell is also required where a homogeneous distribution of cargo in the two foremost cargo holds is required as a condition of compliance and the loading booklet is to clearly specify the applicable operating restrictions
- explains the Damage Stability Requirements as per SOLAS Regulation XII/4
- explains the structural requirements as per SOLAS Regulations XII/5 and 6
- explains the Density declaration and verification requirements as per SOLAS Regulation XII/10
- explains the loading instrument requirements as per SOLAS Regulation XII/11
- explains the Hold, ballast and dry space water ingress alarms requirements as per SOLAS regulation XII/12
- explains the Availability of pumping systems

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requirements as per SOLAS Regulation XII/13
- explains the Restrictions from sailing with any hold empty as per SOLAS Regulation XII/14

7.3 CSR Bulk (1 hour)

- explains that Common structural rules (CSR) are rules covering structural requirement for Bulk Carriers and Tankers
- states that IACS Common Structural Rules (CSR) Bulk which contains structural requirements are applicable for Bulk Carriers with L > 90 m signed for construction after 1 April 2006
- explains that vessels built to CSR shall have overall safety of the hull structure equivalent to or better than that currently achieved by present rules
- explains that the reasons for implementing of these rule are:
  - to eliminate competition between class societies with respect to structural requirements and standards
  - to employ the combined experience and recourses of all IACS societies to develop a single standard, or set of rules
  - to fully embrace the intentions of the anticipated IMO requirements for goal based new construction standards
  - to ensure that a vessel meeting this new standard will be recognised by the industry as being at least as safe and robust as would have been required by any of the existing rules
- explains that the intention of the new Rules is to encourage the design and construction of robust tankers and bulk carriers and to eliminate competition on scantlings
- explains that the benefit of these rules are:
  - these rules will allow shipbuilders and designers to work with one common set of Rules, instead of one set from each class society
  - greater transparency of the technical background to the Rules
  - the minimum fatigue design life has been upgraded from the 20 year worldwide trading to 25 year North Atlantic environment
  - the Rules include design standards for the net scantlings of a vessel meaning that the renewal

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thicknesses for the in service time is checked and known at the new building stage
- the corrosion additions that have been established takes into account the location and the environment to which the structural member's surface is subjected
- stringent and clarified requirements to critical areas

– explains that the stringent and clarified requirements for critical areas, include:
  - longitudinals in way of the hopper tank at shell, as they are most exposed to fatigue cracks.
  - increased safety factor for single side shell according to SOLAS Chapter XII
  - fatigue check of main frame connection to hopper sloping plating and improved steel grade for bracket and adjacent side plating
  - fatigue check of inner bottom plating connection with lower stool and hopper sloping plating
  - in transverse bulkhead and lower stool areas, fatigue check of lower stool and corrugated bulkhead connection and mandatory strengthening for grab loading
  - IACS UR S21 (Rev. 4) for Hatch Covers and Hatch Coamings

2.1.8 LOADING, CARE AND UNLOADING OF BULK CARGOES

Textbooks / Bibliography: B71, B72, B73, B74, B76, B77, B78, B88, B89, B95, B104, B106, B109, B110, B113, B117, B128, B129, B130, B146, B182, B193, B198

Teaching Aids: A1, V59, V172

Required performances:

8.1 Application of all available shipboard data related to loading, care and unloading of bulk cargoes (5 hours)

– outlines and describes all relevant information to be appraised prior planning of loading a bulk cargo
– outlines all relevant publications, IMO codes and recommendations to be referred prior loading a bulk cargo
– explains the procedure for loading a bulk cargo in detail
– explains that the cargo stowage plan should be prepared after carefully considering and assessing information

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such as seasonal load line zones, port restrictions, shipboard limits, e.g. draft, cargo capacity, stability, stresses and loading rates

– explains that the consumption of ship's bunkers, consumption/generation of fresh water, during the voyage should be taken into account when carrying out the stress and displacement calculations
– states that the ship's approved loading manual is an essential onboard documentation for the planning of cargo stowage, loading and discharging operations
– states that it is a statutory requirement of the International Load Line Convention that, noting exemptions, "the Master of every new vessel be supplied with sufficient information, in an approved form, to enable him to arrange for the loading and ballasting of his ship in such a way as to avoid the creation of any unacceptable stresses in the ship's structure" and if the Master feels that he has insufficient information regarding the structural limitations or requires advice on the interpretation of the classification society's structural limitations imposed on his ship, advice should be sought from the ship's classification society
– explains that loading manual is a document which describes:
  - the loading conditions on which the design of the ship has been based, including permissible limits of still water bending moments (SWBM) and shear forces (SWSF);
  - the results of the calculations of still water bending moments, shear forces and, where applicable, limitations due to torsional loads;
  - envelope results and permissible limits of still water bending moments and shear forces (SWBM) in the hold flooded condition as applicable;
  - the cargo hold(s) or combination of cargo holds that might be empty at full draught
  - if no cargo hold is allowed to be empty at full draught, this should be clearly stated in the loading manual; and the allowable local loads for the structure (e.g. hatch covers, decks, double bottom, tank top)
– explains that the loading manual contains typical loading sequences from commencement of cargo loading to reaching full deadweight capacity for homogeneous conditions, relevant part load conditions and alternate hold loading conditions where applicable

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- explains that the loading manual contains typical unloading sequences also
- explains that the typical loading sequences is developed paying due attention to the loading rate, the de-ballasting capacity and the applicable strength and draught limitations
- explains that the ship's loading manual is a ship specific document, the data contained therein is only applicable to the ship for which it has been approved
- states that the loading computer is an invaluable shipboard calculation tool which assists the ship's cargo officer in:
  - planning and controlling cargo and ballasting operations
  - quickly calculating and assessing that SWSF and SWBM and the still water torsional moments, where applicable, in any loading or ballast condition will not exceed the specified permissible values during planned loading, unloading and ballast water exchange
  - identifying the imposed structural limits which are not to be exceeded
- explains that for each occasion when the ship is loaded or unloaded or ballast water is exchanged at sea, the sequence of the operations should be checked, using the approved loading instrument
- explains that the officer in charge of cargo operation should also refer to the loading manual when planning or controlling cargo operations as the loading instrument is not a substitute for the ship's loading manual
- explains that the ship's loading instrument is a ship specific onboard equipment and the results of the calculations are only applicable to the ship for which it has been approved
- explains that the operation manual of this loading instrument is an essential part of the loading instrument and it should be kept onboard at all times
- states that all the ship's deck officers should familiarise themselves with the operation of the onboard loading instrument
- explains that it is recommended that Master should carry out checks to ascertain the accuracy of the loading instrument against the test cargo loading conditions at regular intervals
- explains that prior to loading bulk cargo, the shipper

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should declare characteristics & density, stowage factor, angle of repose, amounts and special properties of the cargo

- explains that in preparing the vessel for a safe planning and cargo stowage, the loading and unloading sequences and other operational matters should be informed well in advance by the charterers / terminal
- explains that for the loading, unloading and stowage of solid bulk cargoes, reference should be made to SOLAS regulation VI/7 and the related code of practice for the safe loading and unloading of bulk carriers (BLU Code)
- explains the importance of referring to IMO International Maritime Solid Bulk Cargoes (IMSBC) code prior loading the cargo
- explains the importance of referring the IMO International Code for the Safe Carriage of Grain in Bulk, prior loading grain cargo
- explains the importance of referring to the Code of Safe Practice for Cargo Stowage and Securing prior loading and stowage of bulk cargoes
- explains that charterers may give special instructions, on the loading, carriage/stowage and unloading of the bulk cargo, the content of which has to be carefully read, understood and followed, and in case there is any doubt, especially if it is contrary to the International Maritime Solid Bulk Cargoes (IMSBC) code, the Master should immediately inform the owners and charterers, before executing this instruction

8.2 Code of practice for the safe loading and unloading of bulk carriers (BLU code) (1 hour)

- outlines the contents of the Code of practice for the safe loading and unloading of bulk carriers (BLU code)
- states that the BLU Code, adopted in November 1997, provides guidance to the ship masters of bulk carriers, terminal operators and other parties concerned with the safe handling, loading and unloading of solid bulk cargoes
- states that this code has been developed by IMO to minimize losses of bulk carriers
- states that SOLAS chapter VI, regulation 7.3 requires that before any solid bulk cargo is loaded or unloaded, the master and the terminal representative shall agree on a plan which shall ensure that the permissible forces and

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moments on the ship are not exceeded during loading and unloading

- states that to facilitate the development of the plan the code of practice for the safe loading and unloading of bulk carriers (BLU Code) (resolution A.862(20), as amended) is referenced
- states that the purpose of the Code is to assist persons responsible for the safe loading or unloading of bulk carriers to carry out their functions and to promote the safety of bulk carriers
- states that the BLU Code requires co-operation and mutual agreement between the terminal representative and master with regard to how the ship is to be loaded and unloaded
- states that the basic requirement of the Code is an agreed plan detailing the loading, unloading, ballasting and de-ballasting sequences
- explains that the preparation of a plan and maintaining control of the loading and unloading process in accordance with the plan and the BLU Code is fundamental to the safe loading of dry bulk cargoes
- states that the code primarily covers the safety of ships loading and unloading solid bulk cargoes, excluding grain, and reflects current issues, best practices and legislative requirements
- states that broader safety and pollution issues such as those covered by the SOLAS, MARPOL and Load Line Conventions are not specifically included in the Code
- explains that the BLU Code advises that charterers and shippers should allocate ships to terminals at which the ship will be capable of safely loading or unloading
- explains that the BLU code also advises ships to be maintained in a sound, seaworthy condition and be free of defects that may prejudice the ship's safe loading, unloading or navigation
- explains that the BLU code also advises terminal equipment to be properly certified, maintained and operated by duly qualified and, if appropriate, certificated personnel
- states that as per BLU code, all personnel, ship and terminal, should be trained in all aspects of safe loading and unloading of bulk carriers, commensurate with their responsibilities; including knowledge of the adverse effect that failure to comply with the agreed loading/unloading plan may have on the safety of the ship

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- states that the recommendations are subject to terminal and port requirements, or national regulations
- states that the persons responsible for the loading or unloading of bulk carriers should also be aware of such regulations and requirements
- states that Masters and terminals loading and unloading solid bulk cargoes possessing chemical hazards should also refer to SOLAS chapters II-2 and VII and to MSC/Circ.675 (Recommendations on the safe transport of dangerous cargoes and related activities in port areas)
- explains that to supplement the BLU Code, guidance for terminal representatives and others involved in the handing of solid bulk cargoes is given in the manual on loading and unloading of solid bulk cargoes for terminal representatives (BLU Manual)
- states that the BLU code also advises that the ship charterer and shipper when accepting a ship for a particular cargo or service should ensure that the ship:
  - is suitable for access to the planned loading or unloading facilities; and
  - does not have cargo handling equipment which would inhibit the safety of the loading and unloading Operations
- explains that arriving in port in a very lightly ballasted state should be avoided as such conditions can have detrimental consequences on manoeuvrability and structural strength
- explains that manoeuvrability can be significantly affected by a large trim associated with a very light ballast condition, for example: increasing bodily drift and difficulty in swinging the ship in windy conditions, decreasing turning performance and increasing difficulty in maintaining the ship’s course and position under the actions of wind and currents
- explains that in terms of hull structures, loading cargo in a shallow draught condition can impose high stresses in the double bottom, cross deck and transverse bulkhead structures if the cargo in the holds is not adequately supported by the buoyancy up thrust
- states that in developing the loading plan, and determining the arrival condition, consideration should be given to manoeuvrability issues and local loading criteria in the loading manual
- outlines the information given by the ship to the terminal prior arrival

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- outlines the information given by the terminal to the ship prior arrival
- outlines the procedures between the ship and terminal prior to cargo handling
- explains that the loading sequences must be agreed to in advance of loading and must take into account the safe operational limits of the ship and the terminal
- states that this agreement must be a part of the loading plan required under SOLAS chapter VI, regulation 7.3, and should also be in line with the provisions of the BLU Code
- states that in developing loading sequences it should be noted that in general the stress range imposed on the ship can be reduced by increasing the number of pours
- states that it is recommended that the loading sequences consist of a minimum of two pours per hold plus two trim pours
- explains that when calculating the stresses at each step consideration may be given to using a margin (i.e. using less than 100% of the permissible limit) to allow for potential over-runs or decoupling of ballast synchronization; providing time to stop loading operations, and subsequently take corrective action, while remaining within permissible limits
- states that the master is responsible at all times for the safe loading and unloading of the ship, the details of which is confirmed to the terminal representative in the form of a loading or unloading plan.
- explains during loading, the need of ballast operations to be synchronized with loading operations as laid down and agreed in the loading plan required under SOLAS chapter VI, regulation 7.3
- states that ballast and loading operations should be carried out in a controlled manner in accordance with the loading plan and the provisions of BLU Code
- states that if at any time during loading the safe operational limits of the ship are exceeded, or likely to become so if the loading continues, the ship master has the right to suspend loading operations in order to take corrective actions (refer SOLAS chapter VI, regulation 7.7).
- describes the consequences of failure to apply BLU Code
- states that exceeding the permissible limits specified in the ship's approved loading manual will lead to over-stressing of the ship's structure and may result in

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catastrophic failure of the hull structure
- explains that it is important to be aware that over-stressing of local structural members can occur even when the hull girder still water shear forces and bending moments are within their permissible limits, in this regard particular attention should be given to double bottom loading utilizing local loading diagrams in the loading manual

2.1.9 SAFE CARGO HANDLING IN ACCORDANCE WITH THE PROVISIONS OF THE RELEVANT INSTRUMENTS — R56, R64

Textbooks / Bibliography: B21, B71, B72, B73, B74, B75, B76, B77, B78, B79, B80, B81, B82, B83, B88, B89, B90, B91, B92, B93, B94, B95, B97, B98, B011, B101, B102, B104, B106, B109, B110, B113, B117, B128, B129, B130, B146, B152, B153, B156, B157, B158, B159, B161, B162, B167, B182, B189, B190, B191, B192, B193, B196, B197, B198, B203, B215, B216, B217

Teaching Aids: A1, V47, V48, V67

Required performances:

9.1 Establish Procedures for safe cargo handling in accordance with the provisions of the relevant instruments such as;
- **IMDG Code**
- **IMSBC Code**
- **MARPOL 73/78, Annexes III and V** (3 hours)

- states that SOLAS II-2/19 requires a ship carrying dangerous goods to have a Document of Compliance (DOC) issued by the flag Administration
- states that ships carrying, packaged dangerous goods of class 6.2 and 7 in limited quantities and/or excepted quantities is not required to be issued with a DOC
- states that all the ship personnel should be familiar with the Document of Compliance, provided by the administration as evidence of compliance of construction and equipment with the requirements
- states that the master should ensure that he has received full details of the cargo like UN Number, correct technical name etc. prior loading any dangerous cargo
- states that the master should ensure that the segregation and stowage is in complete compliance with the IMDG

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Code

- explains on ships carrying dangerous goods in packaged form, the master should be provided with the dangerous goods manifest or stowage plan as required by SOLAS 1974 as amended, Regulations VII/4.5 and VII/7-2 and MARPOL 73/78, Annex III, Regulation 4
- states that this dangerous goods manifest must show all IMO controlled cargo and must include the container number, commodity description, IMDG class and UN number, port of discharge, gross and net weight, packaging details, technical name, booking number and packing group and the emergency medical code number
- states that a dangerous cargo declaration and packing list should accompany each shipment
- states that the master has to ensure that all packaged dangerous goods are checked by the duty officer for compliance with packaging and labelling
- explains that the duty officers should be well trained and briefed prior loading / unloading any dangerous goods, that any doubts about the suitability and integrity of packages is to be reported to the master or chief mate
- explains the fire precautions which should be taken when carrying dangerous goods
- states that the duty officer should be given all the information on the special measures to be taken when a certain dangerous cargo is handled
- states that the duty officer should be given all the information on the quantities, types of package, proper shipping names (correct technical names), classification, stowage and segregation of the dangerous goods to be handled
- explains that all the duty officers should be well trained and briefed prior loading / unloading any dangerous goods, that any incident or accident during the handling of dangerous goods should be reported immediately to the person in charge of the operation
- explains that the actions to be taken are laid down in the IMO Emergency Procedures for Ships Carrying Dangerous Goods (Ems), the IMO Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG) and the International Medical Guide for Ships (IMGS)
- explains that the all the duty officers should be well trained and briefed about measures to be taken in the event of an incident or accident during the handling of

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dangerous goods and that any necessary equipment and sufficient crew to operate it should be available

- states that the dangerous goods should be stowed on board in conformity with the Document of Compliance, using the dangerous goods manifest or the stowage plan, required by SOLAS Chapter VII
- states that Annex III of MARPOL 73/78 contains requirements for the carriage of harmful substances in packaged form which are identified in the IMDG code as marine pollutants (MP)
- states that cargoes which are determined to be marine pollutants (MP) should be labelled and stowed in accordance with Annex III of MARPOL 73/78
- states that the ship carrying MP, should be provided with a shipping/transport document for each of the MP carried
- states that the master and chief mate should ensure when receiving shipping/transport documents, that they comply with the requirement of IMDG Code Chapter 5.4, Section 5.4.1.4,specifically where the technical name and order of information are to be correct and in compliance with MARPOL Annex III/4(1)
- states that this dangerous goods shipping /transport document should contain the following information for each dangerous substance, material or article offered for transport;
  - the UN number preceded by the letters, “UN”;
  - the Proper Shipping Name, as determined according to 3.1.2, including the technical name enclosed in parenthesis, as applicable;
  - the primary hazard class or, when assigned, the division of the goods, including for Class 1, the compatibility group letter. The words “Class” or division” may be included preceding the primary hazard class or divisional numbers;
  - subsidiary hazard class or division number(s) corresponding to the subsidiary risk label(s) required to be applied, when assigned, shall be entered following the primary hazard class or division and shall be enclosed in parenthesis. The words “Class” or division” may be included preceding the primary hazard class or divisional numbers;
  - where assigned, the packing group for the substance or article which may be preceded by “PG” (e.g. “PG II”)
  - the five elements of the dangerous goods description

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specified in 5.4.1.4.1 should be shown in order list above (i.e. 1, 2, 3, 4 and 5) with no information interspersed, excepted as provided in this code

- states that the master and chief officer should verify that shipping/ transport documents, when carried should include a certificate, which is signed and dated by the consignor which is required to comply with the MARPOL Annex III/4(2)
- states that the nature of the declaration is prescribed in IMDG Code, Chapter 5.4 Section 5.4.1.6
- states that the master and chief mate should ensure that the relevant emergency response for the dangerous goods carried onboard ship as stated in the MARPOL Annex III/8(1)are those detailed in the IMDG Code Section 5.4.3.2
- states that the master should make sure emergency response to accidents and incidents involving dangerous goods must be readily available and accessible in the event of the accident and this information is to be available away from packages containing dangerous goods
- states that the master should ensure that the crew are aware of this emergency response procedure
- states that the master may employ the method(s) to ensure the emergency response is in compliance, for e.g.
  - appropriate entries in the special list, manifest or dangerous goods declaration; or
  - provision of a separate document such as a safety data sheet; or
  - provision of separate documentation, such as the emergency response procedures for ship carrying dangerous goods (EMs Guide)
- states that the master may rely upon the emergency response procedures for ship carrying dangerous goods using the copy of current IMDG Code supplement
- explains that there are procedures also given in the shipboard SMS for the reporting of incidents involving the loss, or likely loss of harmful substances
- states that the ship carrying MP should have a special list or manifest or detailed plan showing the location of these goods as per MARPOL Annex III/4(3)
- states that the master and chief mate should ensure MP are stowed in the location specified in the special list or manifest or detailed plan
- states that the information provided on the special list or

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manifest should be compliant with section 5.4.3 of the IMDG code as per MARPOL Annex III/4(3)

- states that the master and chief mate should ensure that when MP or any other dangerous goods are loaded on their ship, they must be stowed as required by Chapter 7.1, Section 7.1.4 of the IMDG Code in order to comply with MARPOL Annex III/5
- states that to avoid accident which may lead to marine pollution, the master and chief mate should take note that MP goods should not be placed on the outer row or out board stow at the side of the ship. In addition, if they are stowed on deck, they should be located in such a way that any leakage will not escape into the sea and containers are not in exposed location where they may be damaged by the action of the sea or weather
- states that as given in MARPOL Annex III/5, the master and chief officer should ensure that when MP or any other dangerous goods is carried on their ship, the stowage and securing must be in accordance with the requirements of the Document of Compliance (DOC) and approved Cargo Securing Manual (CSM)
- states that as given in MARPOL Annex III/3, the containers loaded with MP should be appropriately marked to indicate they are carrying MP
- states that that the disposal of dry bulk cargo residues is regulated by the requirements of MARPOL Annex V which governs garbage disposal at sea
- states that as per the guidelines given in MARPOL Annex V, cargo-associated waste means all materials which have become wastes as a result of use on board a ship for cargo stowage and handling and this includes but is not limited to dunnage, shoring, pallets, lining and packing materials, plywood, paper, cardboard, wire, and steel strapping
- states that as per the guidelines given in MARPOL Annex V, operational wastes means all cargo-associated waste and maintenance waste, and cargo residues
- states that as per the guidelines given in MARPOL Annex V, cargo residues, expected to be in small quantities, are defined as the remnants of any cargo material on board that cannot be placed in proper cargo holds (loading excess and spillage) or which remain in cargo holds and elsewhere after unloading procedures are completed (unloading residual and spillage)
- states that this means that under the terms of MARPOL

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73/78, discharge of cargo residues, except in limited safety circumstances, is prohibited until the ship is more than twelve nautical miles from the nearest land

- states that minimisation of cargo residue wash down and discharge should form part of the ship's Garbage Management Plan and all residue discharges should be recorded as garbage category 4
- states that discharges of cargo residues also require start and stop positions to be recorded in the Garbage record book
- states that cargo materials contained in the cargo hold bilge water is not treated as cargo residues provided that the cargo material is not classified as a marine pollutant in the IMDG Code and the bilge water is discharged from a loaded hold through the vessel's fixed piping bilge drainage system
- explains that cargo residues are created through inefficiencies in loading, unloading and on-board handling
- states that as cargo residues fall under the scope of these guidelines provided by MARPOL annex V, it may, in certain cases, be difficult for port reception facilities to handle such residues and is therefore recommended that cargo be unloaded as efficiently as possible in order to avoid or minimize cargo residues
- states that spillage of the cargo during transfer operations should be carefully controlled, both on board and from dockside and since this spillage typically occurs in port, it should be completely cleaned up prior to sailing and either delivered into the intended cargo space or into the port reception facility
- states that areas on the ship where spillage is most common should be protected such that the residues are easily recovered
- states that the International Maritime Solid Bulk Cargoes Code (IMSBC Code) amplifies the mandatory provisions contained in the parts A and B of chapter VI and part A-1 of chapter VII, of the International Convention for the Safety of Life at Sea, 1974 (SOLAS Convention), as amended, governing the carriage of solid bulk cargoes and the carriage of dangerous goods in solid form in bulk, respectively
- states that the provisions contained in the IMSBC Code apply to all ships to which the SOLAS Convention, as amended, applies and that are carrying solid bulk cargoes as defined in regulation 2 of part A of chapter VI

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of the Convention

- states that the prime hazards associated with the shipment of solid bulk cargoes are those relating to structural damage due to improper cargo distribution, loss or reduction of stability during a voyage and chemical reactions of cargoes
- states that the primary aim of the IMSBC Code is to facilitate the safe stowage and shipment of solid bulk cargoes by providing information on the dangers associated with the shipment of certain types of solid bulk cargoes and instructions on the procedures to be adopted when the shipment of solid bulk cargoes is contemplated
- states that the observance of the Code harmonizes the practices and procedures to be followed and the appropriate precautions to be taken in the loading, trimming, carriage and discharge of solid bulk cargoes when transported by sea, ensuring compliance with the mandatory provisions of the SOLAS Convention
- states that typical cargoes currently shipped in bulk, together with advice on their properties and methods of handling, are given in the schedules for individual cargoes
- states that appendix 1 of the IMSBC Code, contains individual schedules of solid bulk cargoes
- states that if a solid cargo which is not listed in appendix 1 to this Code is proposed for carriage in bulk, the shipper shall, prior to loading, provide the competent authority of the port of loading with the characteristics and properties of the cargo in accordance with section 4 of this Code
- states that based on the information received, the competent authority will assess the acceptability of the cargo for safe shipment
- states that regulation 2 of the IMSBC Code states that, the shipper shall provide the master or his representative with appropriate information on the cargo sufficiently in advance of loading to enable the precautions which may be necessary for proper stowage and safe carriage of the cargo to be put into effect
- states that the fore mentioned information shall be confirmed in writing and by appropriate shipping documents prior to loading the cargo on the ship
  - states that the cargo information shall include:
  - the Bulk Cargo Shipping Name (BCSN) when the

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cargo is listed in this Code. Secondary names may be used in addition to the BCSN;
- the cargo group (A and B, A, B or C);
- the IMO Class of the cargo, if applicable;
- the UN number preceded by letters UN for the cargo, if applicable;
- the total quantity of the cargo offered;
- the stowage factor;
- the need for trimming and the trimming procedures, as necessary;
- the likelihood of shifting, including angle of repose, if applicable;
- additional information in the form of a certificate on the moisture content of the cargo and its transportable moisture limit in the case of a concentrate or other cargo which may liquefy;
- likelihood of formation of a wet base (see subsection 7.2.3 of this Code);
- toxic or flammable gases which may be generated by cargo, if applicable;
- flammability, toxicity, corrosiveness and propensity to oxygen depletion of the cargo, if applicable;
- self-heating properties of the cargo, and the need for trimming, if applicable;
- properties on emission of flammable gases in contact with water, if applicable;
- radioactive properties, if applicable; and
- any other information required by national authorities

– states that as per definitions listed in the IMSBC Code, Bulk Cargo Shipping Name (BCSN) identifies a bulk cargo during transport by sea
– states that when a cargo is listed in this Code, the Bulk Cargo Shipping Name of the cargo is identified by capital letters in the individual schedules or in the index
– states that as per definitions listed in the IMSBC Code, Group A consists of cargoes which may liquefy if shipped at a moisture content in excess of their transportable moisture limit
– states that as per definitions listed in the IMSBC Code, Group B consists of cargoes which possess a chemical hazard which could give rise to a dangerous situation on a ship
– states that as per definitions listed in the IMSBC Code, Group C consists of cargoes which are neither liable to liquefy (Group A) nor to possess chemical hazards

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(Group B)

- outlines and describe the content of section 2, General loading, carriage and unloading precautions, of the IMSBC Code
- outlines and describes the content of section 3, Safety of personnel and ship, of the IMSBC Code
- outlines and describes the information provided in appendix 1 of the IMSBC Code, which contains individual schedules of solid bulk cargoes
-

2.1.10 EFFECTIVE COMMUNICATIONS AND IMPROVING WORKING RELATIONSHIP — R56, R64

Required performances:

10.1 Basic principles for establishing effective communications and improving working relationship between ship and terminal personnel (1 hour)

- states that one of the reason of introducing and implementing the Code of practice for the safe loading and unloading of Bulk Carriers (BLU code), is that Misunderstandings can occur and mistakes will be made when ships' officers do not fully understand the intentions of the terminal personnel, and the same applies when terminal personnel do not understand what the ship can and cannot safely do
- outlines and describes the information that should be given by the ship to the terminal, prior to ship's arrival , in order to plan the proper disposition and availability of the cargo so as to meet the ship's loading plan
- describes what advise should the ships provide the terminals with when arriving at loading or unloading terminals in a part loaded condition prior ship's arrival
- describes what additional information should combination carriers (OBO or O/O) advise the terminals prior's ship's arrival
- states that the ship should confirm to the terminals, as soon as possible, that all holds into which cargo is to be loaded are clean, and free from previous cargo residues which in combination with the cargo to be loaded could create a hazard
- states that the information on the loading or unloading plan and on intended arrival and departure draughts

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should be progressively updated, by the ship and passed to the terminal as circumstances change
- outlines and describes the information that should be given as soon as possible by the terminal to the ship, on receipt of the ship's initial notification of its estimated time of arrival (ETA)
- states that the information on estimated times for berthing and departure and on minimum water depth at the berth should be progressively updated, by the terminal and passed to the ship's master on receipt of successive ETA advices
- states that the terminal representative should be satisfied that the ship has been advised as early as possible of the information contained in the cargo declaration as required by chapter VI of SOLAS 1974, as amended
- states that the principles of the procedures between the ship and terminal prior to cargo handling is that the master is responsible at all times for the safe loading and unloading of the ship, the details of which should be confirmed to the terminal representative in the form of a loading or unloading plan
- outlines and describes what should the ship's master do in addition to the fore mentioned confirmation through the loading and unloading plan
- states that the principles of the procedures between the ship and terminal prior to cargo handling is that the terminal representative is responsible for loading or unloading cargo in accordance with the hatch sequence and tonnages stated on the ship's loading or unloading plan
- outlines and describes what should the terminal do in addition to adhering the ship's loading and unloading plan
- outlines and describes the procedures that are considered important in respect of cargo loading
- outlines and describes the procedures that are considered important in respect of cargo unloading
- states that the loading or unloading plan should only be changed when a revised plan has been prepared, accepted and signed by both parties
- states that the loading plans should be kept by the ship and terminal for a period of six month
- outlines and describes the ship's duties during cargo loading and handling of ballast
- outlines and describes the terminal's duties during cargo

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference
	loading and handling of ballast – outlines and describes the ship's duties during cargo unloading and handling of ballast – outlines and describes the terminal's duties during cargo unloading and handling of ballast – states that to avoid misunderstanding that can have a catastrophic result, the BLU code also incorporates a Ship/Shore Safety Checklist – states that the purpose of the Ship/Shore Safety Checklist is to improve working relationships between ships and terminal, and thereby improving the safety of operation – outlines and describes the points in the ship/shore safety checklist for loading or unloading dry bulk cargo carriers contained in the BLU code – describes the guidelines given in the BLU code for completing the ship/shore safety checklist	

COMPETENCE 2.2	Assess Reported Defects and Damage to Cargo Spaces, Hatch Covers and Ballast Tanks and take appropriate action	IMO Reference

TRAINING OUTCOMES:

STCW Code Table A-II/2

Demonstrates a knowledge and understanding of:

2.2.1 LIMITATIONS ON STRENGTH OF THE VITAL CONSTRUCTIONAL PARTS OF A STANDARD BULK CARRIER AND INTERPRET GIVEN FIGURES FOR BENDING MOMENTS AND SHEAR FORCES

2.2.2 METHODS TO AVOID THE DETRIMENTAL EFFECTS ON BULK CARRIERS OF CORROSION, FATIGUE AND INADEQUATE CARGO HANDLING

COMPETENCE 2.2	Assess Reported Defects and Damage to Cargo Spaces, Hatch Covers and Ballast Tanks and take appropriate action	IMO Reference

2.2.1 LIMITATIONS ON STRENGTH OF THE VITAL CONSTRUCTIONAL PARTS OF A STANDARD BULK CARRIER AND INTERPRET GIVEN FIGURES FOR BENDING MOMENTS AND SHEAR FORCES — R63

Textbooks / Bibliography: T35, B71, B72, B73, B74, B76, B77, B78, B88, B89, B95, B104, B106, B109, B110, B113, B117, B128, B129, B130, B146, B182, B193, B198

Teaching Aids: A1, V60, V120, V121, V122, V155

Required performance:

1.1 Limitations on strength of the vital constructional parts of a standard bulk carrier and interpret given figures for bending moments and shear forces (2 hours)

- states that the longitudinally continuous upper deck of a bulk carrier suffers hull girder stress
- explains that the longitudinal bending causes an axial force on the upper deck that may cause cracking of the deck plate at the locations where the stress is concentrate
- states that bulk carriers have cargo hatchways for the convenience of cargo-handling facilities
- explains that these hatchways reduce the ship’s torsional strength and invite concentrated stress at the hatchway corners which may be evident by cracking of the deck plates in these areas
- states in this regard upper deck plating at hatchway corners is one of the focal points for cracking
- explains that cross-deck strips come under stress by transverse bending
- explains that the transverse bulkheads provide transverse strength to a bulk carrier and the cross-deck strips provide the strength to withstand the resultant axial forces in a transverse direction
- explains that there are various types of cracking in the upper deck
- states that those propagating from the cargo hatchways are generally considered serious to the ship’s safety
- explains that various metal fittings are welded to the upper deck plating and these installations may cause stress concentrations at the welded joints or have defects in the welds
- states that deck platings in the vicinity of manholes,

COMPETENCE 2.2	Assess Reported Defects and Damage to Cargo Spaces, Hatch Covers and Ballast Tanks and take appropriate action	IMO Reference

hatchside coaming end brackets, bulwark stays, crane post foundations and deck houses, etc. are to be carefully watched for cracking

- states that hatch coamings are subjected to hull girder stress
- explains that although they are not critical longitudinal strength members, they should be watched carefully to ensure that these cracks do not spread
- states that the area around the corners of a main cargo hatch can be subjected to high cyclical stress due to the combined effect of hull girder bending moments, transverse and torsional loading
- explains that discontinuous cargo hatch side coamings can be subjected to significant longitudinal bending stress
- explains that this introduces additional stresses at the mid-length of hatches and stress concentrations at the termination of the side coaming extensions
- explains that hatch cover operations, in combination with poor maintenance, can result in damage to cleats and gasket, leading to the loss of weathertight integrity of the hold spaces
- states that damage to hatch covers can also be sustained by mishandling and overloading of deck cargoes
- states that the marine environment, the humid atmosphere due to the water vapour from the cargo in cargo holds, and the high temperature on deck and hatch cover plating due to heating from the sun may result in accelerated corrosion of plating and stiffeners making the structure more vulnerable to the exposures described above
- states that when carrying out visual inspection, special attention should be paid to areas where pipes, e.g. fire main pipes, hydraulic pipes and pipes for compressed air, are fitted close to the plating, making proper maintenance of the protective coating difficult to carry out
- states that cracking may be initiated at defects in welded joints and metal fittings to the coamings that will invite stress concentration
- states that such cracking is considered serious to the ship's safety because it may be the initiation of a fracture on a large scale
- states that on typical bulk carriers, the topside and bilge hopper tanks compose a double hull surrounding the cargo space, which together with the double bottom provides hull strength and rigidity
- states that if corrosion and waste become excessive,

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failure of hold frames invites additional loads to the adjacent ones, which may lead to failure throughout the side shell structure

- explains that the transverse bulkheads may also be susceptible to accelerated corrosion, particularly at the midheight and at the bottom
- states that particular care should be exercised when inspecting hold frames
- states that the transverse bulkheads, in that these members may appear in deceptively good condition
- states that the tanktop and side shell plating generally corrodes from the steel surface facing the cargo hold and corrosion from inside the double bottom is usually less than that from the cargo hold side
- states that cargo hold frames should also be carefully inspected for mechanical damage, corrosion and waste, because many cargoes will damage hold frames through direct contact
- states that this damage will invite corrosion from seawater brought on board in loading operations
- states that the most important aspects of cargo hold inspections are the condition of side shell structures and their reinforcements
- states that special attention should be paid to the condition of hold frames and their connection to the shell plating
- outlines and describes the common damage/defects that may occur on watertight transverse bulkheads situated at the ends of dry cargo holds of a bulk carrier
- states that cracks may often be found at or near the connection of the stool of the transverse bulkhead and the tanktop in bulk carriers having combination cargo/ballast holds
- states that wastage/corrosion may affect the integrity of steel hatch covers and the associated moving parts, e.g. cleats, pot-lifts, roller wheels, etc
- explains that deformation/twisting of exposed structure above deck, such as side-coaming brackets and bulwarks, may result from impact due to improper handling of cargo and cargo handling machinery
- explains that such damages may also be caused by shipping of green sea water on deck in heavy weather
- outlines and describes other fractures that may occur in the deck plating at hatches and in connected coamings
- outlines and describes the damages caused by cargoes in

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cargo holds, especially to tanktop plating and side
- at loading and unloading ports for coal or iron ore, large grab buckets, high-capacity cargo
- loaders, bulldozers and pneumatic hammers may be employed for cargo-handling operations
- large grab buckets may cause considerable damage to tank top plating when being dropped to grab cargo
- use of bulldozers and pneumatic hammers may also be harmful to cargo hold structures and may result in damage to tank tops, bilge hoppers, hold frames and end brackets
- lumber cargoes may also cause damage to the cargo hold structures of smaller bulkers that are employed in the carriage of light bulk cargoes and lumbers

– states that side stringers and/or side shells in way of No. 1 cargo hold along the collision bulkhead are often found cracked
– explains that this kind of damage is considered to be caused by insufficient continuity between forepeak construction and cargo hold structure
– explains that on large bulk carriers such as capesize and panamax bulkers, bilge hopper plating around the knuckle line may be cracked along the bilge hopper transverse webs
– states that this is considered to be caused by insufficient local reinforcement
– states that though the water ballast tanks of newer bulk carriers are well protected against corrosion, the upper portion is susceptible to corrosion because the protective coating will easily deteriorate due to heat from the upper deck and the cyclic wet/dry effect of seawater
– states that cracks may be found at the intersections of longitudinals and transverse members
– states that cracks may be found in the side, bottom and/or tanktop longitudinals at intersections with solid floors or bilge hopper transverses
– states that cracks also may be found in the floors or transverses occurring at the corners of the slots cut for longitudinal
– states that longitudinals may be cracked at the ends of additional (partial) side girders provided in the double bottom below cargo hold bulk heads or at the side walls of bilge wells for cargo holds, due to additional stress concentration caused by the structural discontinuity at those connections

COMPETENCE 2.2	Assess Reported Defects and Damage to Cargo Spaces, Hatch Covers and Ballast Tanks and take appropriate action	IMO Reference

- states that cracks may be observed in transverse webs in bilge hoppers initiating from the slot openings for longitudinals and at the knuckled corners of the lower ends of the hoppers
- states that corrosion accelerated by heat have been observed in double-bottom water ballast tanks adjacent to fuel oil tanks
- states that in recent years, the grade of bunker oil being used requires the temperature in the tank to be 80°C or more and such a temperature can accelerate corrosion of the steel in the tanks, particularly in the vicinity of the boundaries of the fuel oil tanks
- states that bottom plates are often eroded under the suction bellmouths in tank
- states that a sounding pipe has a pad plate at its bottom end for protection of the tank bottom against the strike of the sounding scale's lead and extent of diminution of the protection plate should be examined during inspections
- states that connection trunks provided between topside and bilge hopper spaces are to be carefully watched for signs of corrosion and waste of the steelworks inside
- explains that on some bulk carriers, bilge hopper tanks and topside tanks form one integral tank connected with trunk spaces
- states that the inside surface of a connection trunk is liable to corrosion and should be examined carefully

INTERPRET GIVEN FIGURES FOR BENDING MOMENTS AND SHEAR FORCES

- states that the bulk carriers are assigned 2 sets of permissible still water shear forces (SWSF) and still water bending moment (SWBM) limit to each ships, namely;
  - seagoing (at sea) SWSF and SWBM limits
  - harbour (in port) SWSF and SWBM limits
- states that the seagoing SWSF and SWBM limits should not be exceeded when the ship is put to sea or during any part of a seagoing voyage
- explains that in harbour, where the ship is in sheltered water and is subjected to reduced dynamic loads, the hull girder is permitted to carry a higher level of stress imposed by the static loads
- states that the harbour SWSF and SWBM limits should not be exceeded during any stage of harbour cargo operations

COMPETENCE 2.2	Assess Reported Defects and Damage to Cargo Spaces, Hatch Covers and Ballast Tanks and take appropriate action	IMO Reference

- explains that when a ship is floating in still water, the ship's lightweight (the weight of the ship's structure and its machinery) and deadweight (all other weights, such as the weight of the bunkers, ballast, provisions and cargo) are supported by the global buoyancy up thrust acting on the exterior of the hull
- explains that along the ship's length there will be local differences in the vertical forces of buoyancy and the ship's weight and these unbalanced net vertical forces acting along the length of the ship causes the hull girder to shear and to bend, inducing a vertical still water shear force (SWSF) and still water bending moment (SWBM) at each section of the hull
- explains that at sea, the ship is subjected to cyclical shearing and bending actions induced by continuously changing wave pressures acting on the hull
- explains that these cyclical shearing and bending actions give rise to an additional component of dynamic, wave induced, shear force and bending moment in the hull girder
- explains that at any one time, the hull girder is subjected to a combination of still water and wave induced shear forces and bending moments
- explains that the stresses in the hull section caused by these shearing forces and bending moments are carried by continuous longitudinal structural members
- explains that these structural members are the strength deck, side shell and bottom shell plating and longitudinals, inner bottom plating and longitudinals, double bottom girders and topside and hopper tank sloping plating and longitudinals, which are generally defined as the hull girder
- states that over-loading will induce greater stresses in the double bottom, transverse bulkheads, hatch coamings, hatch corners, main frames and associated brackets of individual cargo holds, and it can be observed as;
  - increased stress at hatch corners and coamings
  - increased stress in main frames and brackets
  - increased stress in double bottom structure
  - increased stress in transverse bulkhead
  - increased stress in cross deck strip
  - greater distortion of topside tank
- states that exceeding the permissible limits specified in the ship's approved loading manual will lead to over-stressing of the ship's structure and may result in

COMPETENCE 2.2	Assess Reported Defects and Damage to Cargo Spaces, Hatch Covers and Ballast Tanks and take appropriate action	IMO Reference

catastrophic failure of the hull structure
- states that when deviating from the cargo load conditions contained in the ship's approved loading manual, it is necessary to ensure that both the global and local structural limits are not exceeded
- explains that all officers should be aware over-stressing of local structural members can occur even when the hull girder still water shear forces (SWSF)and bending moments (SWBM) are within their permissible limits
- analyses and interprets the causes and effects of shearing forces and bending moments on ship's structures
- demonstrate the knowledge gained on the fore mentioned topics by interpreting given figures for bending moments and shear forces

2.2 METHODS TO AVOID THE DETRIMENTAL EFFECTS ON BULK CARRIERS OF CORROSION, FATIGUE AND INADEQUATE CARGO HANDLING (3 hours)

- states that deterioration of structure through corrosion, fatigue and damage is identified as a principal factor in the loss of many bulk carriers
- states that failing to identify such deterioration may lead to sudden and unexpected failure
- states that it is critical to inspect the cargo holds, ballast tanks and vital constructional parts of the bulk carriers, after every operation to ensure, rapid action can be taken if the inspection reveals any cracks, fracture or other damages
- states that Internal degradation through corrosion may be accelerated through chemical action from certain cargoes
- states that certain cargoes, including coal, phosphates and sulphur, transported by bulk carriers can rapidly corrode the hold side frames and promote fractures
- states that the scouring effect of abrasive cargoes may cause hold coatings to deteriorate rapidly
- explains that corrosive effects of some cargoes like coal which produces acidic conditions, accelerates the rate of deterioration of internal structures in cargo holds, welds in particular, may be subject to "grooving" corrosion, in which the material forming the weld corrodes at a faster rate than the plating to which it is attached, hence regular monitoring of bilge water, is vital and if there is evidence of accumulation of this acidic water, contained in the cargo holds, the hold bilges should be pumped out, in

COMPETENCE 2.2	Assess Reported Defects and Damage to Cargo Spaces, Hatch Covers and Ballast Tanks and take appropriate action	IMO Reference

accordance with MARPOL 73/78, Annex V, maintaining a proper record

- states as per researches, for a capesize bulk carrier carrying coal and iron ore it has been recorded that a hull web frame, with an original thickness of 10 mm can corrode to only 3 to 5 mm along the bottom portion of the hold in a short period
- explains that since bulk carriers tend to have low freeboard the uppermost continuous deck and other fittings including hatch covers are prone to exposure to green seas, which may again cause accelerated corrosion, and in some cases even structural damages which may again lead to catastrophic result, if not detected early and appropriate action taken
- states that since improper cleaning during hold cleaning leads to accelerated corrosion all crew should be well trained for hold cleaning, and proper checks to be made after the holds have been cleaned, to ensure no remnants of previous cargo is left behind
- states that in ballast holds, sloshing forces due to partially filled spaces, during ballast exchange at sea may result in damage to the structure and this damage may go unnoticed if it is in inaccessible positions, this has to be prone in mind while carrying out inspections
- states that coatings are the first barriers to protect metal surfaces against corrosion
- states that ballast exchange, especially for cargo hold, can also cause accelerated corrosion, if the hold has any exposed, unprotected steel surface
- states that intact coatings prevent corrosion of the steel surface, however a local absence of coating (due to coating depletion, deterioration, damage, etc) can result in corrosion rates similar or greater than those of unprotected steel
- states that periodic inspections at appropriate intervals and repair of coating as required are effective in minimizing corrosion damage
- states that to ensure that such exposures are not neglected, all officers should be well trained in identifying and reporting to the chief officer or the Master
- states that care should be taken, to tend any unprotected surfaces in cargo holds caused due to any reasons, after carefully examining the structure for any signs of fatigue or fracture
- states that hold cleaning, ballasting at sea and ballast

COMPETENCE 2.2	Assess Reported Defects and Damage to Cargo Spaces, Hatch Covers and Ballast Tanks and take appropriate action	IMO Reference

exchange carried out at sea are vulnerable aspects of a bulk carrier operation, and thus to avoid any kind of undue stress, proper, careful procedures, specified, in loading manual, ballast water management plan, among others should be followed

- states that in single side-skin bulk carriers, bulkheads, trunks and ballast tank boundaries, can present "hard spots" that concentrate forces where the change in construction occurs (e.g. longitudinal to transverse framing)
- states that this may lead to undetected fractures, hence careful examination at periodic intervals is necessary
- states that damage to bow plating is possible through impacts associated with swinging or loosely stowed anchors may cause an initiating fracture or fatigue in bow shell plating that could lead to failure and subsequent flooding
- states that internal integrity of forward spaces (that are usually used for ballast and/or stores) is therefore of vital importance
- states that to prevent this from happening, the anchor must be fully hauled-in, stowed and retained in position by the lashing arrangement provided, ensuring there is three-point contact of anchor with the ship side at all given times
- states that corrosion degradation will seriously reduce the ability of plating and stiffening to withstand the forces to which it will be subjected
- states that any external forces - horizontal and/or vertical - may cause hatch cover dislodgement
- states that the cargo hatchway, if it loses its protection in this way, is a major access for water ingress and a serious threat to the integrity of the hull
- states that to ensure such thing does not happen, the hatch covers must be stowed, secured, battened down at all given times
- states that metal fatigue is the progressive failure of metal under cyclic loading and as the name “fatigue” implies, it is a mode of degradation in which the steel is worked until it simply gets tired
- states that bulk carriers are susceptible to many modes of cyclic forces that combine with other forces acting upon the vessel’s structure and over time these cyclic stresses, can seriously weaken the vessel’s structural capacity
- states that fatigue failure may result due to loss of cross-sectional area in the plating joints

COMPETENCE 2.2	Assess Reported Defects and Damage to Cargo Spaces, Hatch Covers and Ballast Tanks and take appropriate action	IMO Reference

- states the areas that are prone to fatigue cracks in the cargo holds, which have to be carefully examined during routine, periodic, scheduled inspections, are;
  - corrugated bulkhead
  - shedder plate
  - inner bottom longitudinal (tank top)
  - side frames
  - side longitudinals
  - hopper tank
  - lower stool
  - toes of the hatch coaming termination brackets
- states that carriage of high density cargoes can cause buckling, structural deformities over a period of years, which can result in acceleration of corrosion and fatigue
- states that many terminals have the practice of dislodging cargo from side shell, frames, hoppers using mechanical grabs, bulldozers, hydraulic hammers, and other machineries
- states that these machineries produce local damage and loading that can weaken the ship's structure
- states that precaution must be taken to ensure the terminals are instructed not to use any machinery which may cause damage, clearly, during the formal filling and agreeing as per the ship/shore checklist, contained in the BLU code, and duty officer's to be instructed to stop any such activities that may endanger the ship's structure, also bringing it to the notice of Master
- states that buckling of plating caused due to high density cargoes, found generally on cargo hold tanktops, can lead to fractures or accelerated corrosion, if not inspected thoroughly
- states that damage to side shell caused externally through contact with docksides or tugs and, internally from impact by cargo dislodging equipment during discharge, can result in initiating fractures and/or fatigue of the structure
- states that careful examination is of prime importance after any such incidents, to assess the extent of damage and action required.

COMPETENCE 2.3 Carriage of Dangerous Cargoes	IMO Reference
TRAINING OUTCOMES: Demonstrates a knowledge and understanding of 2.3.1 INTERNATIONAL REGULATIONS, STANDARDS, CODES INCLUDING THE INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG) CODE AND THE INTERNATIONAL MARITIME SOLID BULK CARGOES (IMSBC) CODE AND RECOMMENDATIONS ON CARRIAGE OF DANGEROUS CARGOES 2.3.2 CARRIAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES; PRECAUTIONS DURING LOADING AND UNLOADING AND CARE DURING THE VOYAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES	STCW Code Table A-II/2

COMPETENCE 2.3 Carriage of Dangerous Cargoes	IMO Reference

2.3.1 INTERNATIONAL REGULATIONS, STANDARDS, CODES INCLUDING THE INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG) CODE AND THE INTERNATIONAL MARITIME SOLID BULK CARGOES (IMSBC) CODE AND RECOMMENDATIONS ON CARRIAGE OF DANGEROUS CARGOES — R54, R55, R56

Textbooks / Bibliography: B21, B71, B89, B104, B113, B128, B146, B182

Teaching Aids: A1

Required performance:

1.1 International Regulations and Codes (2 hours)

- understands the content and applies the of International Regulations Standards, Codes and Recommendations on the carriage of dangerous cargoes, including the International Maritime Dangerous Goods (IMDG) Code and the International Maritime Solid Bulk Cargoes (IMSBC) Code, which replaces the Code of Safe Practice for Solid Bulk Cargoes (BC Code), which aims primarily to facilitate the safe stowage and shipment of solid bulk cargoes by providing information on the dangers associated with the shipment of certain types of solid bulk cargoes and instructions on the procedures to be adopted when the shipment of solid bulk cargoes is contemplated plans loading, stowage and segregation in accordance with the IMDG Code
- plans loading and stowage in accordance with the IBC Code

2.3.2 CARRIAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES; PRECAUTIONS DURING LOADING AND UNLOADING AND CARE DURING THE VOYAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES — R54, R55

Textbooks / Bibliography: T15, B21,B71, B89, B104, B113, B128, B146, B182

Teaching Aids: A1, V136, V154, V170, V173

Required performance:

2.1 Dangerous Goods in Packages (10 hours)

COMPETENCE 2.3 Carriage of Dangerous Cargoes **IMO Reference**

- describes the requirements of SOLAS chapter VII on the carriage of dangerous goods
- explains that the IMDG Code should be followed to ensure compliance with the requirements of SOLAS for the carriage of dangerous goods in packaged form
- explains that the Code ensures safety mainly by stipulating the packaging required and the segregation from other cargoes with which there could be an adverse reaction
- states that the IMDG Code is an evolving document and is updated every two years to take account of:
  - new dangerous goods which have to be included
  - new technology and methods of working with or handling dangerous goods
  - safety concerns which arise as a result of experience
- states that the Code comprises 7 parts, which is presented in two books; Volume 1 and Volume 2
- states that it is necessary to use both books to obtain the required information when shipping dangerous goods by sea
- states that the Code also contains a supplement
- lists the contents of Volume 1 (Parts 1-2 & 4-7 of the Code) which comprises:
  - part 1general provisions, definitions and training
  - part 2classifications
  - part 4packing and tank provisions
  - part 5consignment procedures
  - part 6construction and testing of packagings, intermediate bulk containers (IBCs), large packagings, portable tanks, multi-element gas containers (MEGCS) and road tank vehicles
  - part 7requirements concerning transport operations
- lists the contents of Volume 2 (Part 3 and the Appendices of the Code) which comprises:
  - part 3 dangerous goods list (DGL) and limited quantities exceptions
  - appendix a list of generic and n.o.s. (not otherwise specified) proper shipping names
  - appendix b glossary of terms
  - alphabetical index
- states that the dangerous goods list (DGL) is the central core of the IMDG Code and presents information on transport requirements in a coded form
- states that the supplement contains the following texts related to the Code:
  - emergency response procedures for ships carrying dangerous goods

COMPETENCE 2.3 Carriage of Dangerous Cargoes **IMO Reference**

  - medical first aid guide
  - reporting procedures
  - IMO/ILO/ECE guidelines for packing cargo transport units
  - safe use of pesticides in ships
  - international code for the carriage of packaged irradiated nuclear fuel, plutonium and high-level radioactive wastes on board ships
- states that the purpose of the IMDG Code's classification system is:
  - to distinguish between goods which are considered to be dangerous for transport and those which are not
  - to identify the dangers which are presented by dangerous goods in transport
  - to ensure that the correct measure are taken to enable these goods to be transported safely without risk to persons or property (both within the port and on the ship)
- states that dangerous goods are classified into 9 classes according to properties
- states that the way in which different classes of dangerous goods are handled in transport will depend upon these properties and hazards, for example:
  - the type of packaging that can be used
  - what classes of dangerous goods can be transported together in freight containers
  - where the goods can be stored within the port and on the ship
- lists the 9 classes of dangerous goods in the IMDG code, which are:
  - class 1 explosives
  - class 2 gases
  - class 3 flammable liquids
  - class 4 flammable solids
  - class 5 oxidizing substances and organic peroxides
  - class 6 toxic and infectious substances
  - class 7 radioactive material
  - class 8 corrosive substances
  - class 9 miscellaneous dangerous substances and articles
- states that the 9 hazard classes have been established internationally by a United Nations (UN) committee to ensure that all modes of transport (road, rail, air and sea) classify dangerous goods in the same way
- states why damaged or leaking packages should not be accepted until they have been checked and repaired and

COMPETENCE 2.3 Carriage of Dangerous Cargoes **IMO Reference**

declared to be in satisfactory condition for carriage

– describes the contents of the shipper's declaration of dangerous goods
– states that by testing the dangerous goods according to UN test procedures, a shipper is able to classify dangerous goods according to the 9 hazard classes
– explains that the hazard presented by each class is identified by an internationally accepted hazard warning label (diamond)
– states that this hazard warning label appears on the outer packaging of the dangerous goods when they are being transported as a warning to all those working within the transport chain or coming into contact with them
– states that these hazard warning labels are pictured inside the front cover of Volume 1 of the IMDG Code
– states that the dangerous goods, within each of the 9 hazard classes, are uniquely identified by two pieces of information:
  - a four-digit number known as the UN number which is preceded by the letters UN
  - the corresponding proper shipping name (PSN)
  - for example, kerosene is identified in the IMDG Code by its UN number UN 1223 and the PSN Kerosene
– states that together the UN Number and PSN uniquely identifies dangerous goods to:
  - enable rapid and precise identification during transport to
  - ensure the correct handling, stowage, segregation etc, and
  - in the event of an emergency, ensure that the correct procedures are followed
– explains that the purpose of using a four-digit number to identify dangerous goods is to enhance safety by:
  - overcoming language barriers- the four-digit number is easily understood in all languages
  - avoiding confusing similar names- e.g. TITANIUM POWDER, WETTED UN 1352 which is a flammable solid in class 4.1 and has very different transport requirements to TITANIUM POWDER, DRY UN 2546 which is spontaneously combustible in class 4.2
– states the PSN must be used for transport purposes on documentation/labelling etc
– states that no alternatives or variations are permitted unless specifically stated
– states that the PSN is that part of the name which appears in the Dangerous Goods List or the Alphabetical Index in capital letters only

COMPETENCE 2.3 Carriage of Dangerous Cargoes	IMO Reference

- states that any text in lower case is only descriptive and is not part of the PSN
- states that the Dangerous goods list (DGL) is presented across 2 pages of the IMDG Code and is divided into 18 columns for each individual dangerous good listed
- states that much of the information contained in the DGL is coded to make it easier to present in a table
- states that the DGL is arranged in UN Number order; column 1 and column 18 contains the UN Number
- states that to look up an entry only the UN Number is required
- states that dangerous goods can also be searched using the PSN
- explains that if the UN Number is not given but the dangerous good has the PSN, its associated UN Number can be located by looking at the alphabetical index at the back of Volume 2 of the IMDG code explains that the IMDG Code contains clearly defined recommendations for the training of all staff who handle or process dangerous goods shipments for transportation by sea. The full training requirements can be found in the IMDG Code Volume 1, Chapter 1.3 states that a packing certificate is also required, certifying that a container or vehicle has been properly packed and secured, if loaded with dangerous goods
- identifies the marking and labelling required on packages or cargo units
- states why additional labelling may be necessary to meet the requirements for through transport
- describes the information given for individual substances
- states that an index of dangerous goods is included in Volume I of the IMDG Code
- explains how to obtain the references to the relevant Emergency Schedule (EmS) and the entry in the Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG)
- describes the information given for individual substances
- states the requirement for a dangerous goods manifest or stowage plan and describes how they should be prepared
- lists the explosives which may be carried on a passenger ship
- lists, by headings, the information given in an emergency schedule
- given a loading list of dangerous goods, uses the IMDG code to plan a stow and segregation and extracts the relevant references to EmS and MFAG

COMPETENCE 2.3 Carriage of Dangerous Cargoes **IMO Reference**

- defines 'dangerous substances', 'port authority', 'regulatory authority', 'designated port office' and 'responsible person' as used in the Recommendations on the Safe Transport, Handling and Storage of Dangerous Substances in Port Areas
- explains that a port authority may be empowered to refuse dangerous substances if it is considered that their presence would endanger life or property because of:
  - their condition
  - the condition of their containment
  - the condition of their mode of conveyance
  - conditions in the port area
- states that, if any dangerous substance constitutes an unacceptable hazard, the port authority should be able to order the removal of such substance or any ship, package, container, portable tank or vehicle containing it
- states that a port authority will normally require notification at least 24 hours in advance of the transport or handling of dangerous substances, including those which are not for discharge at that port
- describes the inspections which may be made by a port authority
- states that the designated port officer should be empowered to:
  - direct when and where a ship having any dangerous substances on board may anchor, moor or berth
  - direct a ship to be moved within or to leave the port area
  - attach conditions appropriate to local circumstances and the quantity and nature of the dangerous substances
- states that the regulatory authority may require signals to be shown while transporting or handling dangerous substances
- describes the signals as:
  - by day, flag 'B' of the International Code of Signals
  - by night, an all-round fixed red light
- explains how effective communications with the port authority can be maintained
- describes the requirements regarding mooring a ship carrying dangerous substances
- states that at all times there should be sufficient crew on board to maintain a proper watch and operate appliances in the case of an emergency, taking into account the nature and quantity of dangerous substances on board
- states that a responsible person should be designated to supervise the handling of dangerous goods

COMPETENCE 2.3 Carriage of Dangerous Cargoes	IMO Reference

– lists the measures which should be taken by the responsible person in connection with:
  - the weather
  - lighting
  - protective clothing and equipment
  - intoxicated persons
  - fire and other emergency procedures
  - reporting of incidents and safety precautions
– states that the port authority should be informed of the intention to carry out repair work when dangerous substances are on board
– explains the handling precautions which should be observed regarding:
  - avoidance of damage to packages
  - access to handling areas
  - lifting goods over dangerous goods stowed on deck
  - escape of a dangerous substance from a package entry into enclosed spaces
– describes the special precautions for loading or unloading explosives

2.3 Solid Bulk Cargoes (9 hours) R56

– outlines the contents of the I International Maritime Solid Bulk Cargoes (IMSBC Code)
– states that the main hazards associated with the shipment of bulk solids are:
  - structural damage due to improper distribution of the cargo
  - loss or reduction of stability during a voyage
  - chemical reactions
– explains how to distribute a high-density cargo between holds when detailed information is not available
– states that the loading calculator should be used to check the suitability of a proposed stow for stresses and stability
– states that the data in the ship's stability information book should be used where appropriate
– describes how to prevent shifting of bulk cargo loaded in a tween-deck space to reduce an excessively high GM
– describes precautions to take before, during and after loading of bulk cargo
– describes the precautions to take to minimize the effect of dust on deck machinery, navigational aids and living quarters
– describes the health hazards which may be associated with bulk materials
– states that safety precautions and any appropriate

COMPETENCE 2.3 Carriage of Dangerous Cargoes	IMO Reference

national regulations should be complied with during the handling and carriage of bulk materials
- states that a copy of the Medical First Aid Guide for Use in Accidents Involving Dangerous Goods should be on board
- lists the information which should be supplied by the shipper to the master before loading
- states that a certificate stating the relevant characteristics of the material should be provided to the master at the loading point
- explains that certificates stating transportable moisture limits should be accompanied by a statement that the moisture content is the average moisture content at the time of presenting the certificate
- describes how to trim cargoes having an angle of repose:
  - less than or equal to 35 degrees
  - greater than 35 degrees
- describes how to stow material which flows freely like grain
- states that the IMSBC code contains a method for determining angle of repose on board ship
- describes the types of cargo which may liquefy during carriage
- states that cargoes which may liquefy should not be carried with a moisture content above that of the transportable moisture limit
- explains that such cargoes may look relatively dry when loaded but liquefy as a result of compaction and vibration during the passage
- states that such cargoes should be trimmed reasonably level, regardless of the angle of repose stated
- explains the precautions to be taken to keep liquids out of holds where such cargoes are carried and the danger of using water to cool a shipment of these materials
- states that specially fined or constructed cargo ships may carry materials with a moisture content above the transportable moisture limit if approved by their Administrations
- describes the test for approximately determining the possibility of flow which may be carried out on board ship
- states that some materials transported in bulk present hazards because of their chemical properties
- explains that some materials are classified as dangerous goods in the IMDG code while others are Materials Hazardous only in Bulk' (MHB)
- states that the IMSBC Code categorises cargoes into three groups - A, B and C:

COMPETENCE 2.3 Carriage of Dangerous Cargoes	IMO Reference

   - Group A consist of the cargoes which may liquefy if shipped with moisture content in excess of their transportable moisture limit.
   - Group B consists of cargoes which possess a chemical hazard which could give rise to a dangerous situation on a ship.
   - Group C consists of cargoes which are not liable to liquefy (Group A) and do not possess chemical hazards (Group B)
- explains that in the added supplement of the IMSBC code, the IMO documents contained are:
   - The BLU code
   - The BLU manaual
   - MSC/Circ. 908 - Uniform Method of Measurement of the Density of Bulk Cargoes
   - MSC/Circ. 1146 - Lists of Solid Bulk Cargoes for which a Fixed Gas Fire-extinguishing System may be Exempted or for which a Fixed Gas Fire-extinguishing System is Ineffective
   - Res. A. 864(20) - Recommendations for Entering Enclosed Spaces Aboard Ships
   - MSC.1/Circ.1264 - Recommendations on the Safe Use of Pesticides in Ships Applicable to the Fumigation of Cargo Holds
   - BC.1/Circ.66 - Contact Names and Addresses of the Offices of Designated National Competent Authorities Responsible for the Safe Carriage of Grain and Solid Bulk Cargoes
- explains the list of materials possessing chemical hazards is not exhaustive, that the properties listed are for guidance only and that it is essential to obtain currently valid information about bulk materials before loading
- explains the use of the tables for segregation between incompatible bulk materials and between bulk materials and dangerous goods in packaged form
- states that the IMDG code should also be consulted for additional requirements regarding the stowage and segregation of packaged dangerous goods
- states that particular care should be taken with the segregation of toxic substances and foodstuffs
- uses the IMSBC code to extract all necessary information for the safe carriage in bulk of a stated cargo, describes how it should be loaded and lists any special precautions or requirements to be observed during loading, carriage and discharge

COMPETENCE 2.3 Carriage of Dangerous Cargoes **IMO Reference**

2.3 International Code for the Safe Carriage of Grain in Bulk (International Grain Code) (7 hours)

- explains that the International Code for the Safe Carriage of Grain in Bulk (International Grain Code) are based on the recognition that in a compartment nominally filled with grain there exists a void space between the surface of the grain and the deckhead of the loaded equipment
- explains that the code assume a pail em of movement of grain in the void spaces above the grain surfaces which gives rise to adverse heeling effects
- explains that the code require demonstration, by calculation, that at all times during a voyage the ship will have sufficient intact stability to provide adequate dynamic stability after taking into account the adverse heeling moments
- states that the code stipulate the minimum level of acceptable stability for the carriage of grain in terms of initial meta centric height, angle of heel due to assumed grain shift and residual dynamic stability
- states that the international Grain code apply to all ships to which the SOLAS regulations apply and to cargo ships of less than 500 gross tons
- defines the following terms as used in chapter VI of SOLAS:
  - grain
  - filled compartment
  - partly filled compartment
  - angle of flooding
- explains the importance of trimming to fill all of the spaces under decks and hatch covers to the maximum extent possible
- states the intact stability requirements for a ship carrying bulk grain
- states that the ability to comply with the stability criteria may have to be demonstrated before loading
- states that the master should ensure that the ship is upright before proceeding to sea
- describes the use and fitting of longitudinal divisions in both filled and partly filled compartments
- states that the scantlings for uprights and shifting boards are contained in Part C of the International grain code
- describes the construction of a saucer as an alternative to a longitudinal division in a hatchway
- describes the use of bagged grain or other suitable cargo

COMPETENCE 2.3 Carriage of Dangerous Cargoes	IMO Reference

stowed in the wings and ends of a compartment to reduce the heeling effects of a grain shift

- describes methods of securing the free grain surface in partly filled compartments
- states that the hatch covers of filled compartments which have no cargo stowed over them should be secured as laid down in the document of authorization
- explains that all ships loaded with bulk grain should have a document of authorization issued by or on behalf of their Administration
- states that the document of authorization refers to the ship's grain loading stability booklet and associated plans
- explains that the grain loading stability booklet and associated plans contain all of the information necessary to check that a proposed loading plan complies with the stability requirements of the Regulations at all stages of the voyage
- states that the plans show the arrangements and scantlings of temporary fittings to meet the requirements of the Regulations
- states that in some countries a certificate of loading, certifying that the cargo has been loaded in compliance with the Regulations, is required before sailing
- explains the conditions which must be met before a ship without a document of authorization may load grain
- given a ship's data and details of consumption of fuel and of fresh water for an intended voyage, prepares a stowage plan for a cargo of bulk grain and performs the calculations to check that the proposed stowage complies, at all stages of the voyage, with the stability criteria set out in chapter VI of SOLAS 1974

Part D2: Instructor's Manual

Function 2: Cargo Handling and Stowage at the Management Level

Guidance Notes

The following notes are intended to highlight the main objectives or training outcomes of each part of the function. The notes also contain some material on topics which are not adequately covered in the quoted references.

On completion of training for this function, officers will be able to use cargo plans and tables or diagrams of stability and trim data to calculate the ship's initial stability, draughts and trim for any given description of cargo and other weights. They will also be able to determine whether stresses on the ship are within permitted limits by the use of stress data or calculation equipment, or software.

Officers will be able to plan and supervise the stowage of cargo, taking account of all relevant regulations and safety codes, They will also be able to make the necessary calculations to ensure adequate stability and to check that shear forces and bending moments are within permitted limits.

The safety precautions before entering enclosed or potentially contaminated spaces will be understood and applied.

Officers will be able to supervise the preparation and dunnaging of holds and the operation of ships' cargo gear and will be aware of the importance of adequately securing cargo to prevent damage to the ship of cargo. They will identify dangerous goods and use the IMDG Code (R54 and R55) to ensure such cargoes are stowed and separated correctly. They will know the hazards related to some bulk cargoes and the precautions to take during their loading, carriage and discharge. They will also have a basic knowledge of the piping and pumping arrangements of oil tankers.

Function 2: Cargo Handling and Stowage at the Management Level

2.1 Plan and Ensure Safe Loading, Stowage, Securing, Care During The Voyage And Unloading Of Cargoes

2.1.1 APPLICATION OF INTERNATIONAL REGULATIONS, CODES, AND STANDARDS CONCERNING THE SAFE HANDLING, STOWAGE, SECURING AND TRANSPORT OF CARGOES (6 hours)

Instructors should refer to the many IMO references concerning this topic and design exercises to let officers practice using information contained in the Code of Safe Practice for Cargo Stowage and Securing and in a typical cargo securing manual.

2.1.2 EFFECT ON TRIM AND STABILITY OF CARGOES AND CARGO OPERATIONS (20 hours)

The time allotted to cargo calculations is based on the assumption that trainees have covered the necessary theoretical work in ship stability and strength to enable them to make calculations based on ship's data.

When calculating draughts and trim, solutions are simplified, especially when using calculators or computers, by the consistent use of signs. The convention signs used are:

loading	+	discharging	-
by the head	+	by the stern	-
forward of	+	abaft	-
starboard	+	port	-
hogging	+	sagging	-

If a loading instrument is available, trainees should be given the opportunity to use it to familiarize themselves with the type of input required and the output provided by it. Manufacturers' illustrations and descriptions can be used in addition to or in place of the instrument if trainees do not have access to one.

2.1.3 STABILITY AND TRIM DIAGRAMS AND STRESS-CALCULATING EQUIPMENT (22 hours)

Shear force, bending moments and torsional moments (8 hours)

The load curve is given by the difference between the weight and buoyancy curves,, Conventions on the sign of the load and hence on which side of the axis to plot the value vary between authors.. The convention chosen is not important, but it is recommended that the chosen one is used consistently to avoid confusing trainees.

During the instruction the following properties of the curves should be pointed out to trainees:
- the total area under the weight curve equals the total area under the buoyancy curve;
- the area under the load curve above the axis equals the area below the axis;
- the maximum values of shear force occur where the load curve crosses the axis;
- the maximum values of bending moment occur where the shear-force curve crosses
- the axis; and
- the shear force and bending moment are zero at each end.

The classification society requirement for the carriage of a loading instrument for calculating shear forces and bending moments is commonly satisfied by the provision of a personal computer with approved programs on discs. In addition to calculating shear forces and bending moment, programs normally include the calculation of transverse stability, draught and trim. Other facilities to assist with cargo planning are also provided.

The program is arranged to perform a self-check on starting up, with a warning being given to the user it data corruption has occurred. A new copy of the master disc can be made and run to rectify that fault. If a printer is connected, a hard copy of results can be obtained.

Torsion

Torsional stresses tend to produce twisting of the ship's hull about the longitudinal centreline, All ships experience torsional stresses when subject to oblique sea waves. At a particular instant, the sea may be attempting to roll the forward end to starboard while the after end is trying to roll to port. The ship's structure is designed to withstand this wave-induced torsion.

For most ships, normal cargo operations do not induce torsional stresses but in container ships it is possible that an excess of weight to one side at one bay is balanced by an excess to the other side at another bay, thus setting up a torsional stress.

Because of their very large hatch openings, container ships are particularly liable to structural damage, such as cracking at hatch corners, resulting from torsional stress. The classification societies state maximum permissible cargo torsion values!! They also recommend that uneven transverse distributions of weights should be avoided and that excess torsion should be monitored for each load condition by means of calculation sheets and graphical representation. If the torsional moments exceed the permissible level, water ballast can be added at appropriate positions to reduce them.

An example of part of a calculation sheet is shown in Figure 1

The levers for each row are printed on the sheet, the weights are entered and the products are calculated. The resulting moment for each bay is found and recorded, with the correct sign.

An example of loading is shown in Figure 2 (below).

The accumulated moment for each group of bays is plotted on a graph, as Figure 3

Example of loading

	1	2	3	4
Twin Bays	Torsion moment	Accumulated moments	Torsion moment	Accumulated moments
01/03	+150	+150	+150	+150
05/07	−200	−50	−200	−50
09/11	−1000	−1050	−1000	−1050
13/15	−100	−1150	−100	−1150
17/19	+50	−1100	+50	−1100
21/23	−600	−1700	+850	−250
25/27	−200	−1900	−200	−450
29/31	−300	−2200	−300	−750
33/35	+800	−1400	+800	+50
37/39	−50	−1450	−50	0

Column 2 shows a total listing moment of 1450 metre-tonnes to starboard and an excessive torsional moment at bays 25 to 31.

Water ballast is added or the anti-heeling tanks are adjusted to reduce the listing moment to zero and at the same time to reduce the excessive torsional moment. In this case, a moment of 1450 metre-tonnes to port has been introduced at bays 21 /23.

Columns I and 2 are amended to take account of the ballast and are shown as columns 3 and 4. The graph is then re-drawn.

SHIP'S NAME: ______ VOYAGE: ______ PORT: ______

TORSION A

FOR CARGO LOADED IN THIS PORT – EXPORTS ONLY

BAY	ON DECK ROW	12	10	08	06	04	02	00	01	03	05	07	09	11	EXPORTS: Loaded This Port +P −S	EXPORTS: Loaded Prev. Port +P −S	EXPORTS: Total on Departure +P −S	ACCUM. +P −S
01	D			9.85 ×	7.39 ×	4.92 ×	2.46 ×		2.46 ×	4.92 ×	7.39 ×	9.85 ×						
	U.D.			9.71 ×	7.04 ×	4.01 ×	1.34 ×		1.34 ×	4.01 ×	7.04 ×	9.71 ×						
02	D			9.85 ×	7.39 ×	4.92 ×	2.46 ×		2.46 ×	4.92 ×	7.39 ×	9.85 ×						
03	D			9.85 ×	7.39 ×	4.92 ×	2.46 ×		2.46 ×	4.92 ×	7.39 ×	9.85 ×						
	U.D.			9.71 ×	7.04 ×	4.01 ×	1.34 ×		1.34 ×	4.01 ×	7.04 ×	9.71 ×						
														SUB TOTAL				
05	D		12.31 ×	9.85 ×	7.39 ×	4.92 ×	2.46 ×		2.46 ×	4.92 ×	7.39 ×	9.85 ×	12.31 ×					
	U.D.		12.38 ×	9.71 ×	7.04 ×	4.01 ×	1.34 ×		1.34 ×	4.01 ×	7.04 ×	9.71 ×	12.38 ×					
06	D		12.31 ×	9.85 ×	7.39 ×	4.92 ×	2.46 ×		2.46 ×	4.92 ×	7.39 ×	9.85 ×	12.31 ×					
07	D	14.77 ×	12.31 ×	9.85 ×	7.39 ×	4.92 ×	2.46 ×		2.46 ×	4.92 ×	7.39 ×	9.85 ×	12.31 ×	14.77 ×				
	U.D.		12.38 ×	9.71 ×	7.04 ×	4.01 ×	1.34 ×		1.34 ×	4.01 ×	7.04 ×	9.71 ×	12.38 ×					
														SUB TOTAL				
09	D	14.77 ×	12.31 ×	9.85 ×	7.39 ×	4.92 ×	2.46 ×		2.46 ×	4.92 ×	7.39 ×	9.85 ×	12.31 ×	14.77 ×				
10	D	14.77 ×	12.31 ×	9.85 ×	7.39 ×	4.92 ×	2.46 ×		2.46 ×	4.92 ×	7.39 ×	9.85 ×	12.31 ×	14.77 ×				
	U.D.		12.38 ×	9.71 ×	7.04 ×	4.01 ×	1.34 ×		1.34 ×	4.01 ×	7.04 ×	9.71 ×	12.38 ×					
11	D	14.77 ×	12.31 ×	9.85 ×	7.39 ×	4.92 ×	2.46 ×		2.46 ×	4.92 ×	7.39 ×	9.85 ×	12.31 ×	14.77 ×				
														SUB TOTAL				
13	D	14.77 ×	12.31 ×	9.85 ×	7.39 ×	4.92 ×	2.46 ×		2.46 ×	4.92 ×	7.39 ×	9.85 ×	12.31 ×	14.77 ×				
	U.D.		12.38 ×	9.71 ×	7.04 ×	4.01 ×	1.34 ×		1.34 ×	4.01 ×	7.04 ×	9.71 ×	12.38 ×					
14	D	14.77 ×	12.31 ×	9.85 ×	7.39 ×	4.92 ×	2.46 ×		2.46 ×	4.92 ×	7.39 ×	9.85 ×	12.31 ×	14.77 ×				
15	D	14.77 ×	12.31 ×	9.85 ×	7.39 ×	4.92 ×	2.46 ×		2.46 ×	4.92 ×	7.39 ×	9.85 ×	12.31 ×	14.77 ×				
	U.D.		12.38 ×	9.71 ×	7.04 ×	4.01 ×	1.34 ×		1.34 ×	4.01 ×	7.04 ×	9.71 ×	12.38 ×					
														SUB TOTAL				
17	D	14.77 ×	12.31 ×	9.85 ×	7.39 ×	4.92 ×	2.46 ×		2.46 ×	4.92 ×	7.39 ×	9.85 ×	12.31 ×	14.77 ×				
	U.D.		12.38 ×	9.71 ×	7.04 ×	4.01 ×	1.34 ×		1.34 ×	4.01 ×	7.04 ×	9.71 ×	12.38 ×					
18	D	14.77 ×	12.31 ×	9.85 ×	7.39 ×	4.92 ×	2.46 ×		2.46 ×	4.92 ×	7.39 ×	9.85 ×	12.31 ×	14.77 ×				
19	D	14.77 ×	12.31 ×	9.85 ×	7.39 ×	4.92 ×	2.46 ×		2.46 ×	4.92 ×	7.39 ×	9.85 ×	12.31 ×	14.77 ×				
	U.D.		12.38 ×	9.71 ×	7.04 ×	4.01 ×	1.34 ×		1.34 ×	4.01 ×	7.04 ×	9.71 ×	12.38 ×					
														SUB TOTAL				
BAY	U.D. ROW		10	08	06	04	02		01	03	05	07	09			TOTAL TO CARRY FWD TORSION		

Figure 1

Graph of cargo torque

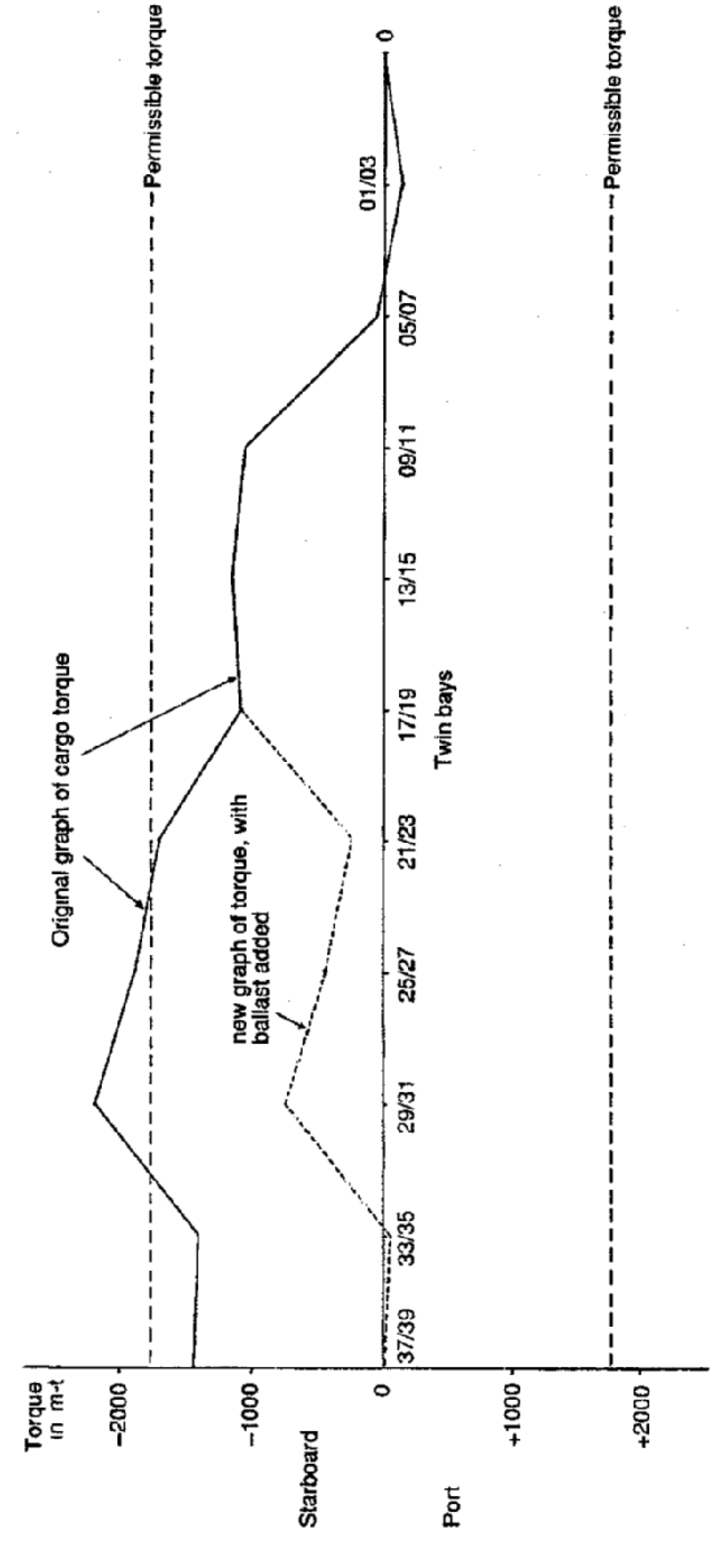

Figure 3

Knowledge of loading cargoes and ballasting in order to keep hull stress within acceptable limits (6 hours)

The importance of devising a cargo stowage plan and loading / unloading plan refering to the loading manual to ascertain an appropriate cargo load distribution, satisfying the imposed limits on structural loading should be pointed out to the trainees. The ship can undergo excessive stresses during loading/deballasting and unloading/ballasting operations and this needs to be emphasized by the instructor. Recent cases involving complete structural failure, during these operations can be discussed in the class, for better understanding, with the assistance of pictures and animations, wherever applicable.

2.1.4 STOWAGE AND SECURING OF CARGOES ON BOARD SHIP, CARGO-HANDLING GEAR AND SECURING AND LASHING EQUIPMENT (19 hours)

Timber deck cargoes (3 hours)

The Code of Safe Practice for Ships carrying Timber Deck Cargoes (R9) should be fully covered. The emergency actions of the master for dealing with incidents such as the partial loss of the deck load or problems with stability resulting from water absorption or ice accretion should be included.

Procedures for receiving and delivering cargo (3 hours)

Trainees should realize that bills of lading are negotiable documents and provide title to ownership of the goods described in them. A cargo may be bought and sold on the evidence of the bill of lading and it is therefore essential that it provides a true and accurate description of the goods. Any damage or evidence of poor condition should be noted on the mate's receipts from which the bills of lading will be drawn up. The acceptance of letters of indemnity in return for clean bills for goods which are not in apparent good condition could be construed as compounding a fraud. When bills of lading contain descriptions which cannot be verified by the ship's officers, e.g. the quality of wheat in a grain cargo, they should be qualified by the inclusion of "said to be….", "contents unknown, said to contain …" and similar expressions.

Where boat notes are signed as mate's receipts, care should be taken not to sign a duplicate note for the same consignment. That could lead to eventual claims for the complete loss of the consignment.

Containers are frequently shipped on through bills of lading which have been issued prior to their arrival at the ship. A check should be made that seals and locks are in place at shipment.

Trainees should be reminded that empty bags or other packages found during discharging should be landed and a receipt obtained for them to ensure that the freight earned on their carriage is obtained. Sweepings should be collected separately, put into bags and discharged as such, V74.

Care of cargo during carriage (4 hours)

The general principles of stowage and care of cargoes should be covered. The requirements for particular commodities can be found in reference books such as T31.

Measures taken for the care of cargo during the voyage, such as the use of ventilation systems or inspections of lashings, should be entered in the log-book. Entries should also be made if ventilation is suspended due to heavy weather or any other circumstances which may have an adverse effect on the cargo. The master will include such entries in the log extracts to support the noting of protest.

Requirements applicable to cargo-handling gear (4 hours)

Where a national register and certificates are applicable, trainees should be made familiar with the requirements of those and the details of tests and examinations which should be entered.

In some ports, the trades union representative of the dock labour force may insist on sighting the register and rigging plan before work commences. It is important that changes in items such as blocks and shackles attached to a derrick are noted on the rigging plan.

Maintenance of cargo gear (3 hours)

This section deals with the practical maintenance and inspection of cargo gear. Attention should be drawn to the requirement that no hew item of loose gear should be made of wrought iron. Any existing items of wrought iron are subject to the requirements for periodic heat treatment, unless exempted.

Maintenance of hatch covers (2 hours)

The water tightness of hatch covers is vital, both for the safety of the ship and for the protection of cargo from water damage. Before loading a bulk cargo that has a tendency to liquefy or which produces dangerous fumes in contact with water, the hatch covers should be hose-tested for water tightness, (V60).

In combination carriers, the proper sealing of hatches is essential to prevent the release of flammable vapour at deck level and for the maintenance of a small positive pressure by the inert gas system.

2.1.5 LOADING AND UNLOADING OPERATIONS, WITH SPECIAL REGARD TO THE TRANSPORT OF CARGOES IDENTIFIED IN THE CODE OF SAFE PRACTICE FOR CARGO STOWAGE AND SECURING (6 hours)

Loading, stowage and discharge of heavy weights (3 hours)

Heavy lifts require careful planning before loading. The position in which they are to be stowed must be prepared to accept the lift, possibly requiring the construction of special cradles to support the load. Adequate means of securing must be provided, which often necessitates the welding of additional eye-bolts to the deck. The stability of the ship must be sufficient to limit the list to a reasonable angle both when loading and discharging with the ship's gear. All heavy-lift operations should be supervised by a senior officer, (V69).

Methods and safeguards when fumigating holds (2 hours)

A thorough knowledge and understanding of the Recommendations on the Safe Use of Pesticides in Ships and its supplement is required.

2.1.6 GENERAL KNOWLEDGE OF TANKERS AND TANKER OPERATIONS (16 hours)

Terms and definitions (1 hour)

Instructors will find much of the material for the basis of lectures in T14.

Contents and application of the International Safety Guide for Oil Tankers and Terminals (ISGOTT) (2 hours)

This section is intended to provide a general introduction to tanker operations and the guidance available in the ISGOTT. The Instructor should point out that the 4 parts of ISGOTT, and brief explanation of each chapters should be discussed with the trainees.

Oil tanker operations and related pollution-prevention regulations (3 hours)

Trainees should be aware of the procedures for ballasting, tank cleaning and gas-freeing and how these are performed within the requirements of MARPOL A detailed treatment of the operations is not required, (V64, V78).

Chemical tankers (3 hours)

This section provides a general introduction to the construction and equipment of chemical tankers as set out in the IBC Code. Only a simple treatment of operations is intended since officers who will serve in such ships are required to undertake additional specialized training. Further information on cargoes and operations may be found in reference Textbook Ref. R82 and video V61, V62, V63

Tank cleaning and control of pollution in chemical tankers (2 hours)

The emphasis should be on how tank-cleaning and ballasting operations are carried out in compliance with Annex II of the MARPOL Convention and, in particular, on the use of the Procedures and Arrangements Manual to ensure compliance with the regulations.

Gas tankers (2 hours)

This section provides a general overview of the different types of gas tanker, their construction and their equipment as set out in the IGC Code. The treatment should take account of the fact that officers who will serve in gas tankers will undertake further specialized training, (V56, V129).

Cargo operations in gas tankers (2 hours)

The objective of this section is to provide a general insight into the sequence of cargo operations carried out aboard gas tankers without going into detail!, Further information will be found in references.

2.1.7 KNOWLEDGE OF THE OPERATIONAL AND DESIGN LIMITATIONS OF BULK CARRIERS (5 hours)

Operational and design limitations of Bulk carriers (3 hours)

Trainees should be able to identify the problems generally considered to be associated with bulk carriers, such as high density cargoes, leading to loss of buoyancy or structural failure, if holds are flooded in the loaded condition, high loading rate, leading to possible loss of control of load condition; with consequent high stresses, vulnerability to internal damage during cargo loading and discharging operations, leading to protective coating damage, accelerated corrosion, and local structural failure, low freeboard, leading to high green sea loads on deck structures, vulnerability to flooding of forward holds, rapid corrosion caused by corrosive cargo. Many points have been included in the detailed teaching, which the Instructors should point out to trainees.

SOLAS Chapter XII Additional Safety Measures for Bulk Carriers (1 hour)

Instructors should explain Chapter XII of the SOLAS convention which contains regulations of Additional Safety Measures for Bulk Carriers with the trainees including, but not limited to, restrictions in carriage of high density dry bulk cargoes, document of compliance, permanent marking on the side shell, damage stability requirements, loading instruments, hold, ballast and dry space water ingress alarms requirements, availability of pumping systems requirements and restrictions from sailing with any hold empty.

CSR Bulk (1 hour)

Instructors should point out the reasons, intention and benefit of the Common Structural rules for Bulk Carriers

2.1.8 LOADING, CARE AND UNLOADING OF BULK CARGOES (6 hours)

Application of all available shipboard data related to loading, care and unloading of bulk cargoes (5 hours)

Procedure for loading a bulk cargo should be explained in detail. The use of ship's approved loading manual, including its content should be discussed thoroughly with the trainees. The trainees knowledge in respect of planning, and loading/un-loading should be assessed from a loading computer.

Code of practice for the safe loading and unloading of bulk carriers (BLU code) (1 hour)

The contents of the BLU code should be discussed in detail with the trainees. Instructors should also point out the consequences of failure to apply BLU Code to the trainees.

2.1.9 SAFE CARGO HANDLING IN ACCORDANCE WITH THE PROVISIONS OF THE RELEVANT INSTRUMENTS (3 hours)

Establish Procedures for safe cargo handling in accordance with the provisions of the relevant instruments such as;

- **IMDG Code**
- **IMSBC Code**
- **MARPOL 73/78, Annexes III and V**

The safe cargo handling in accordance with these codes and conventions should be discussed with the trainees. The points are covered in the detailed teaching syllabus, which the instructors should useful.

2.1.10 EFFECTIVE COMMUNICATIONS AND IMPROVING WORKING RELATIONSHIP

Basic principles for establishing effective communications and improving working relationship between ship and terminal personnel

The information that needs to be exchanged with shore should be discussed in detail with the trainees.

2.2 Assess Reported Defects and Damage To Cargo Spaces, Hatch Covers and Ballast Tanks and Take Appropriate Action

2.2.1 LIMITATIONS ON STRENGTH OF THE VITAL CONSTRUCTIONAL PARTS OF A STANDARD BULK CARRIER AND INTERPRET GIVEN FIGURES FOR BENDING MOMENTS AND SHEAR FORCES

Instructors should make use of the points explained in the detailed teaching syllabus, and discuss them in detail with the trainees

METHODS TO AVOID THE DETRIMENTAL EFFECTS ON BULK CARRIERS OF CORROSION, FATIGUE AND INADEQUATE CARGO HANDLING

Instructors should make use of the points explained in the detailed teaching syllabus, and discuss them in detail with the trainees

2.3 Carriage of Dangerous Cargoes

2.3.1 INTERNATIONAL REGULATIONS, STANDARDS, CODES INCLUDING THE INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG) CODE AND THE INTERNATIONAL MARITIME SOLID BULK CARGOES (IMSBC) CODE AND RECOMMENDATIONS ON CARRIAGE OF DANGEROUS CARGOES

Instructors should refer to the IMO references concerning this topic and design exercises to let officers practice using information contained in the IMDG Code, the **International Maritime Solid Bulk Cargoes (**IMSBC**) Code**, which replaces the **Code of Safe Practice for Solid Bulk Cargoes (BC Code)**, which aims primarily to facilitate the safe stowage and shipment of solid bulk cargoes by providing information on the dangers associated with the shipment of certain types of solid bulk cargoes and instructions on the procedures to be adopted when the shipment of solid bulk cargoes is contemplated and the IBC Code.

2.3.2 CARRIAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES; PRECAUTIONS DURING LOADING AND UNLOADING AND CARE DURING THE VOYAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES.

Dangerous goods in packages

Trainees should be able to use the IMDG Code to find the information, stowage requirements and precautions to take for a given substance. They should also find the correct emergency schedule and the relevant entry in the MFAG for that substance. Given several substances, they should be able to determine the required segregation between them, including applications to containers and RO-RO units.

It should be pointed out to trainees that safety in the handling and carriage of dangerous goods is primarily ensured by the specification of stringent packaging requirements. Damaged packages should not be accepted for loading. The new requirements as per IMDG code, for the training of all staff (shore and sea) at both operational and management level, who handle or process dangerous goods shipments for transportation by sea should be pointed out.

Solid bulk cargoes

This section deals with the **International Maritime Solid Bulk Cargoes** (**I**MSBC Code). A ship may be required to carry a substance not included in the Code. The master should obtain all relevant information about its properties before loading it. The type of information included in the Code should be used as a guide to what questions should be asked.

Previous loading practices and maintenance activity appear to be important factors in the safety of dry bulk carriers. Instructors should explain the problems suffered by some single skin dry bulkers in the early 1990s. The majority were over 15 years of age and were carrying iron ore at the time of the loss. Masters and chief officers should be able to identify potential weak points and carry out routine inspections to detect unsafe conditions and take appropriate actions. Focus should be on the structural arrangements and hull integrity with emphasis on the critical areas of the structure:

hatch corners, coamings; main frames and brackets; topside tanks; transverse bulkheads and any damage caused during cargo handling.

IACS classification societies introduced an enhanced survey programme (ESP) for bulkers and tankers in 1993 covering the preparation and planning of hull surveys, harmonized bottom survey in dry dock with class renewal survey, maintenance of a survey documents file on board and corrosion prevention measures (T35, V59). This was adopted in Chap XI of SOLAS as regulation 2 Enhanced Surveys, applicable to oil tankers and bulk carriers from July 1998.

International Code for the Safe Carriage of Grain in Bulk (International Grain Code)

An example of a grain loading calculation should be made by students.

Master and Chief Mate

Function 3:

Controlling the Operation of the Ship and Care for Persons on Board at the Management Level

Master and Chief Mate
Function 3: Controlling the Operation of the Ship and Care for Persons on Board at the Management Level

INDEX

Part B3: Course Outline

■ Timetable

No formal example of a timetable is included in this model course.
Development of a detailed timetable depends on the level of skills of the officers entering the course and the amount of revision work of basic principles that may be required.

Lecturers must develop their own timetable depending on:

- the level of skills of trainees
- the numbers to be trained
- the number of instructors

and normal practices at the training establishment.

Preparation and planning constitute an important factor which makes a major contribution to the effective presentation of any course of instruction.

■ Lectures

As far as possible, lectures should be presented within a familiar context and should make use of practical examples. They should be well illustrated with diagrams, photographs and charts where appropriate, and be related to matter learned during seagoing time.

An effective manner of presentation is to develop a technique of giving information and then reinforcing it. For example, first tell the trainees briefly what you are going to present to them; then cover the topic in detail; and, finally, summarize what you have told them. The use of an overhead projector and the distribution of copies of the transparencies as trainees handouts contribute to the learning process.

■ Course Outline

The tables that follow list the competencies and areas of knowledge, understanding and proficiency, together with the estimated total hours required for lectures and practical exercises. Teaching staff should note that timings are suggestions only and should be adapted to suit individual groups of trainees depending on their experience, ability, equipment and staff available for training.

COURSE OUTLINE

Knowledge, understanding and proficiency	Total hours for each topic	Total hours for each subject area of Required performance
Competence:		
3.1 CONTROL TRIM, STABILITY AND STRESS		
3.1.1 FUNDAMENTAL PRINCIPLES OF SHIP CONSTRUCTION, TRIM AND STABILITY		
.1 Shipbuilding materials	3	
.2 Welding	3	
.3 Bulkheads	4	
.4 Watertight and weather-tight doors	3	
.5 Corrosion and its prevention	4	
.6 Surveys and dry-docking	2	
.7 Stability	83	102
3.1.2 EFFECT ON TRIM AND STABILITY IN THE EVENT OF DAMAGE AND STABILITY		
.1 Effect on trim and stability of a ship in the event of damage to and consequent flooding of a compartment and countermeasures to be taken	9	
.2 Theories affecting trim and stability	2	11
3.1.3 KNOWLEDGE OF IMO RECOMMENDATIONS CONCERNING SHIP STABILITY		
.1 Responsibilities under the relevant requirements of the International Conventions and Codes	2	2
3.1.2 EFFECT ON TRIM AND STABILITY IN THE EVENT OF DAMAGE AND STABILITY		
3.2 MONITOR AND CONTROL COMPLIANCE WITH LEGISLATIVE REQUIREMENTS AND MEASURES TO ENSURE SAFETY OF LIFE AT SEA AND THE PROTECTION OF THE MARINE ENVIRONMENT		
3.2.1 INTERNATIONAL MARITIME LAW EMBODIED IN INTERNATIONAL AGREEMENTS AND CONVENTIONS		

Knowledge, understanding and proficiency		Total hours for each topic	Total hours for each subject area of Required performance
	.1 Certificates and other documents required to be carried on-board ships by international conventions	1	
	.2 Responsibilities under the relevant requirements of the International Convention on Load Lines	1	
	.3 Responsibilities under the relevant requirements of the International Convention for the Safety of Life at Sea	2	
	.4 Responsibilities under the International Convention for the prevention of pollution from ships	3	
	.5 Maritime declarations of health and the requirements of the International Health Regulations	4	
	.6 Responsibilities under international instruments affecting the safety of the ship, passengers, crew and cargo	23	
	.7 Methods and aids to prevent pollution of the marine environment by ships	2	
	.8 National legislation for implementing international agreements and conventions	-	36

3.3 MAINTAIN SAFETY AND SECURITY OF THE SHIP'S CREW AND PASSENGERS AND THE OPERATIONAL CONDITION OF LIFE-SAVING, FIRE-FIGHTING AND OTHER SAFETY SYSTEMS

3.3.1	KNOWLEDGE OF LIFE-SAVING APPLIANCE REGULATIONS	2	2
3.3.2	ORGANIZATION OF FIRE DRILLS AND ABANDON SHIP DRILLS	-	-

See IMO model courses 2.03 and 1.23 and STCW Code Sections A-V1/3 and A-V1/2

3.3.3	MAINTENANCE OF OPERATIONAL CONDITION OF LIFE-SAVING, FIRE-FIGHTING AND OTHER SAFETY SYSTEMS	-	-

See IMO model courses 2.03 and 1.23 and STCW Code Sections A-V1/3 and A-V1/2

3.3.4	ACTIONS TO BE TAKEN TO PROTECT AND	4	4

Knowledge, understanding and proficiency		Total hours for each topic	Total hours for each subject area of Required performance
	SAFEGUARD ALL PERSONS ON BOARD IN EMERGENCIES		
3.3.5	ACTIONS TO LIMIT DAMAGE AND SALVE THE SHIP FOLLOWING A FIRE, EXPLOSION, COLLISION OR GROUNDING	4	4
3.4	**DEVELOP EMERGENCY AND DAMAGE CONTROL PLANS AND HANDLE EMERGENCY SITUATIONS**		
3.4.1	PREPARATION OF CONTINGENCY PLANS FOR RESPONSE TO EMERGENCIES	9	9
3.4.2	SHIP CONSTRUCTION INCLUDING DAMAGE CONTROL	4	4
3.4.3	METHODS AND AIDS FOR FIRE PREVENTION, DETECTION AND EXTINCTION	-	-
See IMO model courses 2.03 and STCW Code Section A- V1/3			
3.4.4	FUNCTIONS AND USE OF LIFE SAVING APPLIANCES	-	-
See IMO model courses 1.23 and STCW Code Section A- V1/2-1			
3.5	**USE OF LEADERSHIP AND MANAGERIAL SKILLS**		
3.5.1	SHIPBOARD PERSONNEL MANAGEMENT AND TRAINING		
	.1 Shipboard Personnel management	10	
	.2 Training on board ships	6	16
3.5.2	RELATED INTERNATIONAL MARITIME CONVENTIONS, RECOMMENDATIONS AND NATIONAL LEGISLATION		
	.1 Related international maritime conventions, recommendations and national legislation	2	2
3.5.3	APPLICATION OF TASK AND WORKLOAD		

Knowledge, understanding and proficiency		Total hours for each topic	Total hours for each subject area of Required performance
	MANAGEMENT		
	.1 Planning and co-ordination	1	
	.2 Personnel assignment	1	
	.3 Time and resource constraints	1	
	.4 Prioritization	1	4
3.5.4	EFFECTIVE RESOURCE MANAGEMENT		
	.1 Allocation, assignment and prioritization of resources	1	
	.2 Effective communication on board and ashore	1	
	.3 Decisions reflect consideration of team experiences	1	
	.4 Assertiveness and leadership, including motivation	1	
	.5 Obtaining and maintaining situational awareness	1	5
3.5.5	DECISION MAKING TECHNIQUES		
	.1 Situation and risk assessment	1	
	.2 Identify and generate options	1	
	.3 Selecting course of action	1	
	.4 Evaluation of outcome effectiveness	1	4
3.5.6	DEVELOPMENT, IMPLEMENTATION AND OVERSIGHT OF STANDARD OPERATING PROCEDURES	1	1
3.6	**ORGANISE AND MANAGE THE PROVISION OF MEDICAL CARE ON BOARD**		
3.6.1	MEDICAL PUBLICATIONS		
	.1 International Medical Guide for Ships	0.5	
	.2 International Code of Signals (medical section)	0.5	
	.3 Medical First-Aid Guide for Use in Accidents Involving Dangerous Goods	3	4
Total for Function 3: Controlling the Operation of the Ship and Care for Persons on Board at the Management Level			**210**

Part C3: Detailed Teaching Syllabus

■ Introduction

The detailed teaching syllabus is presented as a series of learning objectives. The objective, therefore, describes what the trainee must do to demonstrate that the specified knowledge or skill has been transferred.

Thus each training outcome is supported by a number of related performance elements in which the trainee is required to be proficient. The teaching syllabus shows the Required performance expected of the trainee in the tables that follow.

In order to assist the instructor, references are shown to indicate IMO references and publications, textbooks and teaching aids that instructors may wish to use in preparing and presenting their lessons.

The material listed in the course framework has been used to structure the detailed teaching syllabus; in particular,

- o Teaching aids (indicated by A)
- o IMO references (indicated by R)
- o Textbooks (indicated by T) and
- o Bibliography (indicated by B)

will provide valuable information to instructors.

■ Explanation of Information Contained in the Syllabus Tables

The information on each table is systematically organised in the following way. The line at the head of the table describes the FUNCTION with which the training is concerned. A function means a group of tasks, duties and responsibilities as specified in the STCW Code. It describes related activities which make up a professional discipline or traditional departmental responsibility on board.

In this Model course there are three functions:

- o Navigation at the Management Level
- o Cargo Handling and Stowage at the Management Level
- o Controlling the Operation of the Ship and Care for Persons on Board at the Management Level.

The header of the first column denotes the **COMPETENCE** concerned. Each function comprises a number of competences. For example, the Function 3, Controlling the Operation of the Ship and Care for Persons on board at the Management Level, comprises a number of **COMPETENCES**. Each competence is uniquely and consistently numbered in this model course.

In this function the competence is **Control trim, stability and stress**. It is numbered 3.1 that is the first competence in Function. The term competence should be understood as the application of knowledge, understanding, proficiency, skills, experience for an individual to perform a task, duty or responsibility on board in a safe, efficient and timely manner.

Shown next is the required TRAINING OUTCOME. The training outcomes are the areas of knowledge, understanding and proficiency in which the trainee must be able to demonstrate knowledge and understanding. Each COMPETENCE comprises a number of training outcomes. For example, the above competence comprises three training outcomes. The first is concerned with the fundamental principles of FUNDAMENTAL PRINCIPLES OF SHIP CONSTRUCTION, TRIM AND STABILITY. Each training outcome is uniquely and consistently numbered in this model course. That concerned with fundamental principles of Ship Construction, Trim And Stability is uniquely numbered 3.1.1. For clarity training outcomes are printed in black on grey, for example TRAINING OUTCOME

Finally, each training outcome embodies a variable number of Required performances — as evidence of competence. The instruction, training and learning should lead to the trainee meeting the specified Required performance. For the training outcome concerned with fundamental principles of ship construction, trim and stability there are three areas of performance. These are:

3.1.1.1 Shipbuilding materials
3.1.1.2 Welding
3.1.1.3 Bulkheads

Following each numbered area of Required performance there is a list of activities that the trainee should complete and which collectively specify the standard of competence that the trainee must meet. These are for the guidance of teachers and instructors in designing lessons, lectures, tests and exercises for use in the teaching process. For example, under the topic 3.1.1 1, to meet the Required performance, the trainee should be able to:

- o states that steels are alloys of iron, with properties dependent upon the type and amounts of alloying materials used
- o states that the specifications of shipbuilding steels are laid down by classification societies
- o states that shipbuilding steel is tested and graded by classification society surveyors who stamp it with approval marks

and so on.

IMO references (Rx) are listed in the column to the right hand side. Teaching aids (Ax), videos and CBT's (Vx) textbooks (Tx) and bibliography (Bx) relevant to the training outcome and required performances are placed immediately following the TRAINING OUTCOME title.

It is not intended that lessons are organised to follow the sequence of Required performances listed in the Tables. The Syllabus Tables are organised to match with the competence in the STCW Code Table A-II2. Lessons and teaching should follow college practices. It is not necessary, for example, for ship building materials to be studied before stability. What is necessary is that all the material is covered and that teaching is effective to allow trainees to meet the standard of the Required performance.

COMPETENCE 3.1 Control Trim, Stability and Stress	IMO Reference
TRAINING OUTCOMES: Demonstrates a knowledge and understanding of 3.1.1 FUNDAMENTAL PRINCIPLES OF SHIP CONSTRUCTION, TRIM AND STABILITY 3.1.2 EFFECT ON TRIM AND STABILITY IN THE EVENT OF DAMAGE AND FLOODING 3.1.3 KNOWLEDGE OF IMO RECOMMENDATIONS CONCERNING SHIP STABILITY	STCW Code Table A-II/2

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

3.1.1 FUNDAMENTAL PRINCIPLES OF SHIP CONSTRUCTION, TRIM AND STABILITY

Textbooks / Bibliography: T4, T5, T17, T28, T35, B3, B29, B35, B118, B144, B206

Teaching aids: A1, A4, V85, V120, V121, V122, V141

Required performance:

1.1 Shipbuilding Materials (3 hours) R1

- states that steels are alloys of iron, with properties dependent upon the type and amounts of alloying materials used
- states that the specifications of shipbuilding steels are laid down by classification societies
- states that shipbuilding steel is tested and graded by classification society surveyors, who stamp it with approval marks
- explains that mild steel, graded A to E, is used for most parts of the ship
- states why higher tensile steel may be used in areas of high stress, such as the sheer strake
- explains that the use of higher tensile steel in place of mild steel results in a saving of weight for the same strength.
- explains what is meant by:
  - tensile strength
  - ductility
  - hardness
  - toughness
- defines strain as extension divided by original length
- sketches a stress-strain curve for mild steel
- explains:
  - yield point
  - ultimate tensile stress
  - modulus of elasticity
- explains that toughness is related to the tendency to brittle fracture
- explains that stress fracture may be initiated by a small crack or notch in a plate
- states that cold conditions increase the chances of brittle fracture
- states why mild steel is unsuitable for the very low temperatures involved in the containment of liquefied gases
- lists examples where castings or forgings are used in

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

ship construction
- explains the advantages of the use of aluminium alloys in the construction of superstructures
- states that aluminium alloys are tested and graded by classification society surveyors
- explains how strength is preserved in aluminium superstructures in the event of fire
- describes the special precautions against corrosion that are needed where aluminium alloy is connected to steelwork

1.2 Welding (3 hours) R1

- describes the process of manual electric arc welding
- explains the purpose of flux during welding
- describes briefly the automatic welding processes, electro-slag, TIG and MIG
- describes butt, lap and fillet welds
- describes the various preparations of a plate edge for welding
- explains what is meant by a full-penetration fillet weld
- explains what is meant by 'single pass', 'multipass' and 'back' run
- explains how welding can give rise to distortion and describes measures which are taken to minimize it
- describes the use of tack welding
- describes weld faults:
  - lack of fusion
  - no inter-run penetration
  - lack of reinforcement
  - lack of root penetration
  - slag inclusion
  - porosity
  - overlap
  - undercut
- states that classification societies require tests on weld materials and electrodes before approving them
- describes gas cutting of metals

1.3 Bulkheads (4 hours) R1

- states that transverse bulkheads serve to subdivide a ship against flooding and spread of tire, to support decks and superstructures and to resist racking stresses
- distinguishes between watertight, non-watertight and oil-tight or tank bulkheads
- defines:

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   - margin line
   - bulkhead deck
   - weather tight
- states that cargo ships must have:
   - a collision bulkhead, watertight up to the freeboard deck, positioned not less than 5% of the length of the ship (or 10 meters, whichever is the less) and not more than 8% of the length of the ship from the forward perpendicular
   - an afterpeak bulkhead enclosing the stem tube and rudder trunk in a watertight compartment
   - a bulkhead at each end of the machinery space
- explains that cargo ships require additional bulkheads, as laid down by classification society rules, according to their length
- describes the construction of a watertight bulkhead and its attachments to sides, deck and tank top
- describes how watertightness is maintained where bulkheads are pierced by longitudinal, beams or pipes
- states the rule regarding penetrations of the collision bulkhead
- states that watertight floors are fitted directly below main watertight bulkheads
- explains that oil tight bulkheads and bulkheads forming boundaries of tanks are built with heavier scantlings than watertight bulkheads
- describes how bulkheads are tested for tightness
- gives examples of non-watertight bulkheads
- explains the purpose of washing bulkheads in cargo tanks or deep tanks
- states longitudinal bulkheads serve to subdivide liquid cargoes, provide additional longitudinal support and reduce free surface effect
- distinguishes between Cofferdam, Flat plate and Corrugated bulkhead construction
- explains the use of cross ties in tanker construction.

1.4 Watertight and Weather tight doors (3 hours) — R1

- states that openings in watertight bulkheads must be fitted with watertight doors
- states that the number of openings in watertight bulkheads of passenger ships should be reduced to the minimum compatible with the design and working of the ship — R2
- categorizes watertight doors as:
  class 1 — hinged doors
  class 2 — hand-opened sliding doors

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class 3 — sliding doors which are power-operated as well as hand-operated

- states that all types of watertight doors should be capable of being closed with the ship listed to 15° either way
- describes with sketches the arrangement of a power-operated sliding watertight door
- describes with sketches a hinged watertight door, showing the means of securing it
- states that hinged watertight doors are only permitted above a deck at least 2.0 metres above the deepest subdivision load line
- explains that weather tight doors in superstructure openings are similar to hinged watertight doors
- states that drills for the operating of watertight doors, side scuttles, valves and other closing mechanisms must be held weekly
- states that all watertight doors in main transverse bulkheads, in use at sea, must be operated daily
- states that watertight doors and their mechanisms and indicators, all valves the closing of which is necessary to make a compartment watertight and all valves for damage-control cross-connections must be inspected at sea at least once per week
- states that records of drills and inspections are to be entered in the log, with a record of any defects found

1.5 Corrosion and its Prevention (4 hours) — R1

- explains what is meant by corrosion
- explains what is meant by erosion of metals and gives examples of where this is likely to occur
- describes the formation of a corrosion cell and defines anode, cathode and electrolyte
- states that corrosion takes place at the anode while the cathode remains unaffected
- describes the galvanic series of metals in seawater
- given the galvanic series, states which of two metals will form the anode in a corrosion cell
- explains the differences in surface condition or in stress concentration can give rise to corrosion cells between two areas of the same metal
- states that corrosion can be controlled by:
  - applying a protective coating to isolate the steel from the air or from seawater electrolyte
  - using cathodic protection to prevent steel from forming the anode of a corrosion cell
- explains that cathodic protection can only be used to

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protect the underwater hull or ballasted tanks

- states that both of the methods mentioned above are normally used together
- explains what mill scale is and states that it is cathodic to mild steel
- describes the treatment of steel in a shipyard and the use of holding primers (shop primers)
- explains that the required preparation of steelwork depends upon the type of paint to be applied
- states that many modem paints, such as epoxy and polyurethane, need to be applied to a very clean shot-blasted surface
- states that paints consist mainly of a vehicle, a pigment and a solvent, and explains the purpose of each
- lists common paint vehicles as:
  - drying oils
  - oleo-resins
  - alkyd resins
  - polymerizing chemicals
  - bitumen
  - and states the suitability of each for various applications
- describes the action of anti-fouling paint
- describes the use of self-polishing anti-fouling paint and the proposed banning of Tributyltin (TBT)
- describes typical paint schemes for
  - underwater areas
  - boot topping
  - topsides
  - weather decks
  - superstructures
  - tank interiors
- states the safety precautions to take when using paints
- describes the system of cathodic protection using sacrificial anodes
- lists the metals and alloys which may be used as anodes
- explains why anodes of magnesium and of magnesium alloy are not permitted in cargo/ballast tanks and in adjacent tanks in tankers
- states that good electrical contact between the anode and the hull or tank is essential
- explains why the anodes are insulated from the hull
- describes the impressed-current system of hull protection
- explains that the system is adjusted for optimum

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protection, often automatically, by use of a reference cell
- states that electrical connection with the hull via slip rings and brushes on the rudder stock and propeller shaft ensures protection of the rudder and propeller
- explains that, as the underwater paintwork deteriorates, higher currents are required for protection
- states that too high a current can result in damage to paintwork and a chalky deposit on areas of bare metal, which has to be removed before repainting can be carried out
- states that a protective shield of epoxy resin is applied for about 1 metre around the anodes to withstand the alkaline conditions there

1.6 Surveys and Dry-docking (2 hours) R1

- states the frequency of classification society surveys
- states that intervals between dry-dockings may be extended up to 2.5 years where a ship has high-resistance paint and an approved automatic impressed- current cathodic protection system
- states that continuous hull survey, in which all compartments are examined over a 5-year period, may replace the special surveys
- explains all types of survey a ship is subjected to, including but limiting to : Initial Survey, Renewal Survey, Periodical Survey, Intermediate Survey, Annual Survey, Inspection of the outside of the ships bottom, Additional Survey.
- Explains Harmonized system of ship survey and certification
- Explains Condition Assessment Scheme (CAS) for oil tankers and Condition Assessment Programme (CAP)
- lists the items inspected at annual survey as:
  - protection of openings: hatches, ventilators, cargo doors, side scuttles, overside discharges and any other openings through which water might enter
  - guardrails
  - water-clearing arrangements, freeing ports, scuppers
  - means of access to crews quarters and working areas
- states that the inspections listed above are also required for the annual inspection under the International Convention on Load Lines, 1966
- lists the items to examine in dry-dock as:

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- shell plating
- cathodic protection fittings
- rudder
- stem frame
- propeller
- anchors and chain cable

- describes the examinations to be made of the items listed above
- describes the cleaning, preparation and painting of the hull in dry-dock
- calculates paint quantities, given the formula for wetted surface area as:

  $S = 2.58 \sqrt{\Delta L}$

  where S = surface area in m^2
  Δ = displacement in tonnes
  L = length of ship in metres

1.7 Stability (83 hours)

Approximate Calculation of Areas and Volumes

- states the trapezoidal rule for the area under a curve in terms of the number of ordinates, the interval and the ordinate values
- uses the trapezoidal rule to find the area under a curve defined by given ordinates
- states Simpson's first rule as

  $A = h (y_1 + 4y_2 + y_3) / 3$

  where: A = area under curve
  h = interval length
  y_1, y_2, y_3 are ordinates

- writes down the repeated first rule for any odd number of ordinates
- uses Simpson's first rule to find the area under a curve defined by an odd number of ordinates
- states that the area is exact for a linear, quadratic or cubic curve but an approximation otherwise

- states, Simpson's second rule as

  $A = 3h (y_1 + 3y_2 + 3y_{3+} y_4) / 8$

  where: A = area
  h = interval length

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y_1, y_2, y_3, y_4 are ordinates

- writes down the repeated second rule for 7, 10, 13, etc, ordinates
- uses Simpson's second rule to find the area under a curve defined by a suitable number of given ordinates
- states that the area is exact for linear, quadratic or cubic curves
- states that the first rule has smaller errors that the second and should be used in preference where possible
- states that errors can be reduced by using a smaller interval
- states the 5, 8, -1 rule as $A = h(5y_1 + 8y_2 - y_3) / 12$

  where: A = area between first and second ordinates
  h = interval length
  y_1, y_2, y_3, are ordinates

- uses Simpson's rules to find the area under a curve defined by any number of ordinates
- explains that the volume of a body may be calculated by using Simpson's rules with cross-sectional areas as ordinates
- calculates the volume of a ship to a stated draught by applying Simpson's rules to given cross-sectional areas or waterplane areas

Effects of Density

- given the density of the water in the dock, calculates the displacement for a particular draught from the seawater displacement for that draught extracted from hydrostatic data
- calculates the TPC for given mean draught and density of the dock water
- derives the formula $FWA = \dfrac{\Delta}{40TPC}$ cm,

here Δ is the displacement in salt water in tonnes at the summer load line and TPC is the tonnes per centimetre immersion in salt water at the summer load line

- states that FWA only applies when the ship is floating at or near its summer load line
- explains why the density of the water in the dock should be taken at the same time as the draughts are read

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- states that the rise of G due to free surface affect (in metres)

  $$= \frac{\text{inertia of tank } (m^4) \text{ x density of liquid in tank}}{\text{Displacement of the ship in tonnes}}$$

  where the density of the liquid is measured in tone / m^3

- states that the inertia of the tank (I) is the second moment of area of the liquid surface about a fore-and-aft axis through the centre of area
- states that for a rectangular tank, I = $Lb^3 / 12$

  L = length of tank
  b = breadth of tank
  I= second moment of area about a fore-and-aft axis through the centre

- deduces from the above objective that halving the breadth of a tank reduces the free surface effect to one eight of its original value
- deduces that subdividing a tank at the centre reduces its free surface effect to one quarter of that of the undivided tank
- states that the quantity 'inertia x density of liquid' is called the 'free surface moment' of the tank, in tonne-metres
- states that information for calculating free surface effect is included in tank capacity tables
- states that the information may be given in one of the following ways:
  - inertia in metre^4
  - free surface moments for a stated density of liquid in the tank
  - as a loss of GM, in tabulated form for a range of draughts (displacements) for a stated density of liquid in the tank
- corrects free surface moments when a tank contains a liquid of different density from that slated in the capacity table
- given a ship's displacement and the contents of its tanks, uses the information from a capacity table to calculate the loss of GM due to slack tanks
- given a ship's departure conditions and the daily consumption of fuel, water and stores, calculates the GM on arrival at destination

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Stability at Moderate and Large Angles of Heel

- states that the formula $GZ = GM \sin \theta$ does not hold for angles in excess of about 10º
- states that the initial KM is calculated from
  $KM = KB + BM$

- uses a metacentric diagram to obtain values of KM, KB and BM for given draughts
- states that the transverse $BM = I / V$

  Where: I = second moment of area of the waterplane about the centre line;
  V = underwater volume of the ship

- states that for a rectangular waterplane $I = LB^3/ 12$

  where: L is the length of the waterplane;
  B is the breadth of the waterplane

- shows that, for a box-shaped vessel, $KM = (B^2 /12d) + (d / 2)$
  where: d = draught

- states that, for moderate and large angles of heel, values of GZ found by calculating the position of the centre of buoyancy are provided by the shipbuilder for a range of displacements and angles of heel for an assumed position of the centre of gravity
- uses cross-curves of stability and KN curves to construct a curve of statical stability for a given displacement and value of KG, making correction for any free surface moments
- explains how to use the initial metacentric height as an aid to drawing the curve
- identifies from the curve the approximate angle at which the deck edge immerses
- describes the effect of increased freeboard on the curve of statical stability for a ship with the same initial GM
- states that the righting lever, GZ, may be found from the wall-sided formula up to the angle at which the deck edge is immersed
- given the wall-sided formula
  $GZ = (GM + BM / 2 \tan^2 \theta) \sin \theta$

  and other relevant data, calculates the value of GZ for a stated angle of heel

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- shows that, for small angles of heel, the term $BM / 2 \tan^2 \theta$ is negligible, leading to the usual expression for GZ at small angles of heel
- uses the wall-sided formula for calculating the angle of loll of an initially unstable ship
- compares the result in the above objective with that obtained by connecting a curve of statical stability
- states that cross-curves and KN curves are drawn for the ship with its centre of gravity on the centre line
- demonstrates how to adjust the curve of statical stability for a ship with a list
- describes the effect when heeled to the listed side on:
  - the maximum righting moment
  - the angle of vanishing stability
  - the range of stability
- states that cross-curves and KN curves are drawn for the ship at the designed trim when upright
- states that righting levers may differ from those shown if the ship has a large trim when upright
- Simplified Stability Data
  - states that stability information may be supplied in a simplified form, consisting of:
  - a diagram or table of maximum deadweight moment
  - a diagram or table of minimum permissible GM
  - a diagram or table of maximum permissible KG all related to the displacement or draught in salt water
- states that a deadweight moment is mass in tonnes X vertical height of the mass above the keel
- states that free surface moments are to be added to the deadweight moments when using the diagram of maximum deadweight moment
- states that if, for a stated displacement or draught, the total deadweight moment or KG is less than the maximum permissible value, the ship will have adequate stability
- reads the maximum permissible deadweight moment from a curve of deadweight moment for a given displacement
- given the masses loaded, their heights above the keel and the free surface moments of slack tanks, calculates the deadweight moment and uses the result with the diagram of deadweight moment to determine if the stability is adequate
- uses the diagram of deadweight moment to calculate the maximum mass that can be loaded in a given position to ensure adequate stability during a voyage, making allowance for the fuel, water and stores

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference
	consumed and for any resulting free surface	
	- states that curves of maximum KG or minimum GM to ensure adequate stability in the event of partial loss of intact buoyancy are provided in passenger ships	R1, R2
	Trim and List	
	- defines longitudinal centre of gravity (LCG) and longitudinal centre of buoyancy (LCB)	R1
	- states that a ship trims about the centre of flotation until LCG and LCB are in the same vertical line	
	- states that a ship trims about the centre of flotation until LCG and LCB are in the same vertical line	
	- states that the distance of the LOB from amidships or from the after perpendicular is given in a ship's hydrostatic data for the ship on an even keel	
	- explains that the LCG must be at the same distance from amidships as LCB when the ship floats on an even keel	
	- shows on a diagram of a ship constrained to an even keel the couple that is formed by the weight and buoyancy forces when LCG is not the same distance from amidships as LCB	
	- states that the trimming moment = displacement x the horizontal distance between LCB (tabulated) and LCG (actual) = Δ x GG1 where GG1 is the horizontal distance between the position of LCG for the even- keel condition and the actual LCG	
	- states that trim = (Δ x GG1) / MCT 1cm	
	- states that if the actual LCG is abaft the tabulated position of LCB, then the trim will be by the stern, and vice versa	
	- given the initial displacement, initial position of LCG, masses loaded or discharged and their LCGs, calculates the final position of LCG	
	- using a ship's hydrostatic data and a given disposition of cargo, fuel, water and stores, determines the trim, the mean draught and the draughts at each end	
	- calculates the mass to move between given positions to produce a required trim or draught at one end	
	- calculates where to load a given mass to produce a required trim or draught at one end	
	- calculates how to divide a loaded or discharged mass between two positions to produce a required trim or draught at one end	
	- calculates where to load a mass so as to keep the after draught constant	

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- states that calculated draughts refer to draughts at the perpendiculars
- given the distance of draught marks from the perpendiculars and the length between perpendiculars, corrects the draughts indicated by the marks
- given draughts forward, aft and amidships, states whether or not the ship is hogged or sagged and the amount
- corrects the draught amidships for hog or sag
- given the forward and after draughts, the length between perpendiculars and hydrostatic data, calculates the correction for trim to apply to the displacement corresponding to the draught amidships
- states that a second correction for trim, using Nemoto's formula, may be applied to the displacement
- given Nemoto's formula, calculates the second correction to displacement
- calculates the maximum list during loading or discharging a heavy lift, using a ship's derrick, given the relevant stability information and the dimensions of the derrick
- calculates the minimum GM required to restrict the list to a stated maximum when loading or discharging a heavy lift
- calculates the quantities of fuel oil or ballast to move between given locations to simultaneously correct a list and achieve a desired trim
- explains how to distinguish between list and loll and describes how to return the ship to the upright in each case
- by making use of curves of statical stability, including those for ships with zero or negative initial GM, determines the equilibrium angle of heel resulting from a transverse moment of mass

Dynamical Stability

- defines dynamical stability at any angle of heel as the work done in inclining the ship to that angle
- states that the dynamical stability at any angle is given by the product of displacement and the area under the curve of statical stability up to that angle
- given a curve of statical stability, uses Simpson's rules to find the area in metre-radians up to a stated angle
- states that dynamical stability is usually expressed in tonne-metres
- explains that the dynamical stability at a given angle of

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

heel represents the potential energy of the ship

- states that the potential energy is used partly in overcoming resistance to rolling and partly in producing rotational energy as the ship returns to the upright
- states that the rotational energy when the ship is upright causes it to continue rolling
- states that, in the absence of other disturbing forces, the ship will roll to an angle where the sum of the energy used in overcoming resistance to rolling and the dynamical stability are equal to the rotational energy when upright
- states that a beam wind exerts a force equal to the wind pressure multiplied by the projected lateral area of the portion of the ship and deck cargo above the waterline
- explains that a heeling moment is formed, equal to the force of the wind multiplied by the vertical separation between the centres of the lateral areas of the portions of the ship above and below the waterline
- states that the heeling lever equals the heeling moment divided by the ship's displacement
- states that a steady wind will cause a ship to heel to an angle at which the righting lever is equal to the heeling over
- states that a ship under the action of a steady wind would roll about the resulting angle of heel
- on a curve of righting levers, indicates the angle of equilibrium under the action of a steady wind and the areas which represent the dynamical stability at angles of roll to each side of the equilibrium position
- by reference to dynamical stability, describes the effect of an increase in wind pressure when a vessel is at its maximum angle of roll to windward
- summarizes the recommendation on severe wind and rolling criterion for the intact stability of passenger and cargo ships
- by reference to a curve of righting levers and dynamical stability, describes the effect of a listing moment on the rolling of the ship about the equilibrium position

Approximate GM by Means of Rolling Period Tests — R1, R96

- states that, for ships up to 70m in length, the GM can be verified in still water by causing the ship to roll and noting the rolling period
- defines the rolling period as the time taken for one complete oscillation from the extreme end of a roll to

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one side, right across to the extreme on the other side and back to the original position

- states that for small angles of roll in still water, the initial metacentric height, GM_o is given by:

  $GM_o = [fB / Tr]^2$

  where: f = rolling factor
  B = breadth of the ship
  Tr = rolling period in seconds

- states that the formula may be given as:

  $GM_o = F / Tr^2$

  where the F-value is provided by the Administration
- summarizes the procedures for determining a ship's stability by means of the rolling period test
- given values of F and T and the equation $GM_o = F / T^2$, calculates GM_o
- states the limitations of the method
- states the limitations of the method states that when construction is completed, a ship undergoes an inclining test to determine the displacement and position of the centre of gravity, KG and LCG, in the light ship condition
- states that the displacement and KM are calculated from the observed draughts and the ship's lines plans, making allowance for density of water and trim
- states that the position of the centre of buoyancy is calculated to enable the LCG for the light ship to be determined
- describes how an inclining test is carded out
- given the mass and the distance through which it was moved, the displacement, length of the plumb line and the deflection, calculates the KG
- states that the values obtained in a test are corrected for masses to be removed and added to obtain the KG and LCG for the light ship
- states that, at periodical intervals not exceeding five years, a light ship survey must be carried out on all passenger ships to verify any changes in light ship displacement and longitudinal centre of gravity
- states that the ship must be re-inclined whenever, in comparison with the approved stability information, a deviation from the light ship displacement exceeding 2% or a deviation of the longitudinal centre of gravity exceeding 1% of L is found or anticipated — R2

COMPETENCE 3.1 Control Trim, Stability and Stress	IMO Reference
Recommendation on Intact Stability for Passenger and Cargo Ships under 100 Metres in Length	R1, R96

- describes the general precautions to be taken against capsizing
- states the recommended criteria for passenger and cargo ships
- given the initial metacentric height and the GZ curve, determines whether the ship meets the recommended criteria
- states that stability information should comprise:
  - stability characteristics of typical loading conditions
  - information to enable the master to assess the stability of the ship in all loading conditions differing from the standard ones
  - information on the proper use of anti-rolling devices, if fitted
  - information enabling the master to determine GMo by means of a rolling test corrections to be made to GMo for free surface liquids
  - for ships carrying timber deck cargoes information setting out changes in deck cargo from that shown in the loading conditions, when the permeability of the deck cargo is significantly different from 25%
  - for ships carrying timber deck cargoes, indications of the maximum permissible amount of deck cargo
- states that criteria are laid down for ships carrying timber deck cargoes
- states the additional criteria recommended for passenger ships
- states that the information includes a curve or table giving, as a function of the draught, the required initial GM which ensures compliance with the recommendations on intact stability

Intact Stability Requirements for the Carriage of Grain — R1

- states the intact stability requirements for the carriage of grain
- states that before loading bulk grain the master may be required to demonstrate that the ship will comply with the stability criteria at all stages of the voyage
- states that the ship must be upright before proceeding to sea
- states that grain loading information includes:
  - curves or tables of grain heeling moments for every compartment, whether filled or partly filled
  - tables of maximum permissible heeling moments or

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

other information sufficient to allow the master to demonstrate compliance with the requirements
    - details of the requirements for temporary fittings and the provisions for the bundling of bulk grain
    - typical loaded service departure and arrival conditions and, where necessary, intermediate worst service conditions
    - a worked example for the guidance of the master
    - loading instructions in the form of notes summarizing the requirements of SOLAS, chapter VI
- explains what are volumetric heeling moments
- states that heeling moment = volumetric heeling moment / stowage factor
- states how the vertical shift of grain surfaces is taken into account in filled compartments and in partly filled compartments
- calculates the heeling arm, λ_O, from:

$$\lambda_O = \frac{\text{Volumetric heeling moment}}{(\text{stowage factor x displacement})}$$

- draws the heeling-arm curve on the righting-arm curve for a given ship and KG, corrected for free surface liquid, and:
    - determines the angle of heel
    - using Simpson's rules, calculates the residual dynamical stability to the angle laid down by Regulation 4 of SOLAS chapter VI
- compares the results of the calculations in the above objective with the criteria set out in Regulation 4 and states whether the ship complies with the requirements or does not comply

Rolling of Ships — R1

- describes the effect on GM of rolling
- explains how increase of draught and of displacement influence rolling
- describes how the distribution of mass within the ship affects the rolling period
- explains what synchronization is and the circumstances in which it is most likely to occur
- describes the actions to take if synchronization is experienced
- describes how bilge keels, anti-rolling tanks and stabilizer fins reduce the amplitude of rolling
- states that a ship generally heels when turning

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- states that, while turning, the ship is subject to an acceleration towards the centre of the turn
- states that the force producing the acceleration acts at the underwater centre of lateral resistance, which is situated at about half-draught above the keel
- states that the force in the above objective is called the centripetal force, given by $F = Mv^2 / r$

where: M = mass of the ship in tonnes
v = speed in metres per second
r= radius of turn in metres
F = centripetal force in kilonewtons

- explains how the force acting at the centre of lateral resistance can be replaced by an equal force acting through the centre of gravity and a heeling couple equal to the force x vertical separation between the centre of lateral resistance and the centre of gravity,
$$\frac{Mv^2}{r}\left(KG - \frac{d}{2}\right)\cos\theta$$
- states that the ship will heel until the resulting righting moment equals the heeling couple, i.e
$$M \times g \times GM \sin\theta = \frac{Mv^2}{r}\left(KG - \frac{d}{2}\right)\cos\theta$$

where: g = acceleration due to gravity
θ = angle of heel

- given the relevant data, calculates the angle of heel from
$$\tan\theta = \frac{v^2\left(KG - \frac{d}{2}\right)}{g \times GM \times r}$$

Dry-docking and Grounding — R1

- states that for dry-docking a ship should:
  - have adequate initial metacentric height
  - be upright
  - have a small or moderate trim, normally by the stern
- states that part of the weight is taken by the blocks as soon as the ship touches, reducing the buoyancy force

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

by the same amount
- states that the upthrust at the stern causes a virtual loss of metacentric height
- explains why the GM must remain positive until the critical instant at which the ship takes the blocks overall
- derives the formula for the upthrust at the stern

$$P = \frac{(MCT \times t)}{L}$$

where: P = upthrust at the stern in tonnes
t = change of trim in cm
L = distance of the centre of flotation from aft

- explains that a ship with a large trim will develop a large upthrust, which may damage the stern frame, trip the blocks or lead to an unstable condition before taking the blocks overall
- by taking moments about the centre of buoyancy, shows that, for a small angle of heel, θ,

righting moment= Δ x GM sin θ – P x KM sin θ

where GM is the initial metacentric height when afloat

- shows that the righting lever is that for the ship with its metacentric height reduced by $\frac{(P \times KM)}{\Delta}$

- by using the equation in the above objective and KM + KG + GM, shows that righting moment = (Δ – P) x GM sin θ – P x KG sin θ
- shows that the righting lever is that for a ship of displacement (Δ – P) and with metacentric height reduced by $\frac{(P \times KG)}{\Delta - P}$

- explains that the righting moment remains positive providing Δ x GM is greater than P x KM or equivalently, (Δ – P) x GM is greater than P x KG
- calculates the minimum GM to ensure that the ship remains stable at the point of taking the blocks overall
- calculates the maximum trim to ensure that the ship
- remains stable on taking the blocks overall for a given GM
- calculates the virtual loss of GM and the draughts of the ship after the after level has fallen by a stated amount
- calculates the draughts on taking the blocks overall

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- explains that the stability of a ship aground at one point on the centre line is reduced in the same way as in dry-docking
- states that when grounding occurs at an off-centre point, the upthrust causes heel as well as trim and reduction of GM
- explains that the increase in upthrust as the tide falls increases the heeling moment and reduces the stability

Shear Force, Bending Moments and Torsional Stress — R1

- explains what is meant by shearing stress
- states that the shear force at a given point of a simply supported beam is equal to the algebraic sum of the forces to one side of that point
- explains that, for a beam in equilibrium, the sum of forces to one side of a point is equal to the sum of the forces on the other side with the sign reversed
- explains what is meant by a bending moment
- states that the bending moment at a given point of a beam is the algebraic sum of the moment of force acting to one side of that point
- states that the bending moment measured to opposite sides of a point are numerically equal but opposite in sense
- draws a diagram of shear force and bending moment for simply supported beams
- states that the bending moment at any given point is equal to the area under the shear-force curve to that point
- uses the above objective to show that the bending-moment curve has a turning point where the shear force has zero value
- explains that shear forces and bending moments arise from differences between weight and buoyancy per unit length of the ship
- states that the differences between buoyancy and weight is called the load
- draws a load curve from a given buoyancy curve and weight curve
- states that the shear force at any given point is equal to the area under the load curve between the origin and that point
- draws a diagram of shear force and bending moment for a given distribution of weight for a box-shaped vessel
- explains how wave profile affects the shear-force

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

curve and bending-moment curve
- states that each ship above a specified length is required to carry a loading manual, in which are set out acceptable loading patterns to keep shear forces and bending moments within acceptable limits
- states that the classification society may also require a ship to carry an approved means of calculating shear forces and bending moment at stipulated stations
- demonstrates the use of a loading instrument
- states that the loading manual and instrument, where provided, should be used to ensure that shear forces and bending moments do not exceed the permissible limits in still water during cargo and ballast handling
- explains what is meant by a torsional stress
- describes how torsional stresses in the hull are set up
- states that wave-induced torsional stresses are allowed for in the design of the ship
- states that cargo-induced torsional stresses are a problem mainly in container ships
- states that classification societies specify maximum
- permissible torsional moments at a number of specified cargo bays
- given details of loading, calculates cumulative torsional moments for stated positions
- describes the likelihood of overstressing the hull structure when loading certain bulk cargoes

3.1.2 EFFECT ON TRIM AND STABILITY IN THE EVENT OF DAMAGE AND FLOODING

Textbooks: T4

Bibliography: B1, B2, B3, B4, B5, B6, B9, B10, B11, B14, B15, B20, B22, B23, B29, B30, B31, B32, B35, B37, B39, B43, B44, B46, B47, B48, B49, B52, B53, B54, B64, B84, B85, B96, B103, B107, B111, 114, B115, B118, B126, B131, B132, B133, 135, B137, B144, B145, B147, B148, B149, B154, B159, B160, B169, B170, B171, B174, B176, B178, B179, B180, B180, B183, B184, B185, B186, B187, B199, B204, B205, B206, B207, B211, B213

Teaching aids: A1

Required performance:

2.1 Effect of flooding on Transverse Stability and Trim (9 hours) R1

- states that, in the absence of hull damage, the stability

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

is calculated in the usual way using the added mass and making allowance for free surface liquid
- states that free surface moments for any compartment that is flooded by salt water can be approximated by

  moment = length x $(\text{breadth})^3$ x 1. 025 / 12

- states that virtual loss of GM = $\dfrac{\text{moment}}{\text{flooded displacement}}$

- states that when a compartment is holed the ship will sink deeper in the water until the intact volume displaces water equivalent to the mass of the ship and its contents
- explains that the loss of buoyancy of a holed compartment is equal to the mass of water which enters the compartment up to the original waterline
- states that the volume of lost buoyancy for a loaded compartment is equal to the volume of the compartment x the permeability of the compartment
- calculates the permeability of cargo, given its density and its stowage factor
- states that if the lost buoyancy is greater than the reserve buoyancy the ship will sink
- states that the centre of buoyancy moves to the centre of immersed volume of the intact portion of the ship
- states that when a compartment is hold the ship's displacement and its centre of gravity are unchanged
- explains that a heeling arm is produced, equal to the transverse separation of G and the new position of B for the upright ship
- states that the area of intact waterplane is reduced by the area of the flooded spaces at the level of the flooded waterline multiplied by the permeability of the space
- states that if the flooded space is entirely below the waterline there is no reduction in intact waterplane
- calculates the increase in mean draught of a ship, given the TPC and the dimensions of the flooded space, using

  increase in draught = $\dfrac{\text{volume of lost buoyancy}}{\text{area of intact waterplane}}$

- states that the height of the centre of buoyancy above
- the keel increases by about half the increase in
- draught due to flooding
- states that a reduction in waterplane area leads to a

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

reduction in the second moment of area (I)

- uses the formula BM = I / V to explain why the BM of a ship is generally less when bilged that when intact
- states that change in GM is the net result of changes in KB and BM
- explains why the GM usually decreases where:
  - there is a large loss of intact waterplane
  - there is intact buoyancy below the flooded space
  - the flooded surface has a high permeability
- explains why the bilging of empty double-bottom tanks or of deep tanks that are wholly below the waterline leads to an increase in GM
- calculates the reduction in BM resulting from lost area of the waterplane, given the following corrections:
- second moment of lost area about its centroid / displaced volume;

  this is $\frac{Lb^3}{12\ V}$ for a rectangular surface

  where: L is length of the lost area
  b is breadth of the lost area
  V is displaced volume = $\frac{\text{displacement}}{\text{density of water}}$

  original waterplane area / intact waterplane area x lost area x (distance from centerline) ^{2} / displaced volume

  this is original waterplance area / intact waterplane area x 1bd ^{2} / V

  for a rectangular surface, where d is the distance of the centre of the area from the centreline
- deduces that the second correction applies only in the case of asymmetrical flooding
- calculates the shift (F) of the centre of flotation (CE) from the centreline, using
  $F = \frac{a \times d}{A - a}$

  where: a is the lost area of waterplane
  A is the original waterplane area
  d is the distance of the centre of lost area of waterplane from the centerline

- shows that the heeling arm is given by

  heeling arm = lost buoyancy (tonnes) / displacement x

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

transverse distance from new CF

- constructs a GZ curve for the estimated GM and superimposes the heeling- arm curve to determine the approximate angle of heel
- uses wall sided formula to determine GZ values
- uses wall sided formula to calculate angle of heel
- states that, for small angles of heel, θ,

$$\tan \theta = \frac{\text{heeling arm}}{\text{GM}}$$

- explains how lost area of waterplane affects the position of the centre of flotation

Effect of Flooding on Trim

- calculates the movement of the centre of flotation (CF), given:

  Movement of CF = moment of lost area about original CF / intact waterplane area

- explains how the reduction in intact waterplane reduces the MCT 1cm

- calculates the reduction of BML, given the following corrections:
  second moment of lost area about its centroids/ displaced volume;

  this is $\frac{bL^3}{12\ V}$ for a rectangular surface

  where: L is length of lost area
  B is breadth of lost area

  V is displaced volume = $\frac{\text{displacement}}{\text{density of water}}$

  Original waterplane area / intact waterplane area x lost area x (distance from CF) ^{2} / displace volume

  This is original waterplane area / intact waterplane area x bld^2 / v

- for a rectangular surface, where d is the distance of the centre of area from the original centre of flotation

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

- calculates the reduction of MCT 1cm, given,
  reduction of MCT 1 cm = (displacement x reduction of GM) / 100 x ship's length

- states that the trimming moment is calculated from:
  trimming moment = lost buoyancy x distance from new CF
  where the lost buoyancy is measured in tonnes
- given the dimensions of a bilged space and the ship's hydrostatic data, calculates the draughts in the damaged condition
- describes measures which may be taken to improve the stability or trim of a damaged ship

2.2 Theories Affecting Trim and Stability (2 hours) R1

- describes the effects on centre of gravity of slack tanks
- identifies free surface moments and shows its application to dead-weight moment curves
- interprets changes in stability which take place during a voyage
- describes effect on stability of ice formation on superstructure
- describes the effect of water absorption by deck cargo and retention of water on deck
- describes stability requirements for dry docking
- demonstrates understanding of angle of loll
- states precautions to be observed in correction of angle of loll
- explains the dangers to a vessel at an angle of loll
- describes effects of wind and waves on ships stability
- lists the main factors which affect the rolling period of a vessel
- explains the term synchronous rolling and describes the dangers associated with it
- describes the actions that can be taken to stop synchronous rolling

3.1.3 IMO RECOMMENDATIONS CONCERNING SHIP STABILITY

Textbooks: T4

Bibliography: B1, B2, B3, B4, B5, B6, B9, B10, B11, B14, B15, B20, B22, B23, B29, B30, B31, B32, B35, B37, B39, B43, B44, B46, B47, B48, B49, B52, B53, B54, B64, B84, B85, B96, B103, B107, B111, 114, B115, B118, B126, B131, B132, B133, 135,

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

B137, B144, B145, B147, B148, B149, B154, B159, B160, B169, B170, B171, B174

Teaching aids: A1

Required performance:

3.1 Responsibilities under the International Conventions and Codes (2 hours)

- states minimum stability requirements required by Load Line Rules 1966 — R1
- demonstrates correct use of IMO Grain Regulations
- explains how grain heeling moment information is used
- describes the requirements for passenger ship stability after damage
- explains how the effects of steady and gusting winds are determined
- states the minimum IMO stability requirements with respect to wind heeling under current regulations

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

TRAINING OUTCOMES:

STCW Code
Table A-II/2

Demonstrates a knowledge and understanding of

3.2.1 INTERNATIONAL MARITIME LAW EMBODIED IN INTERNATIONAL AGREEMENTS AND CONVENTIONS, WITH PARTICULAR REGARD TO CERTIFICATES AND DOCUMENTS TO BE CARRIED ON BOARD BY INTERNATIONAL CONVENTIONS; RESPONSIBILITIES UNDER THE RELEVANT REQUIREMENTS OF THE INTERNATIONAL CONVENTION ON LOAD LINES, SAFETY OF LIFE AT SEA, PREVENTION OF POLLUTION FROM SHIPS, AND METHODS OF AID TO PREVENT POLLUTION OF THE MARINE ENVIRONMENT; REQUIREMENTS OF THE INTERNATIONAL HEALTH REGULATIONS; AND NATIONAL LEGISLATION FOR IMPLEMENTING INTERNATIONAL AGREEMENTS AND CONVENTIONS

COMPETENCE 3.2 Monitor and Control Compliance with Legislative requirements **IMO Reference**

3.2.1 INTERNATIONAL MARITIME LAW EMBODIED IN VARIOUS CONVENTIONS

Textbooks / Bibliography: T10, T42, T43, B1, B2, B4, B5, B6, B9, B10, B11, B14, B15, B20, B22, B23, B29, B30, B31, B32, B35, B37, B39, B43, B44, B46, B47, B48, B49, B52, B53, B54, B64, B84, B85, B96, B107, B111, B114, B115, B126, B132, B133, B135, B137, B145, B147, B148, B149, B154, B160, B169, B170, B171, B174, B176, B178, B179, B180, B183, B184, B185, B186, B187, B199, B204, B205, B207, B211, B213

Teaching aids: A1, V2, V77, V79, V80, V81, V82, V86, V87, V89, V90, V91, V92, V94, V95, V97, V99, V100, V101, V102, V105, V109, V110, V111, V112, V115, V117, V118, V119, V126, V127, V131, V156, V157, V158, V169

Required performance:

1.1 Certificates and Other Documents Required to be Carried on Board Ships by International Conventions (1 hour)

- lists the following certificates and other documents required to be carried on-board ships by international conventions and states their periods of validity:

Section 1 - All ships

- **International Tonnage Certificate (1969)**
  An International Tonnage Certificate (1969) is to be issued to every ship, the gross and net tonnage of which have been determined in accordance with the Convention.

  (Tonnage Convention, article 7)

- **International Load Line Certificate**
  An International Load Line Certificate is to be issued under the provisions of the International Convention on Load Lines, 1966, to every ship which has been surveyed and marked in accordance with the Convention or the Convention as modified by the 1988 LL Protocol, as appropriate.

  (LL Convention, article 16; 1988 LL Protocol, article 18)

- **International Load Line Exemption Certificate**
  An International Load Line Exemption Certificate is to

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

be issued to any ship to which an exemption has been granted under and in accordance with article 6 of the Load Line Convention or the Convention as modified by the 1988 LL Protocol, as appropriate.

(LL Convention, article 6; 1988 LL Protocol, article 18)

- **Intact stability booklet**
  Every passenger ship regardless of size and every cargo ship of 24 metres and over is to be inclined on completion and the elements of their stability determined. The master is to be supplied with a Stability Booklet containing such information as is necessary to enable him, by rapid and simple procedures, to obtain accurate guidance as to the stability of the ship under varying conditions of loading. For bulk carriers, the information required in a bulk carrier booklet may be contained in the stability booklet.

  (SOLAS 1974, regulations II-1/22 and II-1/25-8; 1988 LL Protocol, regulation 10)

- **Damage control plans and booklets**
  On passenger and cargo ships, there are to be permanently exhibited plans showing clearly for each deck and hold the boundaries of the watertight compartments, the openings therein with the means of closure and position of any controls thereof, and the arrangements for the correction of any list due to flooding. Booklets containing the aforementioned information is to be made available to the officers of the ship.

  (SOLAS 1974, regulations II-1/23, 23-1, 25-8)

- **Minimum safe manning document**
  Every ship to which chapter I of the Convention applies is to be provided with an appropriate safe manning document or equivalent issued by the Administration as evidence of the minimum safe manning.

  (SOLAS 1974-2000 amendments, regulation V/14.2)

- **Fire safety training manual**

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

A training manual is written in the working language of the ship and is to be provided in each crew mess room and recreation room or in each crew cabin. The manual contains the instructions and information required in regulation II-2/15.2.3.4. Part of such information may be provided in the form of audio-visual aids in lieu of the manual.

(SOLAS 1974 - 2000 amendments, regulation II-2/15.2.3)

- **Fire Control plan / booklet**
  General arrangement plans are to be permanently exhibited for the guidance of the ship's officers, showing clearly for each deck the control stations, the various fire sections together with particulars of the fire detection and fire alarm systems and the fire-extinguishing appliances etc. Alternatively, at the discretion of the Administration, the aforementioned details may be set out in a booklet, a copy of which is to be supplied to each officer, and one copy are available on board at all times in an accessible position. Plans and booklets are kept up to date; any alterations are recorded as soon as practicable. A duplicate set of fire control plans or a booklet containing such plans are to be permanently stored in a prominently marked weathertight enclosure outside the deckhouse for the assistance of shore-side fire-fighting personnel.

  (SOLAS 1974 - 2000 amendments. regulation II-2/15.2.4)

- **On board training and drills record**
  Fire drills are to be conducted and recorded in accordance with the provisions of regulations III/19.3 and III/19.5.

  (SOLAS 1974 – 2000 amendments, regulation II-2/15.2.2.5)

- **Fire safety operational booklet**
  The fire safety operational booklet is to contain the necessary information and instructions for the safe operation of the ship and cargo handling operations in relation to fire safety. The booklet is written in the working language of the ship and be provided in each

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crew mess room and recreation room or in each crew cabin. The booklet can be combined with the fire safety training manuals required in regulation II-2/15.2.3.

(SOLAS 1974 - 2000 amendments, regulation II-2/16.2)

- **Certificates for masters, officers or ratings**
  Certificates for masters, officers or ratings are to be issued to those candidates who, to the satisfaction of the Administration, meet the requirements for service, age, medical fitness, training, qualifications and examinations in accordance with the provisions of the STCW Code annexed to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended. Formats of certificates are given in section A-I/2 of the STCW Code. Certificates must be kept available in their original form on board the ships on which the holder is serving.

  (STCW 1978, as amended, article VI, regulation I/2; STCW Code, section A-I/2)

- **International Oil Pollution Prevention Certificate**
  An international Oil Pollution Prevention Certificate is to be issued, after survey in accordance with regulation 4 of Annex I of MARPOL 73/78, to any oil tanker of 150 gross tonnage and above and any other ship of 400 gross tonnage and above which is engaged in voyages to ports or offshore terminals under the jurisdiction of other Parties to MARPOL 73/78. The certificate is to be supplemented with a Record of Construction and Equipment for Ships other than Oil Tankers (Form A) or a Record of Construction and Equipment for Oil Tankers (Form B), as appropriate.

  (MARPOL 73/78, Annex I, regulation 5)

- **Oil Record Book**
  Every oil tanker of 150 gross tonnage and above and every ship of 400 gross tonnage and above other than an oil tanker is to be provided with an Oil Record Book, Part I (Machinery space operations). Everyoil tanker of 150 gross tonnage and above are to be also

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provided with an Oil Record Book, Part II (Cargo/ballast operations).

(MARPOL 73/78, Annex I, regulation 20)

- **Shipboard Oil Pollution Emergency Plan**
  Every oil tanker of 150 gross tonnage and above and every ship other than an oil tanker of 400 gross tonnage and above are to be required to carry on board a Shipboard Oil Pollution Emergency Plan approved by the Administration.

  (MARPOL 73/78, Annex I, regulation 26)

- **International Sewage Pollution Prevention Certificate**
  An International Sewage Pollution Prevention Certificate is to be issued, after an initial or renewal survey in accordance with the provisions of regulation 4 of Annex IV of MARPOL 73/78, to any ship which is required to comply with the provisions of that Annex and is engaged in voyages to ports or offshore terminals under the jurisdiction of other Parties to the Convention.

  (MARPOL 73/78, Annex IV, regulation 5; MEPC/Circ.408)

- **Garbage Management Plan**
  Every ship of 400 gross tonnage and above and every ship which is certified to carry 15 persons or more are to be required to carry a garbage management plan which the crew are required to follow.

  (MARPOL 73/78, Annex V, regulation 9)

- **Garbage Record Book**
  Every ship of 400 gross tonnage and above and every ship which is certified to carry 15 persons or more engaged in voyages to ports or offshore terminals under the jurisdiction of other Parties to the Convention and every fixed and floating platform engaged in exploration and exploitation of the sea-bed are to be provided with a Garbage Record Book.

  (MARPOL 73/78, Annex V, regulation 9)

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- **Voyage data recorder system-certificate of compliance**
  The voyage data recorder system, including all sensors, are to be subjected to an annual performance test. The test is conducted by an approved testing or servicing facility to verify the accuracy, duration and recoverability of the recorded data. In addition, tests and inspections are conducted to determine the serviceability of all protective enclosures and devices fitted to aid location. A copy of the certificate of compliance is to be issued by the testing facility, stating the date of compliance and the applicable performance standards, are retained on board the ship.

  (SOLAS 1974, regulation V/18.8)

- **Cargo Securing Manual**
  All cargoes, other than solid and liquid bulk cargoes, cargo units and cargo transport units, are loaded, stowed and secured throughout the voyage in accordance with the Cargo Securing Manual approved by the Administration. In ships with ro-ro spaces, as defined in regulation II-2/3.41, all securing of such cargoes, cargo units and cargo transport units, in accordance with the Cargo Securing Manual, are to be completed before the ship leaves the berth. The Cargo Securing Manual is to be required on all types of ships engaged in the carriage of all cargoes other than solid and liquid bulk cargoes, which are drawn up to a standard at least equivalent to the guidelines developed by the Organization.

  (SOLAS 1974 - 2002 amendments, regulations VI/5.6 and VII/5; MSC/Circ.745)

- **Document of Compliance**
  A document of compliance is to be issued to every company which complies with the requirements of the ISM Code. A copy of the document is kept on board.

  (SOLAS 1974,regulation IX/4; ISM Code, paragraph 13)

- **Safety Management Certificate**

  A Safety Management Certificate is to be issued to

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every ship by the Administration or an organization recognized by the Administration. The Administration or an organization recognized by it, before issuing the Safety Management Certificate, verifies that the company and its shipboard management operate in accordance with the approved safety management system.
(SOLAS 1974, regulation IX/4; ISM Code, paragraph 13)

- **International Ship Security Certificate (ISSC)** or **Interim International Ship Security Certificate**
  An International Ship Security Certificate (ISSC) is to be issued to every ship by the Administration or an organization recognized by it to verify that the ship complies with the maritime security provisions of SOLAS chapter XI-2 and part A of the ISPS Code. An interim ISSC can be issued under the ISPS Code part A, section 19.4.

  (SOLAS 1974 - 2002 amendments, regulation XI-2/9.1.1; ISPS Code part A, section 19 and appendices)

- **Ship Security Plan and associated records**
  Each ship is required to carry on board a ship security plan approved by the Administration. The plan makes provisions for the three security levels as defined in part A of the ISPS Code. Records of the following activities addressed in the ship security plan are kept on board for at least the minimum period specified by the Administration:
  .1 training, drills and exercises;
  .2 security threats and security incidents;
  .3 breaches of security;
  .4 changes in security level;
  .5 communications relating to the direct security of the ship such as specific threats to the ship or to port facilities the ship is, or has been, in;
  .6 internal audits and reviews of security activities;
  .7 periodic review of the ship security assessment;
  .8 periodic review of the ship security plan;
  .9 implementation of any amendments to the plan; and
  .10 maintenance, calibration and testing of any security equipment provided on board, including testing of the ship security alert system.

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(SOLAS 1974 - 2002 amendments, regulation XI-2/9; ISPS Code part A, sections 9 and 10)

- **Continuous Synopsis Record (CSR)**
  Every ship to which chapter I of the Convention applies is to be issued with a Continuous Synopsis Record. The Continuous Synopsis Record provides an on-board record of the history of the ship with respect to the information recorded therein.

  (SOLAS 1974 - 2002 amendments, regulation XI-1/5)

Section 2 - In addition to the certificates listed in section 1 above, passenger ships shall carry:

- **Passenger Ship Safety Certificate**
  A certificate called a Passenger Ship Safety Certificate is to be issued after inspection and survey to a passenger ship which complies with the requirements of chapters II-1, II-2, III and IV and any other relevant requirements of SOLAS 1974. A Record of equipment for the Passenger Ship Safety Certificate (Form P) is permanently attached.

  (SOLAS 1974, regulation I/12, as amended by the GMDSS amendments; 1988 SOLAS Protocol, regulation I/12, - 2000 amendments appendix)

- **Exemption Certificate**
  When an exemption is granted to a ship under and in accordance with the provisions of SOLAS 1974, a certificate called an Exemption Certificate is to be issued in addition to the certificates listed above.

  (SOLAS 1974, regulation I/12; 1988 SOLAS Protocol, regulation I/12)

- **Special Trade Passenger Ship Safety Certificate, Special Trade Passenger Ship Space Certificate**
  A Special Trade Passenger Ship Safety Certificate issued under the provisions of the Special Trade Passenger Ships Agreement, 1971. A certificate called a Special Trade Passenger Ship Space Certificate is to be issued under the provisions of the Protocol on Space Requirements for Special Trade Passenger Ships, 1973.

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(STP 71, rule 5, SSTP 73, rule 5)

- **Search and rescue co-operation plan**
  Passenger ships to which chapter I of the Convention applies are to have on board a plan for co-operation with appropriate search and rescue services in event of an emergency.

  (SOLAS 1974 – 2000 amendments, regulation V/7.3)

- **List of operational limitations**
  Passenger ships to which chapter I of the Convention applies are to keep on board a list of all limitations on the operation of the ship, including exemptions from any of the SOLAS, regulations, restrictions in operating areas, weather restrictions, sea state restrictions, restrictions in permissible loads, trim, speed and any other limitations, whether imposed by the Administration or established during the design or the building stages.

  (SOLAS 1974 - 2000 amendments, regulation V/30)

- **Decision support system for masters**
  In all passenger ships, a decision support system for emergency management are to be provided on the navigation bridge.

  (SOLAS 1974, regulation III/29)

Section 3 - In addition to the certificates listed in section 1 above, cargo ships shall carry:

- **Cargo Ship Safety Construction Certificate**
  A certificate called a Cargo Ship Safety Construction Certificate is to be issued after survey to a cargo ship of 500 gross tonnage and over which satisfies the requirements for cargo ships on survey, set out in regulation I/10 of SOLAS 1974, and complies with the applicable requirements of chapters II-1 and II-2, other than those relating to fire-extinguishing appliances and fire control plans.
  (SOLAS 1974, regulation I/12, as amended by the GMDSS amendments; 1988 SOLAS Protocol, regulation I/12)

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

- **Cargo Ship Safety Equipment Certificate**
  A certificate called a Cargo Ship Safety Equipment Certificate is to be issued after survey to a cargo ship of 500 gross tonnage and over which complies with the relevant requirements of chapters II-1 and II-2 and III and any other relevant requirements of SOLAS 1974. A Record of Equipment for the Cargo Ship Safety Equipment Certificate (Form E) is to be permanently attached.

  (SOLAS 1974, regulation I/12, as amended by the GMDSS amendments; 1988 SOLAS Protocol, regulation I/12 - 2000 amendments, Appendix)

- **Cargo Ship Safety Radio Certificate**5
  A certificate called a Cargo Ship Safety Radio Certificate is to be issued after survey to a cargo ship of 300 gross tonnage and over, fitted with a radio installation, including those used in life-saving appliances, which complies with the requirements of chapters III and IV and any other relevant requirements of SOLAS 1974. A Record of Equipment for the Cargo Ship Safety Radio Certificate (Form R) is to be permanently attached.

  (SOLAS 1974, regulation I/12, as amended by the GMDSS amendments; 1988 SOLAS Protocol, regulation I/12)

- **Cargo Ship Safety Certificate**
  A certificate called a Cargo Ship Safety Certificate may be issued after survey to a cargo ship which complies with the relevant requirements of chapters II-1, II-2, III, IV and V and other relevant requirements of SOLAS 1974 as modified by the 1988 SOLAS Protocol, as an alternative to the above cargo ship safety certificates. A Record of Equipment for the Cargo Ship Safety Certificate (Form C) is to be permanently attached.

  (1988 SOLAS Protocol, regulation I/12 - 2000 amendments, Appendix)
- **Exemption Certificate**
  When an exemption is granted to a ship under and in accordance with the provisions of SOLAS 1974, a certificate called an Exemption Certificate is to be issued in addition to the certificates listed above.

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(SOLAS 1974, regulation I/12 ; 1988 SOLAS Protocol, regulation I/12)

- **Document of authorization for the carriage of grain**
  A document of authorization is to be issued for every ship loaded in accordance with the regulations of the International Code for the Safe Carriage of Grain in Bulk either by the Administration or an organization recognized by it or by a Contracting Government on behalf of the Administration. The document is to accompany or be incorporated into the grain loading manual provided to enable the master to meet the stability requirements of the Code.

  (SOLAS 1974, regulation VI/9; International Code for the Safe Carriage of Grain in Bulk, section 3)

- **Certificate of insurance or other financial security in respect of civil liability for oil pollution damage**
  A certificate attesting that insurance or other financial security is in force is to be issued to each ship carrying more than 2,000 tons of oil in bulk as cargo. It is to be issued or certified by the appropriate authority of the State of the ship's registry after determining that the requirements of article VII, paragraph 1, of the CLC Convention have been complied with.

  (CLC 1969, article VII)

- **Certificate of insurance or other financial security in respect of civil liability for oil pollution damage**
  A certificate attesting that insurance or other financial security is in force in accordance with the provisions of the 1992 CLC Convention shall be issued to each ship carrying more than 2,000 tons of oil in bulk as cargo after the appropriate authority of a contracting State has determined that the requirements of article VII, paragraph 1, of the Convention have been complied with. With respect to a ship registered in a Contracting State, such certificate is to be issued by the appropriate authority of the State of the ship’s registry; with respect to a ship not registered in a Contracting State, it may be issued or certified by the appropriate authority of any Contracting State.

  (CLC 1992, article VII)

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- **Enhanced survey report file**
  Bulk carriers and oil tankers is to have a survey report file and supporting documents complying with paragraphs 6.2 and 6.3 of annex A and annex B of resolution A.744 (18).
  Guidelines on the enhanced programme of inspections during surveys of bulk carriers and oil tankers.

  (SOLAS 1974 - 2002 amendments, regulation XI-1/2; resolution A.744(18))

- **Record of oil discharge monitoring and control system for the last ballast voyage**
  Subject to provisions of paragraphs (4), (5), (6) and (7) of regulation 15 of Annex I of MARPOL 73/78, every oil tanker of 150 gross tonnage and above is to be fitted with an oil discharge monitoring and control system approved by the Administration. The system is to be fitted with a recording device to provide a continuous record of the discharge in litres per nautical mile and total quantity discharged, or the oil content and rate of discharge. This record shall be identifiable as to time and date and is to be kept for at least three years.

  (MARPOL 73/78, Annex I, regulation 15(3)(a))

- **Cargo Information**
  The shipper is required to provide the master or his representative with appropriate information, confirmed in writing, on the cargo, in advance of loading. In bulk carriers, the density of the cargo is to be provided in the above information.

  (SOLAS 1974, regulations VI/2 and XII/10; MSC/Circ.663)

- **Bulk Carrier Booklet**
  To enable the master to prevent excessive stress in the ship's structure, the ship loading and unloading solid bulk cargoes is to be provided with a booklet referred to in SOLAS regulation VI/7.2. The booklet is to be endorsed by the Administration or on its behalf

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to indicate that SOLAS regulations XII/4, 5, 6 and 7, as appropriate, are complied with. As an alternative to a separate booklet, the required information may be contained in the intact stability booklet.

(SOLAS 1974, regulations VI/7 and; XII/8; Code of Practice for the Safe Loading and Unloading of Bulk Carriers (BLU Code))

- **Dedicated Clean Ballast Tank Operation Manual**
  Every oil tanker operating with dedicated clean ballast tanks in accordance with the provisions of regulation 13(10) of Annex I of MARPOL 73/78 is to be provided with a Dedicated Clean Ballast Tank Operation Manual detailing the system and specifying operational procedures. Such a Manual is to be to the satisfaction of the Administration and shall contain all the information set out in the Specifications referred to in paragraph 2 of regulation 13A of Annex I of MARPOL 73/78.

  (MARPOL 73/78, Annex I, regulation 13A)

- **Crude Oil Washing Operation and Equipment Manual (COW Manual)**
  Every oil tanker operating with crude oil washing systems shall be provided with an Operations and Equipment Manual detailing the system and equipment and specifying operational procedures. Such a Manual is required to be to the satisfaction of the Administration and is to contain all the information set out in the specifications referred to in paragraph 2 of regulation 13B of Annex I of MARPOL 73/78.

  (MARPOL 73/78, Annex I, regulation 13B)

– **Condition Assessment Scheme (CAS) Statement of Compliance, CAS Final Report and Review Record**
  A Statement of Compliance is to be issued by the Administration to every oil tanker which has been surveyed in accordance with the requirements of the Condition Assessment Scheme (CAS) (resolution MEPC.94 (46), as amended) and found to be in compliance with these requirements. In addition, a copy of the CAS Final Report which was reviewed by the Administration for the issue of the Statement of

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Compliance and a copy of the relevant Review Record is to be placed on board to accompany the Statement of Compliance.

(MARPOL 73/78, Annex I (2001 amendments (resolution MEPC.95(46), regulation 13G; resolution MEPC.94(46))

- **Hydrostatically Balanced Loading (HBL) Operational Manual**
  Every oil tanker which, in compliance with regulation 13G(6)(b), operates with Hydrostatically Balanced Loading is to be provided with an operational manual in accordance with resolution MEPC.64(36).

  (MARPOL 73/78, Annex I - 2001 amendments (resolution MEPC.95(46)), regulation 13G)

- **Oil Discharge Monitoring and Control (ODMC) Operational Manual**
  Every oil tanker fitted with an Oil Discharge Monitoring and Control system shall be provided with instructions as to the operation of the system in accordance with an operational manual approved by the Administration.

  (MARPOL 73/78, Annex I, regulation 15(3)(c))

- **Subdivision and stability information**
  Every oil tanker to which regulation 25 of Annex I of MARPOL 73/78 applies is to be provided in an approved form with information relative to loading and distribution of cargo necessary to ensure compliance with the provisions of this regulation and data on the ability of the ship to comply with damage stability criteria as determined by this regulation.

  (MARPOL 73/78, Annex I, regulation 25)

Section 4 - In addition to the certificates listed in sections 1 and 3 above, where appropriate, any ship carrying noxious liquid chemical substances in bulk shall carry:

- **International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk**

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(NLS Certificate)
An international pollution prevention certificate for the carriage of noxious liquid substances in bulk (NLS certificate) is to be issued, after survey in accordance with the provisions of regulation 10 of Annex II of MARPOL 73/78, to any ship carrying noxious liquid substances in bulk and which is engaged in voyages to ports or terminals under the jurisdiction of other Parties to MARPOL 73/78. In respect of chemical tankers, the Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk and the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk, issued under the provisions of the Bulk Chemical Code and International Bulk Chemical Code, respectively, is to have the same force and receive the same recognition as the NLS certificate.

(MARPOL 73/78, Annex II, regulations 11 and 12A)

- **Cargo record book**
  Every ship to which Annex II of MARPOL 73/78 applies is to be provided with a Cargo Record Book, whether as part of the ship's official log book or otherwise, in the form specified in appendix IV to the Annex.

  (MARPOL 73/78, Annex II, regulation 9)

- **Procedures and Arrangements Manual (P & A Manual)**
  Every ship certified to carry noxious liquid substances in bulk is required to have on board a Procedures and Arrangements Manual approved by the Administration.

  (Resolution MEPC.18(22), chapter 2; MARPOL 73/78, Annex II, regulations 5, 5A and 8)

- **Shipboard Marine Pollution Emergency Plan for Noxious Liquid Substances**
  Every ship of 150 gross tonnage and above certified to carry noxious liquid substances in bulk is required to carry on board a shipboard marine pollution emergency plan for noxious liquid substances approved by the Administration.

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(MARPOL 73/78, Annex II, regulation 16)

Section 5 - In addition to the certificates listed in sections 1 and 3 above, where applicable, any chemical tanker shall carry:

- **Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk**
  A certificate called a Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk, the model form of which is set out in the appendix to the Bulk Chemical Code, is to be issued after an initial or periodical survey to a chemical tanker engaged in international voyages which complies with the relevant requirements of the Code.

  Note: The Code is mandatory under Annex II of MARPOL 73/78 for chemical tankers constructed before 1 July 1986. **Or** BCH Code, section 1.6; BCH Code as modified by
  resolution MSC.18(58), section 1.6

- **International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk**
  A certificate called an International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk, the model form of which is set out in the appendix to the International Bulk Chemical Code, is to be issued after an initial or periodical survey to a chemical tanker engaged in international voyages which complies with the relevant requirements of the Code.

  Note: The Code is mandatory under both chapter VII of SOLAS 1974 and Annex II of MARPOL 73/78 for chemical tankers constructed on or after 1 July 1986.

  (IBC Code, section 1.5; IBC Code as modified by resolutions MSC.16(58) and MEPC.40(29), section 1.5)

Section 6 - In addition to the certificates listed in sections 1 and 3 above, where applicable, any gas carrier shall carry:

- **Certificate of Fitness for the Carriage of Liquefied**

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Gases in Bulk
A certificate called a Certificate of Fitness for the Carriage of Liquefied Gases in Bulk, the model form of which is set out in the appendix to the Gas Carrier Code, is to be issued after an initial or periodical survey to a gas carrier which complies with the relevant requirements of the Code.
(GC Code, section 1.6)

- **International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk**
  A certificate called an International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk, the model form of which is set out in the appendix to the International Gas Carrier Code, is to be issued after an initial or periodical survey to a gas carrier which complies with the relevant requirements of the Code.

  Note: The Code is mandatory under chapter VII of SOLAS 1974 for gas carriers constructed on or after 1 July 1986.
  (IGC Code, section 1.5; IGC Code as modified by resolution MSC.17(58), section 1.5)

Section 7 - In addition to the certificates listed in sections 1, and 2 or 3 above, where applicable, any high-speed craft shall carry:

- **High-Speed Craft Safety Certificate**
  A certificate called a High-Speed Craft Safety Certificate is to be issued after completion of an initial or renewal survey to a craft which complies with the requirements of the 1994 HSC Code or the 2000 HSC Code, as appropriate.

  (SOLAS 1974, regulation X/3; 1994 HSC Code, section 1.8; 2000 HSC Code, section 1.8)

- **Permit to Operate High-Speed Craft**
  A certificate called a Permit to Operate High-Speed Craft is to be issued to a craft which complies with the requirements set out in paragraphs 1.2.2 to 1.2.7 of the 1994 HSC Code or the 2000 HSC Code, as appropriate.

  (1994 HSC Code, section 1.9; 2000 HSC Code,

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section 1.9)

Section 8 - In addition to the certificates listed in sections 1, and 2 or 3 above, where applicable, any ship carrying dangerous goods shall carry:

- **Document of compliance with the special requirements for ships carrying dangerous goods**
  The Administration is to provide the ship with an appropriate document as evidence of compliance of construction and equipment with the requirements of regulation II-2/19 of SOLAS 1974. Certification for dangerous goods, except solid dangerous goods in bulk, is not required for those cargoes specified as class 6.2 and 7 and dangerous goods in limited quantities.

  (SOLAS 1974 - 2000 amendments, regulation II-2/19.4)

Section 9 - In addition to the certificates listed in sections 1, and 2 or 3 above, where applicable, any ship carrying dangerous goods in packaged form shall carry:

- **Dangerous goods manifest or stowage plan**
  Each ship carrying dangerous goods in packaged form is to have a special list or manifest setting forth, in accordance with the classification set out in the IMDG Code, the dangerous goods on board and the location thereof. Each ship carrying dangerous goods in solid form in bulk is to have a list or manifest setting forth the dangerous goods on board and the location thereof. A detailed stowage plan, which identifies by class and sets out the location of all dangerous goods on board, may be used in place of such a special list or manifest. A copy of one of these documents is to be made available before departure to the person or organization designated by the port State authority.
  (SOLAS 1974, (2002 amendments), regulations VII/4.5 and VII/7-2; MARPOL 73/78, Annex III, regulation 4)

Section 10 - In addition to the certificates listed in sections 1, and 2 or 3 above, where applicable, any ship carrying INF cargo shall carry:

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- **International Certificate of Fitness for the Carriage of INF Cargo**
  A ship carrying INF cargo is to comply with the requirements of the International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships (INF Code) in addition to any other applicable requirements of the SOLAS regulations and is to be surveyed and be provided with the International Certificate of Fitness for the Carriage of INF Cargo.

  (SOLAS 1974, regulation VII/16; INF Code (resolution MSC.88(71)), paragraph 1.3)

Section 11 - In addition to the certificates listed in sections 1, and 2 or 3 above, where applicable, any Nuclear Ship shall carry:

- **A Nuclear Cargo Ship Safety Certificate or Nuclear Passenger Ship Safety Certificate, in place of the Cargo Ship Safety Certificate or Passenger Ship Safety Certificate, as appropriate.**
  Every Nuclear powered ship is to be issued with the certificate required by SOLAS chapter VIII.

  (SOLAS 1974, regulation VIII/10)

1.2 Responsibilities under the Relevant Requirements of the International Convention on Load Lines (1 hour)

- states that, after repairs or alterations, a ship should comply with at least the requirements previously applicable and that, after major repairs or alterations, ships should comply with the requirements for a new ship in so far as the Administration deems reasonable and practicable
- states that a ship to which the Convention applies must comply with the requirements for that ship in the zones and areas described in Annex II, as amended
- explains the treatment of a port lying on the boundary between two zones or areas
- states that the appropriate load lines on the sides of the ship corresponding to the season and to the zone or area in which the ship may be must not be submerged at any time when the ship puts to sea, during the voyage or on arrival

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

- states that when a ship is in fresh water of unit density the appropriate load line may be submerged by the amount of the fresh water allowance shown on the International Load Line Certificate (1966)
- states that when a ship departs from port situated on a river or inland waters, deeper loading is permitted corresponding to the weight of fuel and all other materials required for consumption between the point of departure and the sea
- describes the requirements for initial and periodical surveys
- describes the requirements for periodical inspections and lists the fittings and appliances which are inspected
- states that the periodical inspections should be endorsed on the International Load Line Certificate (1966)
- states that after any survey has been completed no change should be made in the structure, equipment or other matters covered by the survey without the sanction of the Administration
- states that an International Load Line Certificate (1966) should be issued to every ship which has been surveyed and marked in accordance with the Convention or an International Load Line Exemption Certificate should be issued to a ship which has been granted exemption
- explains the circumstances in which an International Load Line Certificate (1966) would be cancelled by the Administration
- describes the information which should be supplied to the master conceming the loading and ballasting of the ship and its stability under varying conditions of Service the arrival
- describes the contents of the record of conditions of assignment which should be supplied to the ship

1.3 Responsibilities under the Relevant Requirements of the International Convention for the Safety of Life at Sea (2 hours) **R2**

- states the obligations of the master concerning the sending of danger messages relating to dangerous ice, a dangerous derelict, other dangers to navigation, tropical storms, sub-freezing air temperature with gale force winds causing severe ice accretion or winds of force 10 or above for which no storm warning has

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference
	been received.	
	- lists the information required in danger messages	
	- states that when ice is reported near his course, the master of every ship at night is bound to proceed at a moderate speed or to alter his course so as to go well clear of the danger zone	R2 Ch V Reg 10
	- states that the use of an international distress signal, except for the purpose of indicating that a ship or aircraft is in distress, and the use of any signal which may be confused with an international distress signal are prohibited	
	- states the obligations of the master of a ship at sea on receiving a signal from any source that a ship or aircraft or a survival craft thereof is in distress	
	- explains the rights of the master of a ship in distress to requisition one or more ships which have answered his call for assistance	
	- explains when the master of a ship is released from the obligation to render assistance	
	- describes the requirements for the carriage of navigational equipment	
	- states that all equipment fitted in compliance with Reg V/12 must be of a type approved by the Administration	
	- states that all ships should be sufficiently and efficiently manned	
	- states that manning is subject to Port State Control inspection	
	- lists the contents of the minimum safe manning document referred to in Assembly resolution A481 (XII), Principles of Safe Manning	
	- states that in areas where navigation demands special caution, ships should have more than one steering gear power unit in operation when such units are capable of simultaneous operation	R2
	- describes the procedure for the testing of the ship's steering gear before departure	
	- describes the requirements for the display of operating instructions and change-over procedures for remote steering gear control and steering gear power units	
	- describes the requirements for emergency steering drills	
	- lists the entries which should be made in the log-book regarding the checks and tests of the steering gear and the holding of emergency drills	
	- states that all ships should carry adequate and up-to-date charts, sailing directions, lists of lights, notices to mariners, tide tables and other nautical publications	

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference
	necessary for the voyage - states which ships should carry the International Code of Signals	
1.4	**Responsibilities under the International Convention for the Prevention of Pollution from Ships, 1973, and the Protocol of 1978 relating thereto (MARPOL 73/78)** (3 hours) - explains who may cause proceedings to be taken when a violation occurs within the jurisdiction of a Party to the Convention - explains the Parties to the Convention must apply the requirements of the Convention to ships of non-Parties to ensure that no more favourable treatment is given to such ships	R9, R10, R11, R12, R13, R26, R27, R28, R72, R73, R74
	Annex I — Oil	R10
	- states that, after survey has been completed, no change should be made in the structure, equipment, fittings, arrangements or materials without the sanction of the Administration, except the direct replacement of equipment and fittings - explains the masters duty to report when an accident occurs or a defect is discovered which substantially affects the integrity of the ship or the efficiency or completeness of its equipment covered by this Annex - states that the dates of intermediate and annual surveys are endorsed on the IOPP Certificate - states that a record of construction and equipment is attached as a supplement to the IOPP Certificate - explains the duration of validity of the IOPP Certificate and the circumstances in which the IOPP Certificate will cease to be valid - states that all new crude oil tankers of 20,000 tonnes deadweight and above must be fitted with a crude oil washing system - states that the competent authority of the Government of a Party to the Convention may inspect the Oil Record Book while the ship is in its port or offshore terminals and may make a copy of any entry and may require the master to certify that the copy is a true copy of such entry. - states that a copy certified by the master is admissible in any judicial proceedings as evidence of the facts stated in the entry - states that the master should be provided with	

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

information relative to loading and distribution of cargo necessary to ensure compliance with the regulation on subdivision and stability and the ability of the ship to comply with the damage stability criteria
- states all ships of 400gt or more must carry an approved shipboard oil pollution emergency plan (SOPEP)

Annex II — Noxious Liquid Substances in Bulk — R11

- states the duration of validity of the certificate
- explains that ships which have been surveyed and certified in accordance with the International Bulk Chemical Code (IBC Code) or the Bulk Chemical Code (BCH Code), as applicable, are deemed to have complied with the regulations regarding survey and certification and do not require to have an International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk

Annex III — Harmful Substances Carried by Sea in Packaged Forms, or in Freight Containers, Portable Tanks or Tank Wagons

- states that the master of the ship, or his representative, should notify the appropriate port authority of the intention to load or unload certain harmful substances at least 24 hours in advance

Annex IV — Sewage

- defines, for the purposes of Annex IV:
- holding tank, sewage and nearest land
- states the ships to which the provisions apply
- states that ships to which the regulations apply are subject to surveys for the issue of an International Sewage Pollution Prevention Certificate (1973)
- states the duration of validity of the certificate

Annex V — Garbage

- explains that when garbage is mixed with other discharges having different disposal requirements, the more stringent requirements apply
- describes the provisions for disposal of garbage from off-shore platforms and from ships alongside or within 500 metres from them

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

- lists the special areas for the purposes of this annex
- explains the requirements for disposal of garbage within special areas
- describes the exceptions to regulations 3, 4 and 5
- describes the form of record keeping required
- states records are subject to scrutiny by port state control officers

Annex VI — (Regulations for the Prevention of Air Pollution from Ships) of the MARPOL Convention.

- states that MARPOL 73/78 Annex VI Regulations for the prevention of Air Pollution from ships entered into force on 19 May 2005
- states that MARPOL Annex VI sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances
- explains that Annex VI emission control requirements are in accordance with the 1987 Montreal Protocol (a UN international environmental treaty), as amended in London in 1990
- states that MARPOL ANNEX VI applies to all ships, fixed and floating drilling rigs and other platforms, but the certification requirements are depending on size of the vessel and when it is constructed
- explains that Regulation 16 sets out requirements for shipboard incineration and as per 16(4) bans the incineration of:
  - MARPOL Annex I, II and III cargo residues and related contaminated packing materials;
  - polychlorinated biphenyls (PCBs);
  - garbage, as defined in MARPOL Annex V, containing more than traces of heavy metals; and
  - refined petroleum products containing halogen compounds
- explains that under regulation 16(5) incineration of sewage sludge and sludge oil generated during the normal operation of a ship may take place in the main or auxiliary power plant or boilers (as well as in an incinerator), but in those cases, must not take place inside ports, harbours and estuaries
- explains that Regulation 16(6) prohibits the shipboard incineration of polyvinyl chlorides (PVCs), except in incinerators for which IMO Type Approval Certificates have been issued
- explains that under regulation 16(7) all ships with

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incinerators subject to regulation 16 must possess a manufacturer's operating manual which must specify how to operate the incinerator within the limits described in paragraph 2 of appendix IV to Annex VI

- explains that under regulation 16(8) personnel responsible for operation of any incinerator must be trained and capable of implementing the guidance in the manufacturer's operating manual
- explains that Regulation 3 provides that the regulations of Annex VI will not apply to any emission necessary for the purpose of securing the safety of a ship or saving life at sea, or any emission resulting from damage to a ship or its equipment, subject to certain conditions
- states that Regulation 15 provides that in ports or terminals in Party States any regulation of emissions of Volatile Organic Compounds (VOCs) from tankers must be in accordance with Annex VI
- states that as per Regulation 15 a tanker carrying crude oil is required to have a "VOC Management Plan" approved by the Administration onboard
- states that ships of 400 gross tons and above engaged in international voyages involving countries that have ratified the conventions, or ships flying the flag of those countries, are required to have an International Air Pollution Prevention Certificate (IAPP Certificate)
- states that the IAPP certificate will be issued following an initial survey carried out by the Flag Administration or by a recognised organization on behalf of the Flag Administration, confirming compliance with MARPOL Annex VI. For ships with the flag of an Administration that have not yet ratified Annex VI, a Certificate of Compliance with Annex VI may be issued

- states that Annex VI also requires diesel engines with a power output of more than 130 kW which is installed on a ship constructed on or after 1 January 2000 or with a power output of more than 130 kW which undergoes a major conversion on or after 1 January 2000 or with a power output of more than 5000 kW and a per cylinder displacement at or above 90 litres which is installed on a ship constructed on or after 1 January 1990 but prior to1 January 2000, to carry individual certificates with regard to NOx emissions, named Engine International Air Pollution Prevention (EIAPP) Certificates

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- states that Annex VI requires that every ship of 400 gross tonnage or above and every fixed and floating drilling rig and other platforms shall be subject to a schedule of surveys that occur throughout the life of a vessel

states that the schedule of surveys include:

- Initial survey: This survey occurs before the ship is put into service or before a vessel certificate is issued for the first time. This survey ensures that the equipment, systems, fitting, arrangements and material used onboard fully comply with the requirements of Annex VI. The vessel's International Air Pollution Prevention certificate (IAPP) will be issued to the vessel by an organization authorized to act on behalf of the state, after this survey.
- Periodic surveys: These surveys occur at least every five years after the initial survey. These surveys confirm that nothing has been done to the ship's equipment that would take it out of compliance. The vessel's IAPP certificate will be re-issued by an organization authorized to act on behalf of the state, after this survey.
- Intermediate surveys: These surveys occur at least once during the period between issuance of an IAPP and the periodic surveys. They also confirm that all of the ship's equipment remains in compliance.
- states that Chapter III of Annex VI (regulations 12 to 19) contains requirements for control of emissions from ships, but the following regulations directly impact Vessel operation:
  - Regulation 12 – Ozone Depleting Substances
  - Regulation 13 – NOx emissions
  - Regulation 14 – Sulphur Oxide emissions
  - Regulation 15 – VOC emissions
  - Regulation 16 – Shipboard Incinerators
  - Regulation 18 – Fuel Oil Quality control
- states that Regulation 12(1) prohibits deliberate emissions of ozone-depleting substances, except where necessary for the purpose of securing the safety of a ship or saving life, as provided in regulation 3
- states that Regulation 12(2) prohibits, on all ships, new installations containing ozone-depleting substances, except that new installations containing hydrochlorofluorocarbons (HCFCs) are permitted until

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1 January 2020
- states that all the ships subject to the requirements of Annex VI, are required to maintain a list of equipment containing ozone depleting substances and in case a ship which has rechargeable systems containing ozone depleting substances, an Ozone depleting Substances Record Book is to be maintained on board
- states that Regulation 13 sets NOx emission limits for diesel engines with a power output of more than 130kW installed on ships built on or after 1 January 2000, and diesel engines of similar power undergoing a major conversion on or after 1 January 2000
- states that Regulation 13 does not apply to emergency diesel engines, engines installed in lifeboats and any device or equipment intended to be used solely in case of emergency, or engines installed on ships solely engaged in voyages within waters subject to the sovereignty or jurisdiction of the flag State, provided that such engines are subject to an alternative NOx control measure established by the Administration
- explains that Regulation 13 further contains a 3-Tier approach;
  - Tier I (current limits)
  - For diesel engines installed on ships constructed from 1 January 2000 to 1 January 2011
  - Tier II
  - For diesel engines installed on ships constructed on or after 1 January 2011
  - Tier III
  - Ships constructed on or after 1 January 2016
- states that Engine surveys are described in Chapter 2 of the NOx Technical Code, a supporting document to Annex VI

states that the four kinds of engine surveys are:
- Pre-certification survey: This survey occurs before an engine is installed onboard a vessel, to ensure the engine meets the NOx limits. The Engine International Air Pollution Prevention certificate (EIAPP) is issued after this survey for each applicable engine, engine family, or engine group
- Initial certification survey: This survey occurs after the engine is installed onboard the ship, but before the ship is placed into service. It ensures that the engine meets the NOx limits as installed. If an engine has an EIAPP, the initial certification survey will primarily ensure that any modifications to the engine's settings

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

are within the allowable adjustment limits specified in the EIAPP
- Periodic and intermediate surveys: These surveys occur as part of the ship's surveys described above. They ensure that the engine continues to comply fully with the NOx limits
- Modification survey: This survey occurs when an engine overhaul meets the criteria for a major conversion. It ensures that the modified engine complies with the NOx limits
- states that there are three documents that are essential for completing the engine and vessel surveys. These are the EIAPP or Statement of Compliance, the Technical File, and the Record Book of Engine Parameters
- states that Regulation 14 provides for adoption of "SOx Emission Control Areas"- "SECA" where the adoption of special mandatory measures for SOx emissions from ships is required to prevent, reduce and control air pollution from SOx and its attendant adverse impacts on land and sea areas with more stringent control on sulphur emissions

states for the purpose of the regulation, Emission Control Areas (ECA) includes:
- The Baltic Sea area as defined in regulation 1.11.2 of Annex I, the North Sea as defined in regulation 5(1)(f) of Annex V
- states that in these areas the sulphur content of fuel oil used on ships must not exceed 1.5% m/m. Alternatively, ships in these areas must fit an exhaust gas cleaning system or use any other technological method to limit SOx emissions
- states that Regulation 15 provides that in ports or terminals in Party States any regulation of emissions of Volatile Organic Compounds (VOCs) from tankers must be in accordance with Annex VI
- explains that Regulation 16 sets out requirements for shipboard incineration and as per 16(4) bans the incineration of:
  - MARPOL Annex I, II and III cargo residues and related contaminated packing materials;
  - polychlorinated biphenyls (PCBs);
  - garbage, as defined in MARPOL Annex V, containing more than traces of heavy metals; and
  - refined petroleum products containing halogen compounds

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

- explains that under regulation 16(5) incineration of sewage sludge and sludge oil generated during the normal operation of a ship may take place in the main or auxiliary power plant or boilers (as well as in an incinerator), but in those cases, must not take place inside ports, harbours and estuaries
- explains that Regulation 16(6) prohibits the shipboard incineration of polyvinyl chlorides (PVCs), except in incinerators for which IMO Type Approval Certificates have been issued
- explains that under regulation 16(7) all ships with incinerators subject to regulation 16 must possess a manufacturer's operating manual which must specify how to operate the incinerator within the limits described in paragraph 2 of appendix IV to Annex VI
- explains that under regulation 16(8) personnel responsible for operation of any incinerator must be trained and capable of implementing the guidance in the manufacturer's operating manual
- states that as per Regulation 15 a tanker carrying crude oil is required to have a "VOC Management Plan" approved by the Administration onboard
- explains that Regulation 3 provides that the regulations of Annex VI will not apply to any emission necessary for the purpose of securing the safety of a ship or saving life at sea, or any emission resulting from damage to a ship or its equipment, subject to certain conditions

1.5 Maritime Declarations of Health and the Requirements of the International Health Regulations

Arrival Documents and Procedures (4 hours) — R104

International Health Regulations (1969) as amended (IHR)

- defines for the purposes of these regulations:
  - arrival of a ship
  - baggage
  - container or freight container
  - crew
  - diseases subject to the Regulations
  - disinsecting
  - epidemic
  - free pratique
  - health administration
  - health authority
  - infected person
  - in quarantine

COMPETENCE 3.2 Monitor and Control Compliance with Legislative requirements **IMO Reference**

- international voyage
- isolation
- medical examination
- ship
- suspect
- valid certificate

- states that a health authority should, if requested, issue, free of charge to the carrier, a certificate specifying the measures applied to a ship or container, the parts treated, methods used and the reasons why they have been applied
- states that, except in an emergency constituting a grave danger to public health, a ship which is not infected or suspected of being infected with a disease subject to the Regulations should not be refused free pratique on account of any other epidemic disease and should not be prevented from discharging or loading cargo or stores, or taking on fuel or water
- states that a health authority may take all practicable measures to control the discharge from any ship of sewage and refuse which might contaminate the waters of a port, river or canal
- describes the measures which the health authority of a port may take with respect to departing travelers
- states that no health measures should be applied by a State to any ship which passes through waters within its jurisdiction without calling at a port or on the coast
- describes the measures which may be applied to a ship which passes through a canal or waterway in a territory of a State on its way to a port in the territory of another State
- states that, whenever possible, States should authorize granting of free pratique by radio
- explains that the master should make known to port authorities, as long as possible before arrival, any case of illness on board, in the interests of the patient and the health authorities and to facilitate clearance of the ship
- states that, on arrival of a ship, an infected person may be removed and isolated and that such removal should be
- compulsory if required by the master
- states that a ship should not be prevented for health reasons from calling at any port, but if the port is not equipped for
- applying the health measures which in the opinion of the health authority of the port are required, the ship

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may be ordered to proceed at its own risk to the nearest suitable port convenient to it
- explains the actions open to a ship which is unwilling to submit to the measures required by the health authority of a port
- describes the measures conceming cargo and goods
- describes the measures conceming baggage

Plague

- states that, forthe purposes of the Regulations, the incubation period of plague is six days
- states that vaccination against plague should not be required as a condition of admission of any person to a territory
- states that during the stay of a ship in a port.. infected by plague, special care should be taken to prevent the introduction of rodents on board
- states that ships should be permanently kept free of rodents and the plague vector or be periodically derailed
- describes the requirements for the issue of a Ship Sanitation Control Certificate or a Ship Sanitation Control Exemption Certificate and states their periods of validity
- states the conditions in which a ship on arrival is to be regarded as infected, suspected or healthy
- describes the measures which may be applied by a health authority on the arrival of an infected or suspected ship
- states that, for the purposes of the Regulations, the incubation period of plague is six days
- states that vaccination against plague should not be required as a condition of admission of any person to a territory
- states that during the stay of a ship in a port.. infected by plague, special care should be taken to prevent the introduction of rodents on board
- states that ships should be permanently kept free of rodents and the plague vector or be periodically derailed
- describes the requirements for the issue of a Ship Sanitation Control Certificate or a Ship Sanitation Control Exemption Certificate and states their periods of validity
- states the conditions in which a ship on arrival is to be regarded as infected, suspected or healthy

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- describes the measures which may be applied by a health authority on the arrival of an infected or suspected ship

Cholera

- describes the measures which may be applied by a health authority on the arrival of a healthy ship from an infected area states that, for the purposes of the Regulations, the incubation period of cholera is five days
- describes the measures to be taken by the health authority if a case of cholera is discovered upon arrival or a case has occurred on board

Yellow Fever

- states that, for the purposes of the Regulations, the incubation period of yellow fever is six days
- states that vaccination against yellow fever may be required of any person leaving an infected area on an international voyage
- states that every member of the crew of a ship using a port in an infected area must be in possession of a valid certificate of vaccination against yellow fever
- states the conditions in which a ship on arrival is to be regarded as infected, suspected or healthy
- describes the measures which may be applied by a health authority on the arrival of an infected or suspected ship

Documents

- states that bills of health or any other certificates concerning health conditions of a port are not require from any ship
- describes the master's obligations concerning a Maritime Declaration of Health
- states that the master and the ship's surgeon, if one is carried, must supply any information required by the health authority as to health conditions on board during the voyage
- states that no health document, other than those provided for in the Regulations, should be required in international traffic

Convention on Facilitation of International Maritime Traffic,

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1965, as amended (FAL 1965)

- states that the purpose of the Convention is to facilitate maritime transport by simplifying and reducing to a minimum the formalities, documentary requirements and procedures on the arrival, stay and departure of ships engaged in international voyages
- explains that the Convention lays down ‘standards’ and ‘recommended practices’ regarding documentation and procedures for facilitating international maritime traffic
- lists the documents which should be the only ones required by public authorities for their retention on arrival, or departure of ships to which the Convention applies
- explains that the provisions do not preclude the requirement for the presentation for inspection by the appropriate authorities of certificates and other papers concerned with registry, measurement, safety, manning and other related matters
- explains that the Convention lays down ‘standards’ and ‘recommended practices’ regarding documentation and procedures for facilitating international maritime traffic
- lists the documents which should be the only ones required by public authorities for their retention on arrival, or departure of ships to which the Convention applies
- explains that the provisions do not preclude the requirement for the presentation for inspection by the appropriate authorities of certificates and other papers concerned with registry, measurement, safety, manning and other related matters
- states that IMO has produced standard forms for:
  - general declaration
  - cargo declaration
  - ship’s effects declaration
  - crew’s effects declaration
  - crew list
  - passenger list
- explains that arrival procedures may be expedited by:
  - providing the public authorities concerned with an advance message giving the best ETA, followed by any information as to change of time, and stating the itinerary of the voyage
  - having ship’s documents ready for prompt review
  - rigging a means of boarding while the ship is en

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route to the berth or anchorage
- providing for prompt, orderly assembling and presentation of persons on board, with necessary documents for inspection, including arrangements for relieving crew members from essential duties

Noting and Extending Protests

- explains that a ‘note of protest’ is a declaration by the master of circumstances beyond his control which may give, or may have given, rise to loss or damage
- states that protests are made before a notary public, magistrate, consular officer or other authority
- states that protests should be noted as soon as possible, and in any case, within 24 hours of arrival in port
- states that, at the time of noting protest, the master should reserve the right to extend it
- states that protests concerning cargo damage should be made before starting to unload
- explains that, although there is no requirement to use a special form, it is usual to do so
- explains that statements under oath are taken from the master and other members of the crew and that such statements must be supported by appropriate entries in the log-book, which must be produced
- states that certified copes of the note of protest should be forwarded to the owners and one copy retained on board
- explains why protest should be noted at each discharging port and not just at the first port of call
- states that a note of protest is advisable when:
    - during the voyage the ship has experienced weather conditions which may result in damage to cargo the ship is in any way damaged, or there is reason to suspect that damage may have occurred
    - normal ventilation of perishable cargo has not been practicable on account of weather
    - cargo is shipped in such a condition that it is likely to deteriorate during the voyage (bills of lading must be appropriately endorsed)
    - the charterer or his agent commits any serious breach of the terms of the charter party
    - consignees fail to discharge cargo, take delivery or pay freight in accordance with the terms of a charter party or bill of lading any general average act has occurred

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- states that, in cases where damage is found to have occurred, it is necessary to extend protest to support claims
- states that the master should consult his owner's agent about the local requirement and practice for extending a protest
- states that the master must normally appear in person accompanied by a number, depending upon local custom, of crew members as witnesses.

Letter of Protest

- explains that a letter of protest, which may also be simply called a "protest", is a written communication intended to convey and record dissatisfaction on the part of the protester (the sender) concerning some matter over which the recipient has control, and holding the recipient responsible for any (legal or financial) consequences of the matter being complained of
- explains that a letter of protest may help to substantiate a claim by the owner, or refute a claim by a charterer, harbor authority, etc., and may prove useful, if properly filed, in the resolution of a dispute long after the related event
- states that a letter of protest should not to be confused with a protest noted or lodged before a notary public or consul
- explains that a letters of protest may be sent, in appropriate circumstances, by the master of any ship, large or small, in any trade, and can be expected to be received by the master of any ship. They are especially common (in both directions) in the tanker trades, where a variety of reasons give occasion for their sending
- explains that letters of protest are in most cases in connection with cargo operations, although they may be written about almost any matter where there may be legal liability, whether there is a contractual arrangement between the employers of the sender and recipient (as in the case of cargo-related protests) or not (as in the case of a protest sent to the master of a closely berthed ship that is causing damage to the sender's ship)
- explain that some companies, especially those in the oil, gas or chemical trades, supply their masters with a stock of printed proforma protest forms phrased in the

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company's "house" style, while others expect their masters to compose suitable protest letters when required

1.6 Responsibilities under International Instruments affecting the Safety of the Ship, Passengers, Crew and Cargo (23 hours) — R104

Ballast water Convention 2004 — R71

- states that The International Convention for the Control and Management of Ships Ballast Water & Sediments was adopted by consensus at a Diplomatic Conference at IMO in London on Friday 13 February 2004
- defines the following:
  - ballast water
  - ballast water management
  - sediments
- describes the application of this convention
- describes the conditions where the application of this convention may be exempted
- describes the management and control requirement based on Section B Regulation B1 to B6
- describes the Annex – Section A, B, C, D and E briefly
- describes the standards that need to be observed in ballast water exchange
- states under Regulation B-4 Ballast Water Exchange, all ships using ballast water exchange should:
  - Whenever possible, conduct ballast water exchange at least 200 nautical miles from the nearest land and in water at least 200 metres in depth, taking into account Guidelines developed by IMO;
  - In cases where the ship is unable to conduct ballast water exchange as above, this should be as far from the nearest land as possible, and in all cases at least 50 nautical miles from the nearest land and in water at least 200 metres in depth
- States as per Annex – Section B Management and Control Requirements for Ships:
  - Ships are required to have on board and implement a Ballast Water Management Plan approved by the Administration (Regulation B-1). The Ballast Water Management Plan is specific to each ship and includes a detailed description of the actions to be taken to implement the Ballast Water

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	Management requirements and supplemental Ballast Water Management practices. - States that a new paragraph, 4, has been added with effect from July 1, 2010 to SOLAS Chapter V, Regulation 22 – Navigation bridge visibility. Some changes are operational and others introduce new requirements applicable to navigation records - states that as a consequence of this amendment, any increase in blind sectors or reduction in horizontal fields of vision resulting from ballast water exchange operations is to be taken into account by the Master before determining that it is safe to proceed with the exchange - states that as an additional measure, to compensate for possible increased blind sectors or reduced horizontal fields of vision, the Master must ensure that a proper lookout is maintained at all times during the exchange. Ballast water exchange must be conducted in accordance with the ship's ballast water management plan, taking into account the recommendations adopted by the IMO - explains that in accordance with SOLAS Chapter V, Regulation28 – Records of navigational activities and daily reporting, the commencement and termination of the operation should be recorded - explains that the navigational records generated during ballast water exchange may be reviewed during ISM Audits and port state control inspections	
	United Nations Convention on the Law of the Sea (UNCLOS) - explains that the outcome of UNCLOS III conference convened at Geneva in 1974 was the United Nations Convention on the Law of the Sea commonly known as "UNCLOS" - explains that UNCLOS attempts to codify the international law of the sea - states that UNCLOS is a treaty document of 320 articles and 9 annexes, governing all aspects of ocean space, such as delimitation, environmental control, marine scientific research, economic and commercial activities, transfer of technology and the settlement of disputes relating to ocean matters - states that UNCLOS came into force internationally on 16 November 1994 - states that UNCLOS sets the width of the territorial	R75, R76

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sea at 12 nautical miles, with a contiguous zone at 24 nautical miles from the baseline
- states that UNCLOS defines innocent passage through the territorial sea and defines transit passage through international straits
- states that UNCLOS defines archipelagic States and allows for passage through archipelagic waters
- states that UNCLOS establishes exclusive economic zones (EEZs) extending to 200 nautical miles from baselines
- explains that it defines the continental shelf and extends jurisdiction over the resources of the shelf beyond 200 miles where appropriate
- states that UNCLOS defines the legal status of the high seas and establishes regulations for the control of marine pollution
- explains that states in dispute about their interpretation of UNCLOS may submit their disagreements to competent courts such as the International Court of Justice (in The Hague), or the Law of the Sea Tribunal (in Hamburg)
- states that the responsibility for enforcement of regulations rests mainly with flag States, but as vessels enter zones closer to the coast the influence of coastal State jurisdiction and, ultimately, port State jurisdiction, gradually increases
- states that Article 94 of the UNCLOS deals with duties of the flag State, while Article 217 deals with enforcement by flag States
- states that Article 218 of the UNCLOS deals with port State jurisdiction
- explains when a vessel is voluntarily within a port or at an offshore terminal, the port State may, where the evidence warrants, begin proceedings in respect of discharges in violation of international rules (i.e. regulations in MARPOL 73/78)
- states that another State in which a discharge violation has occurred, or the flag State, may request the port State to investigate the violation
- states that Article 200 of the UNCLOS deals with coastal State jurisdiction as applied in relation to pollution provisions
- states that where there are clear grounds for believing that a vessel navigating in the territorial sea of a State has violated laws and regulations of the coastal State adopted in accordance with UNCLOS or applicable international pollution regulations, the coastal State

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may inspect the vessel and, where evidence warrants, institute proceedings including detention of the vessel
- states that vessels believed to have violated pollution laws in an EEZ may be required to give identification and voyage information to the coastal State
- explains that as per UNCLOS, States must agree international rules and standards to prevent pollution from vessels (Article 211). (This obligation is currently met by MARPOL 73/78)
- explains that Coastal States may also promulgate and enforce pollution regulations in their own EEZs which may, in some circumstances, include imposition of routeing restrictions
- states that in the territorial sea additional navigational restraints (e.g. traffic separation schemes and sea lanes) may be imposed on vessels with dangerous and hazardous cargoes
- explains that Coastal States and ports may make entry to internal waters and harbours conditional on meeting additional pollution regulations

Maritime Labour Convention (MLC 2006) — R104

- explains that the Maritime Labour Convention, 2006 is an important new international labour Convention that was adopted by the International Labour Conference of the International Labour Organization (ILO), under article 19 of its Constitution at a maritime session in February 2006 in Geneva, Switzerland
- explains that it sets out seafarers' rights to decent conditions of work and helps to create conditions of fair competition for shipowners
- explains that it is intended to be globally applicable, easily understandable, readily updatable and uniformly enforced
- explains that the MLC, 2006, complementing other major international conventions, reflects international agreement on the minimum requirements for working and living conditions for seafarers
- explains that the Maritime Labour Convention, 2006 has two primary purposes:
  - to bring the system of protection contained in existing labour standards closer to the workers concerned, in a form consistent with the rapidly developing, globalized sector (ensuring "decent work");
  - to improve the applicability of the system so that

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	shipowners and governments interested in providing decent conditions of work do not have to bear an unequal burden in ensuring protection (“level playing field” fair competition) - explains that the Maritime Labour Convention, 2006 has been designed to become a global legal instrument that, once it enters into force, will be the “fourth pillar” of the international regulatory regime for quality shipping, complementing the key Conventions of the International Maritime Organization (IMO) such as the International Convention for the Safety of Life at Sea, 1974, as amended (SOLAS), the International Convention on Standards of Training, Certification and Watchkeeping, 1978, as amended (STCW) and the International Convention for the Prevention of Pollution from Ships, 73/78 (MARPOL) - states that it sometimes called the consolidated Maritime Labour Convention, 2006 as it contains a comprehensive set of global standards, based on those that are already found in 68 maritime labour instruments (Conventions and Recommendations), adopted by the ILO since 1920 - states that the new Convention brings almost all of the existing maritime labour instruments together in a single new Convention that uses a new format with some updating, where necessary, to reflect modern conditions and language - explains that the Convention “consolidates” the existing international law on all these matters - states that the MLC, 2006 applies to all ships engaged in commercial activities (except fishing vessels, ships of traditional build and warships or naval auxiliaries) - states that ships of 500 GT or over are required to be certified: they must carry a Maritime Labour Certificate as well as a Declaration of Maritime Labour Compliance - states that ships below 500 GT are subject to inspection at intervals not exceeding three years - explains that the existing ILO maritime labour Conventions will be gradually phased out as ILO Member States that have ratified those Conventions ratify the new Convention, but there will be a transitional period when some parallel Conventions will be in force - explains that countries that ratify the Maritime Labour Convention, 2006 will no longer be bound by the existing Conventions when the new Convention	

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	comes into force for them - explains that countries that do not ratify the new Convention will remain bound by the existing Conventions they have ratified, but those Conventions will be closed to further ratification - describes that the Convention is organized into three main parts: the Articles coming first set out the broad principles and obligations which is followed by the more detailed Regulations and Code (with two parts: Parts A and B) provisions - states that the Regulations and the Standards (Part A) and Guidelines (Part B) in the Code are integrated and organized into general areas of concern under five Titles: - **Title 1: Minimum requirements for seafarers to work on a ship:** minimum age, medical certificates, training and qualification, recruitment and placement. - **Title 2: Conditions of employment:** Seafarers Employment Agreements, Wages, Hours of Work and Hours of Rest, Entitlement to Leave, Repatriation, Seafarer compensation for the ship's Loss or Foundering, Manning Levels, Career and Skill Development and Opportunities for Seafarers' Employment - **Title 3: Accommodation, recreational facilities, food and catering** - **Title 4: Health** protection**, medical care, welfare and social security protection:** Medical Care on-board ship and Ashore, Ship-owners' Liability, Health & Safety Protection and Accident Prevention, Access to Shore-based Welfare Facilities, Social Security - **Title 5: Compliance and enforcement:** **Flag State Responsibilities:** General Principles, Authorization of Organizations, Maritime Labour Certificate and Declaration of Maritime Labour Compliance, Inspection and Enforcement, On-board Complaint Procedures, Marine Casualties - **Port State Responsibilities:** Inspections in Port, Detailed Inspection, Detentions, On-shore Seafarer Complaint Handling Procedures - **Labour-supplying Responsibilities:** Recruitment and Placement services, Social security provisions These five Titles essentially cover the same subject matter as the existing 68 maritime labour instruments, updating them where necessary	

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- explains that it occasionally contains new subjects in comparison to the existing ILO Maritime labour conventions, particularly in the area of occupational safety and health to meet current health concerns, such as the effects of noise and vibration on workers or other workplace risks
- explains that the standards in the new Convention are not lower than existing maritime labour standards as the aim is to maintain the standards in the current maritime labour Conventions at their present level, while leaving each country greater discretion in the formulation of their national laws establishing that level of protection
- explains that the advantages for ships of ratifying countries that provide decent conditions of work for their seafarers will have protection against unfair competition from substandard ships and will benefit from a system of certification, avoiding or reducing the likelihood of lengthy delays related to inspections in foreign ports
- explains that the Maritime Labour Convention, 2006 aims to establish a continuous "compliance awareness" at every stage, from the national systems of protection up to the international system and it will improve compliance and enforcement;
  - Starting with the individual seafarers, who – under the Convention – have to be properly informed of their rights and of the remedies available in case of alleged non-compliance with the requirements of the Convention and whose right to make complaints, both on board ship and ashore, is recognized in the Convention.
  - It continues with the shipowners. Those that own or operate ships of 500 gross tonnage and **above**, engaged in international voyages or voyages between foreign ports, are required to develop and carry out plans for ensuring that the applicable national laws, regulations or other measures to implement the Convention are actually being complied with.
  - The masters of these ships are then responsible for carrying out the shipowners' stated plans, and for **keeping** proper records to evidence implementation of the requirements of the Convention.
  - As part of its updated responsibilities for the labour inspections for ships above 500 gross tonnage

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that are engaged in international voyages or voyages between foreign ports, the flag State (or recognized organization on its behalf) will review the shipowners' plans and verify and certify that they are actually in place and being implemented.

  - Ships will **then** be required to carry a maritime labour certificate and a declaration of maritime labour compliance on board.
  - Flag States will also be expected to ensure that national laws and regulations implementing the Convention's standards are respected on smaller ships that are not covered by the certification system.
  - Flag States will carry out periodic quality assessments of the effectiveness of their national systems of compliance, and their reports to the ILO under article 22 of the Constitution will need to provide information on their inspection and certification systems, including on their methods of quality assessment.
  - This general inspection system in the flag State (which is founded on ILO Convention No. 178) is complemented by procedures to be followed in countries that **are** also or even primarily the source of the world's supply of seafarers, which will similarly be reporting under article 22 of the ILO Constitution.
  - The system **is** further reinforced by voluntary measures for inspections in foreign ports (port State control)

- states that the appendices to the Convention contain key model documents: a maritime labour certificate and a declaration of maritime labour compliance
- explains that the Maritime Labour Certificate would be issued by the flag State to a ship that flies its flag, once the State (or a recognized organization that has been authorized to carry out the inspections), has verified that the labour conditions on the ship comply with national laws and regulations implementing the Convention
- states that the certificate would be valid for five years subject to periodic inspections by the flag State
- explains that the declaration of maritime labour compliance is attached to the certificate and summarizes the national laws or regulations implementing an agreed-upon list of 14 areas of the maritime standards and setting out the shipowner's or

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operator's plan for ensuring that the national requirements implementing the Convention will be maintained on the ship between inspections

- states that the lists of the 14 areas that must be certified by the flag State and that may be inspected, if an inspection occurs, in a foreign port are also set out in the Appendices to the Convention

Collision (2 hours) R 23

- International Convention for the Unification of Certain Rules of Law with Respect to Collision Between Vessels (Collision, 1910)
- states that when collision is accidental, is caused by 'force majeure' or if the cause is left in doubt, the damages are borne by those who have suffered them
- states that if collision is caused by the fault of one of the vessels, liability to make good the damage attaches to the one which committed the fault
- explains the apportionment of liability when two or more vessels are in fault
- explains that liability attaches where the collision is caused by the fault of a pilot even when the pilot is carried by compulsion of law
- describes the duties of the master after a collision
- explains that the Convention extends to the making good of damages which a vessel has caused to another vessel or to goods or persons on board either vessel, either by the execution or non-execution of a manoeuvre or by the nonobservance of regulations, even if no collision has actually taken place
- states that in the event of a collision or any other incident of navigation concerning a sea-going ship and involving the penal or disciplinary responsibility of the master or any other person in the service of the ship, criminal or disciplinary proceedings may be instituted only before the judicial or administrative authorities of the State of which the ship was flying the flag at the time of the collision or other incident of navigation
- states that no arrest or detention of the vessel should be ordered, even as a measure of investigation, by any authorities other than those whose flag the ship is flying
- states that nothing in the present Convention is to prevent any State from permitting its own authorities, in case of collision or other incidents of navigation, to take any action in respect of certificates of

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competence or licences issued by that State or to prosecute its own nationals for offences committed while on board a ship flying the flat of another State
- states that the Convention does not apply to collisions or other incidents of navigation occurring within the limits of a port or in inland waters and that the High Contracting Parties are at liberty to reserve to themselves the right to take proceedings in respect of offences committed within their own territorial waters

Assistance and Salvage (2 hours) — R 21

International Convention on Salvage, 1989 (The London Salvage Convention)
- defines ‘salvage operation’, ‘vessel’ and ‘property’
- describes the ‘no cure — no pay’ principle
- describes the application of the Convention
- describes the duties of the salvor, of the owner and of the master
- describes the rights of salvors
  - states the criteria for assessing a reward as:
  - salved value of property (ship, cargo and bunkers)
  - skill and efforts of salvor
  - measure of success.
  - nature and degree of danger.
  - expenses of salvor.
  - equipment used.
  - vessel’s equipment used.
  - time taken to complete the salvage operation.
  - preventing or minimising the damage to environment.
- states the criteria for assessing Special Compensation
- explains that the apportionment of the remuneration amongst the owners, master and other persons in the service of each salving vessel is to be determined by the law of the vessel’s flag
- explains that every agreement as to assistance or salvage entered into at the moment and under the influence of danger may, at the request of either party, be annulled, or modified by the court, if it considers that the conditions agreed upon are not equitable
- describes the reasons for the court to set aside the agreed remuneration in whole or in part (salvor’s fault, neglect, fraud or dishonesty)
- states that no remuneration is due from persons whose lives are saved except as provided in national law

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- describes the rights of salvors of human life who have taken part in the salvage operations
- states that every master is bound, so far as he can do so without serious danger to his vessel, her crew and her passengers, to render assistance to everybody, even though an enemy, found at sea in danger of being lost
- explains that the convention also applies to assistance or salvage services rendered by or to a ship of war or any other ship owned, operated or chartered by a State or Public Authority
- explains the provision of security by the owner and the application of the salvor's maritime lien

Lloyd's Standard Form of Salvage Agreement (LOF, 2000)

- states that LOF 2000 should be used where the ship or marine environment are at risk and the master has insufficient time to request the owner to arrange salvage services on a the basis of a pre-agreed rate or sum
- describes the Contractor's agreed endeavours to salve the ship and/or cargo, bunkers and stores and while performing the salvage services to prevent or minimize damage to the environment
- explains that the LOF 2000 form does not need to be on board; the masters of the vessels involved simply need to expressly agree to its terms before the salvage services commence
- describes the exception to the 'no cure — no pay' principle
- explains that LOF 2000 superseded LOF 95 and where a salvor offers services on LOF 95 or some other terms, the master of the vessel in difficulties should attempt to get agreement to LOF 2000 terms
- explains that LOF 2000 is regarded by the International Salvage Union as a major advance, with clear, user-friendly language and many innovations
- states that LOF 2000 is a single sheet (2-page) document (whereas LOF 95 consists of 6 pages) in a simplified format
- states that the Contractor's remuneration is to be fixed by arbitration in London and any differences arising out of the Agreement are to be dealt with in the same way
- states that the provisions of the Agreement apply to

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	salvage services, or any part of such services, referred to in the Agreement which have been already rendered by the Contractor at the date of the Agreement - states that English Law is the governing law of the Agreement and of arbitration under it - describes the obligation of the owners, their servants and agents to co-operate with the salvors - describes the Contractor's duty immediately after the termination of the services to notify the Council of Lloyd's and where practicable the owners of the amount for which he requires security - explains that the owners of the vessel, their servants and their agents should use their best endeavours to ensure that cargo owners provide their proportion of security before the cargo is released - explains that, pending the completion of the security, the Contractor has a maritime lien on the property salved for his remuneration - briefly describes how claims for arbitration are decided - states that the master or other person signing LOF on behalf of the property to be salved enters into the agreement as agent for the vessel her cargo, freight, bunkers, stores and any other property thereon and the respective owners thereof and binds each to the due performance thereof - states that when there is no longer any reasonable prospect of a useful result leading to a salvage reward in accordance with Convention Article 13 the owners of the vessel shall be entitled to terminate the services of the Contractor by giving notice to the Contractor in writing - describes the provisions for special compensation set out in Convention Article - explains that Personnel effects of Master, crew and passengers including any car accompanying a passenger are excluded from reward for salvage as per the LOF 2000 - states that the currency of award as per the LOF 2000 is USA $ - explains that as compared to the old LOF 1995, the duty to co-operate as per the new LOF 2000 is extended to provide information about nature of cargo, plans, stability data etc - states that as per LOF 2000, the salvors have right to terminate when "no longer any reasonable prospects of useful result"	

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- states that in the LOF 2000, SCOPIC clause is introduced as an alternative to Art 14 set out in the convention
- states that that as per LOF 2000, the Master is authorized to sign on behalf of cargo
- explains that LOF 2000 defines the conditions under which a casualty is in a safe condition for redelivery to the owner (which can be of crucial importance in the closing stages of a salvage operation

Special Compensation P and I Club (SCOPIC) Clause

- explains that SCOPIC clause is supplementary to any Lloyd's Form Salvage Agreement "No Cure - No Pay" ("Main Agreement") which incorporates the provisions of Article 14 of the International Convention on Salvage 1989 ("Article 14")
- explains that the Contractor have the option to invoke by written notice to the owners of the vessel the SCOPIC clause at any time of his choosing regardless of the circumstances and, in particular, regardless of whether or not there is a "threat of damage to the environment"
- explains that SCOPIC Clause determines the method of assessing special compensation where payable under Article 14(1) to 14(4) of the Convention
- explains that special compensation assessed in accordance with the SCOPIC Clause is called "SCOPIC remuneration"
- explains that the SCOPIC remuneration is payable only by the owners of the vessel (and not by the cargo owners) and is only payable to the extent that it exceeds the total Article 13 award (the salvage award) or, if none, any potential Article 13 award
- explains that where the owner of the vessel is a member of a P&I club the club is normally required to pay the special compensation hence interest and involvement of the P&I clubs in drafting the SCOPIC Clause
- explains that the assessment of SCOPIC remuneration commences from the time the written notice is given to the owners of the vessel and services rendered before the said written notice will not be remunerated under this SCOPIC clause at all but in accordance with Convention Article 13 as incorporated into the Main Agreement ("Article 13")
- explains that the owners of the vessel have to provide

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	the Contractor within 2 working days (excluding Saturdays and Sundays and holidays usually observed at Lloyd's) after receiving written notice from the contractor invoking the SCOPIC clause, a bank guarantee or P&I Club letter (called "the Initial Security") in a form reasonably satisfactory to the Contractor providing security for his claim for SCOPIC remuneration in the sum of US$3 million, inclusive of interest and costs - explains that the rates are based on time and materials plus an uplift of 25% in all cases - explains that in the absence of agreement, any dispute concerning the proposed Guarantor, the form of the security or the amount of any reduction or increase in the security in place shall be resolved by the Arbitrator - explains that if the owners of the vessel do not provide the Initial Security within the said 2 working days, the Contractor, - at his option, and on giving notice to the owners of the vessel, shall be entitled to withdraw from all the provisions of the SCOPIC clause and revert to his rights under the Main Agreement including Article 14 which shall apply as if the SCOPIC clause had not existed - explains that the Owner and Contractor both have option to terminate SCOPIC under certain agreed circumstances - explains that even when the SCOPIC clause is invoked, the duties and liabilities of the Contractor remains the same as under the Main Agreement, namely to use his best endeavours to salve the vessel and property thereon and in so doing to prevent or minimise damage to the environment - explains that the assessment of SCOPIC remuneration includes the prevention of pollution as well as the removal of pollution in the immediate vicinity of the vessel insofar as this is necessary for the proper execution of the salvage - explains that the owner has the right to send on-board a casualty Representative (SCR) - explains that Underwriters have the right to send one special hull representative and one special cargo representative collectively called the "Special Representatives") - explains that the salvage masters are required to send daily reports to Lloyds and the owner until SCR arrives	

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	and thereafter to SCR - explains that the SCOPIC remuneration is not a General Average expense to the extent that it exceeds the Article 13 Award; any liability to pay such SCOPIC remuneration is that of the Shipowner alone and no claim whether direct, indirect, by way of indemnity or recourse or otherwise relating to SCOPIC remuneration in excess of the Article 13 Award is to be made in General Average or under the vessel's Hull and Machinery Policy by the owners of the vessel - explains that any dispute arising out of this SCOPIC clause or the operations is to be referred to Arbitration as provided for under the Main Agreement - explains that a non binding code of practice has been agreed between the International Salvage Union (ISU) and the International Group of Clubs	
	Convention on Limitation of Liability for Maritime Claims, 1976 (LLMC 1976) (1 hour)	R 105
	- lists the persons entitled to limit liability - lists the claims subject to limitation of liability - lists the claims exempted from limitation - explains the circumstances in which limitation would be barred - explains that, except for claims in respect of death or injury of passengers, the calculation of limits of liability is based on the ship's gross tonnage - explains that the limit for claims in respect of death or injury of passengers is based on the number of passengers the ship is authorized to carry, subject to a maximum sum - describes the constitution of a limitation fund - states the scope of application of the Convention	
	Classification Societies (1 hour)	
	- explains the reasons for having a ship classed with a classification society - states that the majority of ships are built under survey - explains that the classification society approves plans, examines the manufacture of parts and tests materials during the building of hull, machinery, equipment and, where appropriate, refrigerating machinery explains that equipment refers to anchors, chain cables, mooring ropes and wires, mooring arrangements, windlasses and mooring winches	

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- states that, if requested, the classification societies will also survey and certificate cargo-handling equipment
- states that on satisfactory completion of surveys and sea trials the society issues certificates of class, which are kept aboard ship, and enters the particulars of the ship in its register
- states that a classification society will also survey an existing ship providing it meets the society's rules regarding scantlings, materials, workmanship and condition, assign a class to it
- states that to retain its class a ship must undergo periodical surveys as laid down in the society's rules
- states that periodical surveys are:
  - annual survey
  - docking survey at approximately 2-yearly intervals
  - intermediate survey
  - special survey every 4 years, which may be extended to five years
- explains the special survey requirements may be met by a system of continuous survey such that the interval between successive surveys on any given item does not exceed 5 years
- states that an occasional survey, additional to the regular surveys, must be conducted after any damage to the hull, machinery or equipment which may affect the ship's seaworthiness
- states that repairs or alterations must be carried out under survey and to the satisfaction of the society's surveyors
- states that classification societies carry out surveys for the issue of statutory certification on behalf of many governments
- states that a classification society may be asked to conduct the loading port survey on its classed refrigerating machinery
- explains that, when convenient, the loading port survey may be combined with a periodical survey for classification

Cargo (5 hours)

International Convention for the Unification of Certain Rules of Law Relating to Bills of Loading, as Amended by the Protocol of 1968 (Hague-Visby Rules)

- defines:
- carrier
- contract of carriage

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  - goods
  - ship
  - carriage of goods
- lists the duties of the carrier to make the ship seaworthy and fit for the carriage of cargo
- describes the carrier's duty to care for the cargo
- describes the duty of the carder, master or agent of the carrier to issue a bill of lading
- lists the information which should be shown in a bill of lading
- explains that a bill of lading is prima facie evidence of the receipt by the carrier of the goods as described in it and proof to the contrary is not admissible when the bill of lading has been transferred to a third party acting in good faith
- explains that the shipper is deemed to have guaranteed the accuracy of marks, number, quantity and weight as furnished by him, and that the shipper is to indemnify the carrier against loss arising from inaccuracies in such particulars
- explains the duty of the carrier, master or agent to issue a 'shipped' bill of lading after the goods are loaded, provided the shipper surrenders any previously taken up document of title
- explains the mandatory domain of the Hague-Visby rules
- explains the carrier's liability for loss or damage arising or resulting from unseaworthiness
- states that whenever loss of damage has resulted from unseaworthiness, the burden of proving due diligence is on the carrier
- lists the exceptions to the carriers responsibility for loss or damage
- explains the shippers responsibility for loss or damage sustained by the carrier or ship
- states the right to deviate for the purpose of saving life or property
- explains the limitation of liability for loss or damage and the circumstances in which benefit of limitation is lost
- describes the provisions regarding goods of an inflammable, explosive or dangerous nature
- explains the liability of the carrier's servants (Himalaya clause) explains that this Convention does not apply to charter-parties, but, if bills of lading are issued under a charter party, they must comply with the terms of this Convention

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- states that any lawful provisions regarding general average may be inserted in a bill of lading
- explains that, in certain circumstances, goods may be carried under an agreement between the carrier and shipper in any contractual terms not contrary to public policy, provided that no bill or lading is issued and that the terms agreed are embodies in a non-negotiable receipt, marked as such
- explains that the Rules do not prevent a carrier or shipper entering into any agreement regarding loss of damage to goods prior to the loading on, and subsequent to, the discharge from the ship on which the goods are carried by sea
- states that the Convention does not affect the rights and obligations of the carrier under any statute relating to the limitation of the liability of owners of sea-going ships
- describes the scope of application of the provisions of this Convention
- describes briefly the system of documentary credit in the sale of goods during shipment

Charter Parties

- states that a charter-party is a contract between the shipowner and the charterer for the use of a ship or her cargo space
- explains that a voyage charter-party is a contract to carry a specified, normally full, cargo between named ports at an agreed freight rate explains that the shipowner remains responsible for the operation of the ship and the costs involved, but the charterer sometimes pays the stevedoring charges
- states that contracts are normally drawn up using standard charter-party forms amended as required by alterations and additional clauses
- describes the tendering of notice of readiness at the loading port
- explains that if the ship is not ready to receive cargo, whether alongside or not, by the cancellation date the charterer may cancel the charter
- explains what is meant by laytime and the terms ‘running days/hours’, ‘Sundays and holidays excepted’ and ‘weather working days’
- states that the laytime for loading and discharging may be stated separately or as a total
- states that all times relevant to cargo working should

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be recorded in the logbook and time sheets for the calculations of laytime completed as a check on the charterer's laytime statement

- explains that if cargo work is not completed within the permitted laytime, the charterer is liable to pay demurrage at the agreed rate per day or hour until it is completed
- explains that time lost due to defects of the ship or its equipment is not counted in the laytime
- explains that in the event of cargo work being completed before the expiration of laytime, dispatch is usually payable by the shipowner to the charterer
- states that bills of lading are normally issued under a voyage charter-party and signed by the master or on his behalf
- explains that the bills of lading may incorporate the terms of the charter-party which, in any case, takes precedence over the bills of lading as between shipowner and charterer
- explains that when bills of lading have been transferred to a third party they constitute the contract between the shipowner and that party
- states that a voyage charter may be arranged to cover a stated number of successive voyages or an unspecified number of voyages to be performed in a given time
- states that in a time charter-party the charterer agrees to hire the ship for a specified period of time
- explains that the charterer may use the vessel for any voyage he wants within the trading area agreed in the charter-party
- explains that the charterer pays for bunkers and for cargo loading and discharging, port dues, canal dues and pilotage
- states that owners pay crew costs and for provisions, necessary stores, insurance of the ship and the costs of maintaining the ship in class and keeping it in an efficient condition to carry out the charterer's wishes
- states that the charter-party contains a description of the ship, including its speed and fuel consumption
- explains that inability to maintain the warranted speed or consumption as a result of heavy weather or other cause should be substantiated by entries in the log-book
- states that crew overtime in connection with the cargo is usually for the account of the charterer, and separate time sheets should be kept

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- explains that the off-hire clause states the circumstances in which payment of hire ceases during time lost to the charterer
- explains that off-hire deductions may be made for time lost due to reduced- speed resulting from defects of ship or machinery, for the cost of additional fuel and for extra expenses
- states that the master is usually required to sign bills of lading as presented to him by the charterer or the charter-party may give the charterer the right to sign them on his behalf
- states that a time charter-party may be used for a single round voyage
- describes the master's actions regarding damage done by stevedores to the ship or cargo
- explains that demise or bareboat charter-party is a leasing arrangement in which the charterer operates the ship as if it were his own
- states that the master and crew are employed by the charterer, to whom they are responsible as if he were the owner
- explains that a tonnage contract or contract of affreightrnent may be used where a shipper needs to transport large quantities over a long period
- explains that the contract does not name particular ships and the shipowner is free to use any suitable ship, his own or chartered, for each shipment
- states that the loading dates are specified and that punctual performance is essential
- states that each individual shipment is normally subject to the terms of a conventional voyage charter-party

Hamburg Rules' Maritime Legislation (1 hour)

- explains the effect of charges where goods are carried under Hamburg Rules
- explains carrier's extended liability for loss or damage to the goods
- explains reductions to exception to liability, inward and outward bills of lading, live animals and deck cargo
- explains the need to inform P & I Club where goods are carried under Hamburg Rules

General Average and Marine Insurance (3 hours)

The York-Antwerp Rules, 1974

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- states that where the York-Antwerp Rules apply, general average should be adjusted according to the Rules to the exclusion of any law or practice inconsistent with them
- defines a general average act
- states that general average sacrifices and expenses are to be borne by the different contributing interests on the basis of these Rules
- explains that only such losses, damages or expenses which are the direct consequence of the general average act are allowed as general average and that no indirect loss whatsoever will be admitted
- explains that rights to contribution in general average when the event which gave rise to the sacrifice was due to the fault of one of the parties to the adventure
- states that the onus of proof is upon the party claiming in general average to show that the loss or expense claimed is properly allowable as general average
- states that any extra expense incurred in place of another expense which would have been allowable as general average is deemed to be general average, but only up to the amount of the general average expense avoided
- explains that general average is to be adjusted, as regards both loss and contribution, on the basis of values at the time and place when and where the adventure ends
- states that the general principles contained in Rules A to G are amplified by numbered rules Ito XXII, dealing with specific points of practice
- states that the master should make a declaration of general average, as is required by the law and custom of the port, at a port of refuge and at a discharging port when general average damage to the cargo is suspected
- explains the duty of the master to see to it that general average contributions (average bonds) are collected for the benefit of those entitled to them, whether they are cargo owners or shipowners, exercising the ship owner's lien on the cargo, where necessary, until they are paid

Marine Insurance

- explains in general terms the purpose of marine insurance explains what is meant by an insurable interest describes briefly how insurance is arranged

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through brokers
- explains the principle of 'utmost good faith' explains the effect of misrepresentation or non-disclosure of material circumstances known to the assured
- explains 'warranty' and the effect on a marine insurance policy of breach of warranty
- describes briefly voyage policies, time policies and floating policies
- explains what is meant by deviation and how the insurer is discharged from liability from the moment a ship deviates
- lists permitted deviations
- explains that a deviation clause will often permit the assured to extend his cover at a premium to be arranged, provided the insurer is given prompt notice of the deviation ('held covered' clause)
- describes briefly the perils usually covered in a marine insurance policy explains the use of 'Institute Clauses'
- explains the 'duty of assured' clause ('Sue and Labour' clause)
- distinguishes between partial loss, total loss and constructive total loss
- explains what is meant by 'particular average'
- explains the doctrine of subrogation
- explains the function of Protection and Indemnity Associations (P and I clubs)
- lists risks, liabilities and expenses covered by P and I clubs

Stowaways

- explains that as per IMO Guidelines -a "stowaway" is defined as "a person who is secreted on a ship, or in a cargo which is subsequently loaded on the ship, without the consent of the shipowner or the master or any other responsible person, and who is detected on board after the ship has departed from a port and is reported as a stowaway by the master to the appropriate authorities"
- explains that an international convention relating to stowaways was adopted in Brussels in 1957, but it has not yet entered into force
- explains that according to the P&I clubs (who deal with many stowaway incidents), certain parts of the world are high-risk areas for stowaways
- explains that since the P&I clubs invariably have the latest intelligence on stowaway risks, masters should

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endeavour to obtain their latest club bulletins and information

- explains that at any port in a high-risk area, great care should be taken to ensure that stowaways do not board, and the following safeguards should be observed:
  1. A watch should be kept on the accommodation ladder or gangway.
  2. Stevedores should only be allowed to work in restricted areas and a watch should be kept on them.
  3. Open spaces should be closed as far as possible.
  4. A search of the ship should be carried out before the ship sails.
  5. All open-top containers on the quay should be checked. All containers on the quay should be stacked door-to-door, if possible
- explains IMO has introduced various guidelines on stowaway matters, the latest being in Resolution A.871(20), adopted on 27 November 1997, and its Annex, “Guidelines on the Allocation of Responsibilities to seek the Successful Resolution of Stowaway Cases”
- explains that the guidelines in the resolution state that the resolution of stowaway cases is difficult because of different national legislation in the various countries involved, nevertheless, some basic principles can be applied generally
- explains that as per the IMO guideline there are nine basic principles which can be applied generally with respect to stowaway cases, the second of these is that stowaway/asylum-seekers should be treated in compliance with international protection principles as set out in international instruments (including the UN Convention relating to the Status of Refugees of 28 July 1951 and the UN Protocol relating to the Status of Refugees of 31 January 1967) and relevant national legislation, the ninth is that stowaway incidents should be dealt with humanely by all parties involved. Due consideration should always be given to the operational safety of the ship and to the well-being of the stowaway
- explains that Paragraph 5.1 of the IMO Guidelines lists responsibilities of the master in stowaway cases, which are as follows:
  1. to make every effort to determine immediately the

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port of embarkation of the stowaway;
2. to make every effort to establish the identity, including the nationality/citizenship of the stowaway;
3. to prepare a statement containing all information relevant to the stowaway, in accordance with information specified in the standard document annexed to these Guidelines, for presentation to the appropriate authorities;
4. to notify the existence of a stowaway and any relevant details to his shipowner and appropriate authorities at the port of embarkation, the next port of call and the flag State;
5. not to depart from his planned voyage to seek the disembarkation of a stowaway to any country unless repatriation has been arranged with sufficient documentation and permission for disembarkation, or unless there are extenuating security or compassionate reasons;
6. to ensure that the stowaway is presented to appropriate authorities at the next port of call in accordance with their requirements;
7. to take appropriate measures to ensure the security, general health, welfare and safety of the stowaway until disembarkation.

- explains the procedure to be adopted, in general, on the discovery at sea of stowaways, which is;
  1. The owner or manager, as appropriate, should be contacted. The owner will normally contact the P&I club's managers to decide on a course of action. The P&I club's correspondent serving the next port of call will normally be contacted by the club managers. The correspondent should be able to advise what information will be required by port State and other officials.
  2. An entry should be made in the Official Log Book recording the discovery of the stowaways.
  3. The compartment or area in which the stowaways were found should be searched. Any documents or articles of clothing, etc. may give an indication of their place of origin. (Most countries only allow a stowaway to be landed if he has the necessary travel documents to return to his own country. Stowaways rarely have any documentation, however, and some will try to destroy all clues as to their identity.)
  4. The clothing of the stowaways should be

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searched for indications as to their origin.

5. The agent at the next port of call should be contacted and instructed to advise the appropriate authorities of the port State of the presence of stowaways on board.
6. Each stowaway found should be individually interviewed in order to establish the following details:
   - name of stowaway;
   - stowaway's date and place of birth;
   - nationality of stowaway;
   - name, date and place of birth of either or both of the stowaway's parents;
   - postal and residential address of the stowaway and either parent;
   - stowaway's passport or seaman's book number, together with date and place of issue; and
   - stowaway's next of kin, if different from above.
7. The Stowaway Details Form contained in MGN 70 should be completed. The completed form should be copied by fax or e-mail to the agent and the P&I club correspondent at the next port of call.
8. Photographs of each stowaway should be taken and, where digital camera facilities are available, transmitted to the P&I club correspondent; these may enable travel documents to be obtained more quickly on the ship's arrival.
9. All stowaways should be housed in some part of the crew accommodation which can be locked when necessary.
10. The stowaways should not be locked in their accommodation when the vessel is at sea and well clear of land unless they are considered a threat to the safety of the ship or personnel on board. Consideration should be given, however, to the possibility of unguarded stowaways launching a liferaft or boat in an attempt to reach land.
11. The stowaways should be locked securely in their accommodation when the vessel approaches any port or nears any land. (Consideration should be given to the possibility of the stowaways' escape through open scuttles.)
12. The stowaways should be provided with adequate food, water, sanitary facilities, etc.

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13. The stowaways should be treated in a humane manner.
14. The stowaways should not be made to work for their keep.
15. The stowaways should not be signed on the Crew Agreement and should not be entered on any List of Crew. A "Stowaway List" should be made recording any known particulars, ready for production to port officials.
16. Evidence of costs relating to the stowaway case, such as fuel, insurance, wages, stores, provisions and port charges, should be gathered to support the owner's claim on his P&I policy. (The owner's costs associated with the landing of stowaways are usually recoverable from his P&I club.)
17. Full details of all events and particulars relating to the stowaway incident should be recorded in the Official Log Book, if necessary in an annexed document. (This may be used as part of any report required by owners, the club, etc.)

- explains that arriving with stowaways on board can have complications
- explains that the IMO Guidelines on the Allocation of Responsibilities to seek the Successful Resolution of Stowaway Cases state (in paragraph 3) that the resolution of stowaway cases is difficult because of different national legislation in each of the potentially several countries involved: the country of embarkation, the country of disembarkation, the flag State of the vessel, the country of apparent, claimed or actual nationality/citizenship of the stowaway, and countries of transit during repatriation
- explains that the IMO Guidelines on the Allocation of Responsibilities to seek the Successful Resolution of Stowaway Cases contain (in paragraph 4) certain basic principles which can be applied generally, the first of these is that there is recognition that stowaways arriving at or entering a country without the required documents are, in general, illegal entrants. Decisions on dealing with such situations are the prerogative of the countries where such arrival or entry occurs, the third is that the shipowner and his representatives on the spot, the master, as well as the port authorities and national Administrations, should co-operate as far as possible in dealing with stowaway cases

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- states that in every case the agent should be notified of the presence of stowaways in advance of arrival
- explains that under the U.S. Refugee Act 1980 a stowaway who arrives in the USA can request political asylum
- explains that the Immigration and Naturalization Service (INS) has taken the position that shipowners are required to provide 24-hour armed guards during the entire asylum process which can take months
- explains that there have been cases where the owner has incurred costs in excess of $1m for such detention
- explains that many countries impose very heavy penalties (in some cases of over US$200,000) on masters who fail to ensure that stowaways are kept securely on board in port

Ship's Agents and Agency

- explains that as per United Nations Conference on Trade and Development, UNCTAD MINIMUM STANDARDS FOR SHIPPING AGENTS, " Shipping agent" means any person (natural or legal) engaged on behalf of the owner, charterer or operator of a ship, or of the owner of cargo, in providing shipping services including;
  i. Negotiating and accomplishing the sale or purchase of a ship;
  ii. Negotiating and supervising the charter of a ship;
  iii. Collection of freight and/or charter hire where appropriate and all related financial matters;
  iv. Arrangements for Customs and cargo documentation and forwarding of cargo;
  v. Arrangements for procuring, processing the documentation and performing all activities required related to dispatch of cargo;
  vi. Organizing arrival or departure arrangements for the ship;
  vii. Arranging for the supply of services to a ship while in port
- explains the authority of the agency and where it may be actual authority or apparent authority (also called ostensible authority)
- explains that actual authority may be express or implied
- states that express authority is given by words (spoken or written) such as when an officer is

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appointed by letter to command of a ship and authority is implied when it is inferred by the conduct of the parties and the circumstances of the case, such as when a shipmaster is appointed to command by a shipowner, who thereby impliedly authorises him to carry out, on the owner's behalf, all the usual things that fall within the scope of a master's position, e.g. engagement and discharge of crew, signing of bills of lading, and purchasing of provisions

- explains that an exception to this would be where the principal has expressly placed a restriction on the implied authority of the agent, e.g. where the master is expressly prohibited from signing bills of lading
- describes the different types of agent and agency
- explains that agents are normally either general agents or special agents
- explains that a general agent is an agent who has authority to act for his principal in all matters concerning a particular trade or business, or of a particular nature, many liner agents, for example, act as general agent in a particular city or country for one or more carriers
- explains that a special agent is an agent appointed for the carrying out of particular duties which are not part of his normal business activities
- explains that a special agent's authority is therefore limited by his actual instructions, most port agents are special agents since their authority does not extend beyond their actual instructions
- states that shipmasters are similarly special agents for purposes of engaging and discharging crew, purchasing ships' stores and bunkers, and making salvage agreements in certain cases
- outlines that an agent's duties to his principal are:
    - to perform his duties in person, using ordinary skill and diligence, and if he purports to have special skills, to use his special skills also;
    - to obey lawful instructions of his principal, and when he is not instructed on a particular matter, to act in his principal's best interests;
    - to disclose all information relevant to the agency to the principal, avoiding any conflict of interest;
    - to maintain confidentiality about matters communicated to him as agent, and not to disclose them to prospective third parties;
    - to keep proper accounts of all transactions and render them to his principal on request;

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- not to make extra profits from the agency without disclosing them to his principal
- explains that under the terms of voyage charters port agents are normally appointed, and therefore paid for, by the shipowner. However, many voyage charterers insist on nominating port agents, and are entitled to do so if the charter party is suitably claused to that effect
- explains where a charter party provides that "the vessel shall be consigned to Charterers' agents….", it means that the charterer will nominate agents
- explains that when on a time charter, most of the "voyage costs" associated with earning the freight or other revenue are normally for the time charterer's account, and it can be expected that port agents will be appointed by the charterer in order to look after his commercial interests
- explains that the charterer's obligation to provide and pay for agents may be in a "Charterers to provide" clause, or a separate Agency Clause or Consignment Clause
- explains that any "protecting" or "husbandry agent" used will be nominated and appointed by the shipowner
- explains that the shipping agents have to adhere to a Code of professional conduct given in United Nations Conference on Trade and Development, UNCTAD Minimum Standards For Shipping Agents, which states that the shipping agent shall:
  - i. discharge his duties to his principal(s) with honesty, integrity and impartiality;
  - ii. apply a standard of competence in order to perform in a conscientious, diligent and efficient manner all services undertaken as shipping agent;
  - iii. observe all national laws and other regulations relevant to the duties he undertakes;
  - iv. exercise due diligence to guard against fraudulent practices;
  - v. exercise due care when handling monies on behalf of his principal(s)

PORT STATE CONTROL R80

- explains that "Port State control" is the inspection of foreign ships present in a nation's ports for the purpose of verifying that the condition of the ships and their equipment comply with the provisions of

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international conventions and codes, and that the ships are manned and operated in compliance with those provisions.

- explains that the primary responsibility for maintaining ships' standards rests with their flag States, as well as their owners and masters. However, many flag States do not, for various reasons, fulfil their obligations under international maritime conventions, and port State control provides a useful "safety net" to catch substandard ships.
- states that a "Port State Control regime", where set up under a "memorandum of understanding" ("MOU") or similar accord between neighbouring port States, is a system of harmonised inspection procedures designed to target substandards ships with the main objective being their eventual elimination from the region covered by the MOU's participating States
- states that there are eight international PSC agreements currently in force world-wide, and they are as follows:
  - Paris Memorandum of Understanding (Paris MOU) Participating countries and Associate Members: Belgium, Canada, Croatia, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Russian Federation, Spain, Sweden, and UK (19). Target inspection rate: 25% annual inspection rate per country. (UK's target is currently 30%.)
  - Acuerdo de Vina del Mar (Latin-American Agreement) Participating countries and Associate Members: Argentina, Bolivia, Brazil, Chile, Colombia, Cuba, Ecuador, Mexico, Panama, Peru, Uruguay, and Venezuela (12).Target inspection rate: 15% annual inspection rate per country within 3 years.
  - Tokyo Memorandum of Understanding (Tokyo MOU)- Participating countries and Associate Members: Australia, Canada, China, Fiji, Indonesia, Japan, Republic of Korea, Malaysia, New Zealand, Papua New Guinea, Philippines, Russian Federation, Singapore, Solomon Islands, Thailand, Vanuatu, Viet Nam, Hong Kong (China) (18). Target inspection rate: 50% annual regional inspection rate by the year 2000 (achieved in 1996).
  - Caribbean Memorandum of Understanding

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(Caribbean MOU)- Participating countries and Associate Members: Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Bermuda, British Virgin Islands, Cayman Islands, Dominica, Grenada, Guyana, Jamaica, Montserrat, Netherlands, Antilles (Curacao, St Maarten), St Kitts & Nevis, Saint Lucia, Saint Vincent & the Grenadines, Suriname, Trinidad & Tobago, Turks and Caicos Islands (20).Target inspection rate: 10% annual inspection rate per country within 3 years.

- Mediterranean Memorandum of Understanding (Mediterranean MOU)- Participating countries and Associate Members: Algeria, Cyprus, Egypt, Israel, Jordan, Malta, Lebanon, Morocco, Tunisia, Turkey, Palestinian Authority (11). Target inspection rate: 15% annual inspection rate per country within 3 years
- Indian Ocean Memorandum of Understanding (Indian Ocean MOU)- Participating countries and Associate Members: Djibouti, Eritrea, Ethiopia, India, Iran, Kenya, Maldives, Mauritius, Mozambique, Seychelles, South Africa, Sri Lanka, Sudan, Tanzania, Yemen (15). Target inspection rate: 10% annual inspection rate per country within 3 years
- West and Central African Memorandum of Understanding (Abuja MOU)- Participating countries and Associate Members: Angola , Benin, Cameroon, Cape Verde, Congo, Côte d'Ivoire, Gabon, Gambia, Ghana, Guinea, Equatorial Guinea, Mauritania, Namibia, Nigeria, Senegal, Sierra Leone, South Africa, The Gambia and Togo (19).Target inspection rate: 15% annual inspection rate per country within 3 years and
- Black Sea Memorandum of Understanding (Black Sea MOU)- Participating countries and Associate Members: Bulgaria, Georgia, Romania, Russian Federation, Turkey, Ukraine (6).Target inspection rate: 15% annual inspection rate per country within 3 years
- the US Coast Guard operates a national Port State Control Initiative

- outlines that the list of certificates and documents which are checked during the inspection are:
  1. International Tonnage Certificate (1969);

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2. Passenger Ship Safety Certificate;
3. Cargo Ship Safety Construction Certificate;
4. Cargo Ship Safety Equipment Certificate;
5. Cargo Ship Safety Radio Certificate;
6. Exemption Certificate;
7. Cargo Ship Safety Certificate;
8. Document of Compliance (SOLAS 74, regulation II-2/54);
9. Dangerous Goods Special List or Manifest, or Detailed Stowage Plan;
10. International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk, or the Certificate of Fitness for the Carriage of Liquefied Gases in Bulk, whichever is appropriate;
11. International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk, or the Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk, whichever is appropriate;
12. International Oil Pollution Prevention Certificate;
13. International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk;
14. International Load Line Certificate (1966);
15. International Load Line Exemption Certificate;
16. Oil Record Book, parts I and II;
17. Shipboard Oil Pollution Emergency Plan;
18. Cargo Record Book;
19. Minimum Safe Manning Document;
20. Certificates of Competency;
21. Medical certificates (see ILO Convention No. 73);
22. Stability information;
23. Safety Management Certificate and copy of Document of Compliance (SOLAS chapter IX);
24. Certificates as to the ship's hull strength and machinery installations issued by the classification society in question (only to be required if the ship maintains its class with a classification society);
25. Survey Report Files (in case of bulk carriers or oil tankers in accordance with resolution A.744(18));
26. For ro-ro passenger ships, information on the A/A max ratio;
27. Document of authorization for the carriage of

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

grain;

28. Special Purpose Ship Safety Certificate;
29. High-Speed Craft Safety Certificate and Permit to Operate High-Speed Craft;
30. Mobile Offshore Drilling Unit Safety Certificate;
31. For oil tankers, the record of oil discharge monitoring and control system for the last ballast voyage;
32. The muster list, fire control plan and damage control plan;
33. Ship's log-book with respect to the records of tests and drills and the log for records of inspection and maintenance of life-saving appliances and arrangements;
34. Procedures and Arrangements Manual (chemical tankers);
35. Cargo Securing Manual;
36. Certificate of Registry or other document of nationality;
37. Garbage Management Plan;
38. Garbage Record Book;
39. Bulk carrier booklet (SOLAS chapter VI regulation 7); and
40. Reports of previous port State control inspections

- outlines that in addition to the general control of above listed certificate and documents, examinations / inspections of the following are generally given priority by Port State Control Officer (PSCO):
  - Nautical publication (SOLAS 74 R V/20)
  - Navigational equipment (SOLAS 74 R V/12 and 19)
  - Emergency starting and running tests (SOLAS 74 R II-2 - 4.3)
  - Lifesaving equipment. Rafts FF (SOLAS 74 R III/20, 23, 26 and 29)
  - Emergency Generator (start/stop only) (SOLAS 74 R II-1/42&43)Hull corrosion and damages (Load Lines) (SOLAS 74 R I/11)
  - Main engine & aux. engines (SOLAS 74 R II/26, 27 &28)
  - Oily water separator 15 ppm alarm (MARPOL Annex I/16(1))
  - Oil discharge monitor (ODM) (MARPOL Annex I/16)
  - Charts corrected and proper scale (SOLAS 74 R V/20)

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

- Fire safety Control plan (SOLAS 74 R II-2/20)
- Ventilation inlets/outlets (SOLAS 74 R II-2/16.9 & 48)
- Emergency training and drills (Log book rec. SOLAS 74 R III/18)
- Emergency lighting/batteries (SOLAS 74 R II/42 &43)
- Deck- and hatches corrosion and damages (LL 1966)
- Steering gear – incl. auxiliary & emergency (Bridge inspection only – SOLAS 74 R V/19)
- Cleanliness in engine room (SOLAS 74 R II-1/26 and ILO 134)
- Cleanliness in accommodation (ILO 92 & 133)

- explains that the Port State Control Inspections may be conducted on the following basis:
  - initiative of the Port State Administration;
  - the request of, or on the basis of, information regarding a ship provided by another Administration
  - information regarding a ship provided by a member of the crew, a professional body, an association, a trade union or any other individual with an interest in the safety of the ship, its crew and passengers, or the protection of the marine environment.
- explains that the PSC inspections may be on random, targeted or periodical basis. The following types of PSC inspections are used in PSC:
  1. Initial Inspection (random)
  2. More detailed inspection (escalated)
  3. Expanded inspection (targeted/periodical)
- states that the definition of Inspection is: “A visit on board a ship to check both the validity of the relevant certificates and other documents, and the overall condition of the ship, its equipment, and its crew”
- explains that the certificates and documents listed above should therefore be readily available and presented to the PSCO at his request during the PSC inspection
- states that the definition of more detailed inspection is: “An inspection conducted when there are clear grounds for believing that the condition of the ship, its equipment, or its crew does not correspond substantially with the particulars of the certificates”
- states that the definition of Clear grounds is: “Evidence that the ship, its equipment, or its crew does not correspond substantially with the

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

requirements of the relevant conventions or that the master or crew members are not familiar with essential shipboard procedures relating to the safety of ships or the prevention of pollution"

- outlines that "Clear grounds" to conduct a more detailed inspection include:
  1) the absence of principal equipment or arrangements required by the conventions;
  2) evidence from a review of the ship's certificates that a certificate or certificates are clearly invalid;
  3) evidence that documentation required by the conventions are not on board, incomplete, are not maintained or are falsely maintained;
  4) evidence from the PSCO's general impressions and observations that serious hull or structural deterioration or deficiencies exist that may place at risk the structural, watertight or weathertight integrity of the ship;
  5) evidence from the PSCO's general impressions or observations that serious deficiencies exist in the safety, pollution prevention or navigational equipment;
  6) information or evidence that the master or crew is not familiar with essential shipboard operations relating to the safety of ships or the prevention of pollution, or that such operations have not been carried out;
  7) indications that key crew members may not be able to communicate with each other or with other persons on board;
  8) the emission of false distress alerts not followed by proper cancellation procedures;
  9) receipt of a report or complaint containing
  10) information that a ship appears to be substandard.
- explains that the PSCO during a more detailed inspection generally take the following into account:
  - structure;
  - machinery spaces;
  - conditions of assignment of load lines;
  - life-saving appliances;
  - fire safety;
  - regulations for preventing collisions at sea;
  - Cargo Ship Safety Construction Certificate;
  - Cargo Ship Safety Radio Certificates;
  - equipment in excess of convention or flag State requirements;

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- guidelines for discharge requirements under Annexes I and III of MARPOL 73/78 which includes:
  - inspection of crude oil washing (COW) operations;
  - inspection of unloading, stripping and prewash operations;
  - guidelines for control of operational requirements – which include:
  - muster list;
  - communication;
  - fire drills;
  - abandon ship drills;
  - damage control plan and Shipboard Oil Pollution Emergency Plan;
  - fire control plan;
  - bridge operation;
  - cargo operation;
  - operation of the machinery;
  - manuals, instructions etc.;
  - oil and oily mixtures from machinery spaces;
  - loading, unloading and cleaning procedures for cargo spaces of tankers;
  - dangerous goods and harmful substances in packaged form;
  - garbage;
- minimum manning standards and certification;
- STCW 78;
- ISM; and
- ISPS Code.

- states that expanded inspection is an inspection conducted according to non-mandatory guidelines only once during 12 months period for certain types of ships and certain categories of age and size
- explains that Oil tankers, bulk carriers, gas and chemical carriers and passenger ships are subject to expanded inspections once during a period of 12 months
- outlines the IMO RESOLUTIONS pertaining to Port State Controls are as follows:
  - A.9/Res.321 Procedures for the control of ships 12/11/1975
  - A.12/Res.466 Procedures of port state control 19/11/1981
  - A.15/Res.597 Amendments to the procedures for the control of ships 19/11/1987
  - A.19/Res.787 Procedures for port state control

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23/11/1995

- A 21/Res.882 Amendments to the procedures for port state control (Resolution A.787(19) 25/11/1999

- states that the publication by IMO which gives the General Procedural Guidelines for Port State Control Officers are also of particular relevance to shipmaster
- explains that a record of port State control inspections including safety-related details of many ships is available on the internet from the Equasis database and may be viewed by any member of the public
- explains that Equasis forms part of the Quality Shipping campaign launched by the EU in 1997 which is formally supported by signatories from marine Administrations, classification societies, P&I clubs and the ITF
- explains that more than 40 organisations provide information to Equasis and is used heavily by charterers and insurers as well as marine Administrations with port State control functions

PORT OF REFUGE

- states that a "port of refuge" is a port or place that a vessel diverts to when her master considers it unsafe to continue the voyage due to a peril that threatens the "common safety", e.g. when there is a dangerous ingress of water into the vessel, a dangerous shift of cargo, the vessel adopts an angle of loll, there is a serious fire on board, etc
- explains that where such a deviation is for the preservation from peril of property involved in a common maritime adventure, it will usually constitute a general average act and the costs of the deviation to and stay at the port of refuge will be allowed in general average
- explains that where the shipowner or carrier is a party to a contract of carriage, discontinuation of the voyage is a deviation from the contract
- explains that a deviation to a port of refuge will be regarded as a justifiable deviation if the reason can be shown to be a valid one within the terms of the contract. All contractual rights would, in that case, be unaffected
- explains that if the reason for deviating could not be shown to be valid, the deviation would be considered unjustifiable and the consequences could be severe for the shipowner or carrier, in that it would probably

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

constitute a repudiatory breach of the contract, making the owner/carrier liable for all costs of any accident to ship or cargo sustained during the deviation

- outlines that Valid reasons for deviating to a port of refuge usually include:
  - weather, collision or grounding damage affecting seaworthiness of the ship;
  - serious fire;
  - dangerous shift of cargo;
  - serious machinery breakdown;
  - any other accident causing some serious threat to the vessel and cargo;
  - shortage of bunkers (if it can be proved that the vessel left port with adequate bunkers for the foreseeable voyage, and ran short as a consequence of weathering exceptionally severe weather, contamination, etc.)
- explains that a "Port of refuge" is a term usually associated with a general average act since, under the York-Antwerp Rules, certain costs and expenses incurred in making for, entering, staying at and leaving a port or place of refuge, even where the ship returns to her port or place of loading, are admitted as general average
- describes the explanation given in Rule X for expenses at port of refuge provided in the York-Antwerp Rules
- explains that a port or place where a vessel seeks temporary shelter from adverse weather is not a port of refuge, since running for shelter is "ordinary" practice and not "extraordinary" in the context of Rule A of the York-Antwerp Rules
- explains that a "common maritime adventure" is said to be terminated on completion of discharge of cargo (or disembarkation of passengers) at the port of destination following a general average act. If the voyage is abandoned at an intermediate port (e.g. a port of refuge), then the adventure terminates at that port
- explains that a declaration of general average should be formally made in compliance with local law and custom before delivery of cargo at the termination of the voyage, in order to initiate an adjustment
- explains that the declaration is usually made by the shipowner or the master, but in some countries any one of the interested parties may make it. The owners or agent should be able to advise on local

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

requirements

- explain the procedure for any particular port or place of refuge in general, the following basic steps should be followed
  - as soon as the decision is taken to discontinue the voyage and make for a port or place of refuge, (whether under tow or otherwise) inform the owner and charterer (if any), stating the reason for the deviation
  - record the ship's position. Sound tanks for quantity of bunkers on board. From this point until departure from the port or place of refuge, keep accurate records of events and expenditure, etc., for eventual delivery to the owner and average adjuster
  - request the owner to arrange the appointment of an agent at the port of refuge to handle the vessel's visit
  - if the cause of the deviation is an "accident" inform MAIB
  - call the agent as soon as his identity is known. Pass ETA and information necessary for making preparations for the vessel's arrival, including tonnage, length, flag, P&I club, classification society, etc. Request the agent to notify:
    - port State Administration if vessel is damaged or seaworthiness is affected;
    - harbour master or port authority. Inform port authority of the full facts, as the authority may want to keep vessel outside port until cargo discharged, etc. Give details of the nature and severity of damage, mentioning any disabled navaids, steering gear, machinery, etc. State any pollution hazard.
    - pilot station, linesmen, boatman, customs, port health, immigration, etc.
    - local correspondent of the owner's P&I club. (See club handbook for name and address, or ask owners.) A representative from the correspondent firm, or a surveyor appointed by the correspondent, should attend on arrival.
  - on arrival at the port or place of refuge, the salvor (if any) will require salvage security, which should be arranged by the owner and cargo owners. Failing this, the salvor may have vessel arrested pending satisfaction of his claim.
  - obtain health clearance in accordance with local

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

regulations (as advised by the agent).
- enter vessel in with customs "under average".
- inform the owner (and charterer, if any) of vessel's safe arrival.
- owners will declare general average. (Any of the parties involved may declare general average, but the owners will normally do this since they are closest to "the action".)
- note protest as soon as possible but in any case within 24 hours, in compliance with local custom (ask the agent about this), reserving the right "to extend at a time and place convenient".
- where there is hull or machinery damage, the agent should be requested to notify local Lloyd's Agent (a requirement of the Notice of Claim and Tenders Clause in Institute Time Clauses - Hulls 1.10.83).
- Hull and machinery underwriters normally instruct a surveyor, in major cases from the Salvage Association
- where there is hull or machinery damage, a class surveyor, if available at the port, will inspect and report on the damage, stipulating repairs necessary for the vessel to maintain class. Temporary repairs may be acceptable.
- if no class surveyor is available, the class society should be contacted, and will advise the appropriate steps to take in order for class to be maintained until a port can be reached for survey, the old practice of requesting two independent masters or engineers to inspect temporary repairs and issue a Certificate of Seaworthiness should no longer be necessary. Even where a class surveyor cannot reach a damaged ship, the classification society can usually be notified of the damage and asked for instructions.
- if cargo damage is probable, or cargo discharge is necessary before repairs can be made, call a hatch survey before commencing discharge. Employ only registered and unbiased surveyors recommended by the P&I club correspondent. Cargo interests should be notified so that they can appoint their own surveyors. Remember that cargo surveyors are appointed by cargo interests and may criticise the master's actions or allege that the vessel was unseaworthy. Be guided by the P&I club correspondent as to who to allow on board and about making statements which may adversely

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

affect the owner's legal position.

- if the voyage is being terminated and cargo owners are taking delivery of their consignments, General Average Bond and General Average Guarantee forms will first have to be signed. The owner's lien on cargo should be exercised if necessary; this should be discussed with the owner and agent.
- arrange cargo discharge (under survey) and either trans-shipment or warehousing of cargo during the repairs, if necessary. (This will depend on the length of time in port, nature of cargo, etc.)
- on receipt of class surveyor's report re-hull/machinery damage, the owner will advertise for tenders.(Superintendents and the Salvage Association surveyor will jointly attend to this, bearing in mind the Notice of Claim and Tenders Clause and underwriters' power of veto. Tenders should only be accepted with guidance from Salvage Association surveyor and Lloyd's or IUA Agent.)
- carry out repairs under class and Salvage Association surveyors' guidance.
- on completion of repairs, class surveyor will carry out another survey. If, in his opinion, the vessel is seaworthy he will issue an Interim Certificate of Class, and will send his report to the classification society. If acceptable to the society's committee, the vessel will retain class. If the class surveyor is employed by an authorised society, he may also issue provisional statutory certificates on behalf of MCA (or other flag State Administration) to enable the vessel to continue her voyage.
- reload cargo (under survey) if voyage being continued.
- extend Protest to include all details of the damage and repairs. Obtain copies for owners.
- port agent will pay repairers. (If unpaid, repairers will have a maritime lien on the vessel.) Allow general average and Salvage Association surveyors (representing H&M insurers) to see the agent's account before paying.
- send all relevant documents to the owner for onwards delivery to the average adjuster.
- enter vessel outwards with Customs (in accordance with local regulations, as advised by the agent). Obtain outwards clearance.
- continue the voyage.

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

- explains that in most general average cases the main evidence required for the adjustment comes from the various survey reports, supported by statements by witnesses and ship's records
- outlines the evidence required at port of refuge as listed below:
  - full and accurate records should be kept of the general average incident and the call at the port of refuge, including details of all the various parties involved and their actions
  - photographs and video footage may be useful; the general average statement may take more than a year to produce
  - where salvage services are engaged, a full record should be kept of the salvor's actions and of the equipment used by both parties
  - in order to assess the various contributory values, the average adjuster will require the following documents:
    - all general average security documents including signed average bonds, average guarantees, counterfoils of average deposit receipts and cancelled deposit receipts;
    - casualty reports from the master;
    - certified extracts from deck and engine room logs;
    - copies of extended protests;
    - survey reports on hull and machinery damage;
    - survey reports on cargo lost or damaged by general average sacrifice;
    - account sales of any cargo sold;
    - copies of any shipping invoices;
    - copies of telexes;
    - accounts for disbursements incurred together with all supporting vouchers;
    - cargo valuation forms;
    - manifest of cargo onboard at time of the general average act;
    - copies of bills of lading;
    - portage account for the voyage, and an account of stores consumed;
    - any other evidence relating to the casualty.

The master / pilot relationship

- explains that the law in most countries regards a

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

ship's pilot as being merely an advisor to the master, without having command, navigational control or charge of the vessel

- states that the pilot's duty is restricted to advising the master of local conditions affecting safe navigation
- explains that in almost every country (with the notable exception of Panama, where Panama Canal pilots have extraordinary responsibility and powers, the master has full responsibility for the navigation and manoeuvring of his ship during all acts of pilotage
- states that Paragraph II.6 of Memorandum of Understanding Between the National Response Team and the Panama Canal Commission, dated December 12, 1997, the Pilotage in the Panama Canal provides: "Ships operating in the Panama Canal come under the direction of a Panama Canal Pilot who assumes operational control of the ship when it enters the Canal, unlike pilots in other locales who act as advisors to the Master of the ship. The Panama Canal Pilots are employees, or agents, of the PCC making the PCC effectively the ship operator for the time the ship is under the control of a Panama Canal Pilot"
- explains that the master should generally:
  - follow the pilot's advice unless he has good reason to believe that following it will endanger the ship;
  - see that the ship's navigation is monitored (including plotting fixes/positions on charts) as if there were no pilot on board;
  - insist that the pilot takes all reasonable precautions;
  - ensure that officers, helmsmen, etc. attend to the pilot's requests with efficiency and courtesy;
  - instruct the officer-of-the-watch that he has charge of the vessel whilst under pilotage, unless specifically informed otherwise by the master;
  - always state his opinion to the pilot on important matters of navigation and manoeuvring.
  - warn the pilot if it appears that the pilot is taking or proposing to take any action of which the master disapproves
- states that examples of cases where the master should interfere are:
  - where the pilot is incapable through apparent illness, drink or drugs;
  - where the pilot gives orders to the helmsman which will, if carried out, result in a breach of the law
- states that the shipowner is generally liable for the consequences of negligent navigation whilst the ship

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

is under pilotage

1.7 Methods and Aids to Prevent Pollution of the Marine Environment by Ships (2 hours)

Convention of the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention) (LDC) — R 106

- explains the aims of the Convention
- defines, for the purpose of the Convention:
  - dumping
  - wastes or other matter
  - special permit
  - general permit
- states that the dumping of wastes or other matter in whatever form or condition, as listed in annex I, is prohibited
- states that the dumping of wastes or other matter listed in annex II requires a prior special permit
- states that the dumping of all other wastes or mater requires a prior general permit
- explains that the provisions of Article IV do not apply when d is necessary to secure the safety of human life or of vessels in cases of 'force majeure' caused by stress of weather, or in any case which constitutes a danger to human life or a real threat to vessels
- states that such dumping should be done so as to minimize the likelihood of damage to human or marine life and must be reported immediately
- states that the Addendum to Annex I contains regulations on the incineration of wastes at sea
- explains that the appropriate authority of a Contracting Party should issue prior special or general permits in respect of matter intended for dumping:
  - loaded in its territory
  - loaded by a vessel flying its flag when the loading occurs in the territory of a State not party to the Convention

International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969 — R 107

- describes the rights of Parties to the Convention to intervene on the high seas following a maritime casualty
- defines, for the purposes of the Convention:
  - maritime casualty

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

- ship
- oil
- related interests

- describes the provisions which a coastal State should apply when exercising the right to take measures in accordance with Article I

Protocol relating to Intervention on the High Seas in Cases of Pollution by Substances other than Oil, 1973

- describes the rights of Parties to the Protocol to intervene on the high seas following a maritime casualty
- defines 'substances other than oil'
- explains that the Protocol extends the rights and obligations of coastal States to cases involving imminent threat of pollution by substances other than oil

International Convention on Civil Liability for Oil Pollution Damage,1969 (CLC 1969) — R 108

- states that no claim for compensation may be made against the servants or agents of the owner
- explains that, with certain exceptions, the owner may limit his liability by constituting a fund for the sum representing the limit of his liability with the Court of a Contracting States where the action is brought
- states that claims in respect of expenses reasonably incurred by the owner voluntarily to prevent or minimize pollution damage rank equally with other claims against the fund
- explains that where a fund has been constituted and the owner is entitled to limit his liability, no person having a claim for pollution damage resulting from that incident is entitled to exercise any rights over other assets of the owner and that the ship or any other property belonging to the owner should be released
- states that the owner of a ship registered in a Contracting State and carrying more than 2,000 tons of oil in bulk as cargo is required to maintain insurance in the sum of his limit of liability
- states that the appropriate authority of a Contracting State, after determining that the requirements have been, complied with, should issue a certificate attesting that insurance or other financial security is in force

COMPETENCE 3.2	Monitor and Control Compliance with Legislative requirements	IMO Reference

- states that the certificate should be carried on board ship and a copy deposited with the relevant authorities
- states that a Contracting State must not permit a ship under its flag to which this Article applies to trade without a certificate
- states that Contracting States must ensure under their national legislation, that insurance or other security is in force in respect of any ship, whenever registered, entering or leaving their ports of offshore terminals if the ship actually carries more than 2,000 tons of oil in bulk as cargo

1.8 National legislation for implementing international agreements and conventions

- see Instructor Guidance Notes

COMPETENCE 3.3	Maintain Safety and Security of Crew and Passengers and the Operational Condition of Safety Equipment	IMO Reference

TRAINING OUTCOMES:

STCW Code Table A-II/2

Demonstrates a knowledge and understanding of:

3.3.1 LIFE-SAVING APPLIANCE REGULATIONS (SOLAS)
3.3.2 ORGANIZATION OF FIRE AND ABANDON SHIP DRILLS
3.3.3 MAINTENANCE OF LIFE-SAVING, FIRE-FIGHTING AND OTHER SAFETY SYSTEMS
3.3.4 ACTIONS TO PROTECT AND SAFEGUARD ALL PERSONS ON BOARD IN EMERGENCIES
3.3.5 ACTIONS TO LIMIT DAMAGE AND SAVE THE SHIP FOLLOWING A FIRE, EXPLOSION, COLLISION OR GROUNDING

COMPETENCE 3.3	Maintain Safety and Security of Crew and Passengers and the Operational Condition of Safety Equipment	IMO Reference

3.3.1 LIFE SAVING APPLIANCE REGULATIONS (SOLAS)

Textbooks / Bibliography: T42, T43, B59, B62

Teaching aids: A1, V95, V96, V100

Required performance:

1.1 Life-Saving Appliance Regulations (SOLAS) (2 hours) — R2

- demonstrate a knowledge of the regulations concerning life-saving appliances and arrangements (SOLAS), including the LSA Code

3.3.2 ORGANIZATION OF FIRE AND ABANDON SHIP DRILLS

Required performance:

2.1 Organization of Fire and Abandon Ship Drills

- See IMO Model Courses 1.23 and 2.03

3.3.3 MAINTENANCE OF LIFE-SAVING, FIRE-FIGHTING AND OTHER SAFETY SYSTEMS

Required performance:

3.1 Maintenance of Life-saving, Fire-fighting and Other Safety Systems

- See IMO Model Courses 1.23 and 1.03

3.3.4 ACTIONS TO PROTECT AND SAFEGUARD ALL PERSONS ON BOARD IN EMERGENCIES

Textbooks: T3

Teaching aids: A1, V35

Required performance:

4.1 Actions to Protect and Safeguard all Persons on Board in Emergencies (4 hours) — R1, R2

- states that some crew members will be assigned specific duties for mustering and control of passengers

COMPETENCE 3.3	Maintain Safety and Security of Crew and Passengers and the Operational Condition of Safety Equipment	IMO Reference

- lists those duties as:
  - warning the passengers
  - ensuring that all passenger spaces are evacuated
  - guiding passengers to muster stations
  - maintaining discipline in passageways, stairs and doorways
  - checking that passengers are suitably clothed and that life jackets are correctly donned
  - taking a roll-call of passengers
  - instructing passengers on procedure for boarding survival craft or jumping into the sea
  - directing passengers to embarkation stations
  - instructing passengers during drills
  - ensuring that a supply of blankets is taken to the survival craft

Rescue of Persons from a Vessel in Distress or from a Wreck — R1

- states why it is preferable to wait for daylight when no immediate danger exists
- states that communications should be established between the ships and the method of rescue agreed upon when time permits
- states that rescue boats or motor-lifeboats would be used if conditions permitted
- states that unnecessary equipment should be removed from the boats and replaced by lifejackets, if buoys, blankets and a portable VHF radio
- states that the rescue vessel should reconnoitre the area to see if there is any wreckage which could be a danger to boats
- describes how both ships can spread oil in rough weather
- describes the preparations for taking survivors on board from the boats
- describes how to provide a lee and launch boats
- describes how boats should approach the wreck and pick up survivors
- describes the recovery of boats and survivors
- describes the methods of rescue which may be used when sea conditions are too dangerous to use boats

Man-overboard Procedure — R1

- describes methods of recovering a person from the sea when heavy weather prevents the use of the normal

COMPETENCE 3.3	Maintain Safety and Security of Crew and Passengers and the Operational Condition of Safety Equipment	IMO Reference

manoeuvres and boats
- describes and explains the actions to take when a person is reported missing at sea

3.3.5 ACTIONS TO LIMIT DAMAGE AND SAVE THE SHIP FOLLOWING A FIRE, EXPLOSION, COLLISION OR GROUNDING

Textbooks: T10

Teaching aids: A1, V24, V25, V28, V29

Required performance:

5.1 Actions to Limit Damage and Save the Ship following a Fire, Explosion, Collision or Grounding (4 hours) R1

Means of limiting damage and salving the ship following a fire or explosion

- describes methods of fighting fires (see IMO Model Course 2.03, Advanced Training in Fire Fighting)
- states that cooling of compartment boundaries where fire has occurred should be continued until ambient temperature is approached
- explains the dangers of accumulated water from fire fighting and describes how to deal with it
- states that watch for re-ignition should be maintained until the area is cold
- describes the precautions to take before entry to a compartment where a fire has been extinguished
- describes the inspection for damage
- describes measures which may be taken to plug holes, shore-up damaged or stressed structure, blank broken piping, make safe damaged electrical cables and limit ingress of water through a damaged deck or superstructure
- outlines the measures to be taken when the inert-gas main and gas lines to a mast riser are fractured
- states that continuous watch should be kept on the damaged area and temporary repairs
- states that course and speed should be adjusted to minimise stresses and the shipping of water

COMPETENCE 3.3	Maintain Safety and Security of Crew and Passengers and the Operational Condition of Safety Equipment	IMO Reference

Procedure for Abandoning Ship

- states that a ship should only be abandoned when imminent danger of sinking, breaking up, fire or explosion exists or other circumstances make remaining on board impossible
- states that a distress call should be transmitted by all available means until acknowledged
- lists the information to include in the distress message
- describes other distress signals which may be used to attract attention
- describes the launching of boats and liferafts when the ship is listing heavily
- describes the launching of boats and liferafts in heavy weather conditions
- describes the use of oil to calm the sea surface and explains why fuel oil is not suitable

COMPETENCE 3.4 Develop Emergency and Control Plans	IMO Reference
TRAINING OUTCOMES: Demonstrates a knowledge and understanding of: 3.4.1 THE PREPARATION OF CONTINGENCY PLANS FOR RESPONSE TO EMERGENCIES 3.4.2 SHIP CONSTRUCTION, INCLUDING DAMAGE CONTROL 3.4.3 METHODS AND AIDS FOR FIRE PREVENTION, DETECTION AND EXTINCTION 3.4.4 FUNCTIONS AND USE OF LIFE-SAVING APPLIANCES	STCW Code Table A-II/2

COMPETENCE 3.4	Develop Emergency and Control Plans	IMO Reference

3.4.1 THE PREPARATION OF CONTINGENCY PLANS FOR RESPONSE TO EMERGENCIES

Textbooks / Bibliography : T3, T42, T43

Teaching aids: A1, V24, V25, V29

Required performance:

1.1 Contingency Plans for Response to Emergencies (9 hours) R1,R2

- draws up a muster list and emergency instructions for a given crew and type of ship
- assigns duties for the operation of remote controls such as:
  - main engine stop
  - ventilation stops
  - lubricating and fuel oil transfer pump stops
  - dump valves
  - CO2 discharge
  - watertight doors
  - and for the operation of essential services such as:
  - emergency generator and switchboard
  - emergency fire and bilge pumps
- describes the division of the crew into a command team, an emergency team, a back-up emergency team and an engine-room emergency team
- explains the composition of the emergency teams in the above objective
- states that crew members not assigned to emergency teams would prepare survival craft, render first aid, assemble passengers and generally assist the emergency parties as directed
- designates muster positions for the command team, both at sea and in port
- designates muster positions for the emergency teams
- states that the engine-room emergency team would take control of engine-room emergencies and keep the command team informed
- states that good communications between the command team and the emergency teams are essential
- draws up plans to deal with:
  - fire in specific areas, such as galley, accommodation, engine-room or cargo space, including co-ordination with shore facilities in port, taking account of the ship’s fire-control plan

COMPETENCE 3.4	Develop Emergency and Control Plans	IMO Reference

- rescue of victims of a gassing accident in an enclosed space
- heavy-weather damage, with particular reference to hatches, ventilators and the security of deck cargo
- rescue of survivors from another ship or from the sea
- leakages and spills of dangerous cargo stranding
- abandoning ship
- explains how drills and practices should be organized

- describes the role of a shipboard safety committee in contingency planning

Actions to be Taken when Emergencies Arise in Port — R1, R2

- describes actions to take in the event of fire on own ship, with particular reference to co-operation with shore facilities
- describes action which should be taken when fire occurs on a nearby ship or an adjacent port facility
- describes the circumstances in which a ship should put to sea for reasons of safety
- describes the actions which can be taken to avoid a ship dragging anchor towards own ship in an anchorage
- describes the actions and precautions to take when a submarine cable is lifted by the anchor
- describes how to buoy and slip an anchor
- describes how an anchor may be recovered when no power is available at the windlass

3.4.2 SHIP CONSTRUCTION, INCLUDING DAMAGE CONTROL

Textbooks: T5

Teaching aids: A1

Required performance:

2.1 Flooding of Compartments (4 hours) — R1

- defines:
  - margin line
  - permeability of a space
- explains what is meant by ‘floodable length’
- explains what is meant by ‘permissible length of

COMPETENCE 3.4	Develop Emergency and Control Plans	IMO Reference

compartments' in passenger ships
- describes briefly the significance of the factor of subdivision
- states the assumed extent of damage used in assessing the stability of passenger ships in damaged condition
- summarizes, with reference to the factor of subdivision, the extent of damage which a passenger ship should withstand
- describes the provisions for dealing with asymmetrical flooding
- states the final conditions of the ship after assumed damage and, where applicable, equalization of flooding
- states that the master is supplied with data necessary to maintain sufficient intact stability to withstand the critical damage
- explains the possible effects of sustaining damage when in a less favourable condition
- distinguishes between ships of Type 'A' and Type 'B' for the purposes of computation of freeboard — R78
- describes the extent of damage which a Type 'A' ship of over 150 metres length should withstand
- explains that a Type 'A' ship of over 150 metres length is described as a 'one- compartment ship
- describes the requirements for survivability of Type 'B' ships with reduced freeboard assigned
- summarizes the equilibrium conditions regarded as satisfactory after flooding
- states that damage to compartments may cause a ship to sink as a result of:
  - insufficient reserve buoyancy, leading to progressive flooding
  - progressive flooding due to excessive list or trim
  - capsizing due to loss of stability structural failure

3.4.3 METHODS AND AIDS FOR FIRE PREVENTION, DETECTION AND EXTINCTION — STCW Code Table A-II/2

Textbooks:

Teaching aids:

Required performance:

3.1 Methods and Aids for Fire-prevention, Detection and Extinction

- See IMO Model Course 2.03

COMPETENCE 3.4	Develop Emergency and Control Plans	IMO Reference

3.4.4 FUNCTIONS AND USE OF LIFE-SAVING APPLIANCES

Textbooks:

Teaching aids:

Required performance:

4.1 Functions and Use of Life-saving Appliances

– See IMO Model Course 1.23

COMPETENCE 3.5 Organize and Manage the Crew	IMO Reference
TRAINING OUTCOMES: Demonstrates a knowledge and understanding of: 3.5.1 SHIPBOARD PERSONNEL MANAGEMENT AND TRAINING 3.5.2 RELATED INTERNATIONAL CONVENTIONS AND RECOMMENDATIONS, AND NATIONAL LEGISLATION 3.5.3 APPLICATION OF TASK AND WORKLOAD MANAGEMENT 3.5.4 EFFECTIVE RESOURCE MANAGEMENT 3.5.5 DECISION MAKING TECHNIQUES 3.5.6 DEVELOPMENT, IMPLEMENTATION AND OVERSIGHT OF STANDARD OPERATING PROCEDURES	STCW Code Table A-II/2

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

3.5.1 PERSONNEL MANAGEMENT, ORGANIZATION AND TRAINING ON BOARD SHIP

Textbooks / Bibliography : T37

Teaching aids: A1, V159, V160, V161, V162, V163, V164, V165, V166

Required performance:

1.1 Shipboard Personnel Management (10 hours)

Principles of Controlling Subordinates and Maintaining Good Relationships R1

- states that the principles include:
  - being consistently calm and even in temperament when giving orders and dealing with offenders
  - being honest and fair in all matters, and being firm when necessary
  - treating all staff on the same basis, i ,e having no favourites
  - avoiding causing disappointment to staff
  - avoiding making promises, if possible; if any are made, then they be kept. The number of promises made should be restricted to perhaps three, as they can be remembered easily keeping staff well informed
  - choosing the more difficult path of making, rather than breaking, a person who has been an offender
  - having a proper attitude towards spokesmen or representatives of trade unions
  - making allowances for differences in nationality, language, religion and other cultural matters affecting behaviour and attitude

- making changes to a management method to allow for the personality of the user
  - being in control as a necessity for good management
  - being aware that managing staff on a ship in a declining fleet is more difficult than normal
  - being aware of the factors which govern attitudes of staff
  - ensuring that all staff feel that their services on board are appreciated
  - having a good attitude to staff welfare by:
  - being helpful when a member of staff requires

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

assistance on a personal problem
- encouraging the social life of the ship
- keeping a watchful eye on the on-board consumption of alcohol, the use of cannabis resin (hash) and hard drugs such as cocaine and its derivatives and illegal trading in pornographic material, and when necessary applying early correction

Staff Attitudes

- states that the reasons why people work include the following:
  - the need to earn money
  - the need to be a useful member of society
  - the need for security of their standard of living
- the need to use their manual and mental skills and to derive satisfaction from them
- the need to achieve their ambitions and improve their status
- the desire to have authority over other people, even for an indirect reason such as avoiding being controlled by a bully

Exercise of Authority

- explains why a person must make his own authority, and states that:
- the appointment of a person to a higher rank gives potential authority only
- the real authority of a rank is achieved when the person concerned demonstrates that he is fit for the rank by showing that:
  - he knows the work
  - he is decisive
  - his decisions are generally correct
  - his orders are clear and are quickly carried out without argument
  - he seeks advice when necessary and helps others
  - he can accept orders from superiors and carry them out
  - the need for a person to be accepted by those with whom he works

Group Behaviour

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

- states that group behaviour, discipline and the amount of work done by the crew are affected by:
  - the need for a person to be accepted by those with whom he works
  - the identification of the main groups on a ship, e.g. deck department officers and crew, and similarly, for other departments, depending on how the ship is manned
  - unofficial groupings, for example by nationality or religion
  - keeping the aims of the groups in line with the well-being of the ship, its commercial success and with the aims of the owning company
  - conflict between a self-chosen leader of a group and the appointed leader
- describes how the performance of individuals can be affected by conforming to the behavioural patterns of the group

Conditions of Employment

- lists methods for obtaining officers and crew as:
  - direct employment by a shipping company
  - employment through a national organization
  - employment through a trade union
  - employment through an agency
  - employment through a combination of any of these methods and discusses how attitudes to work vary with the method of recruitment
- states that conditions of service can vary between countries and between companies, but may include:
  - salary scales for officers and crew
  - a career structure for officers and crew
  - salary scales which show ‘begin at’ rates, with increments for seniority and qualifications
  - leave scales, showing how the leave is earned and paid
  - other allowances, showing items such as subsistence allowances, where applicable, and paid study leave when studying for Certificates of Competency issued by an Administration
  - other benefits, such as insurance and pension arrangements, whether contributory or not, or whether included in salary payment
  - other information, such as whether overtime is paid separately and at what rates
- states that, for safety and operational reasons, the

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

officers and crew must be able to communicate with each other in a common language and those responsible for the mustering and safety of passengers must be able to communicate effectively with them

- states that officers and crew should have had the necessary training appropriate to their duties
- states that officers and crew must be informed as to the scope and methods used for training aboard the ship

1.2 Training (6 hours) R2

Training Methods

- explains the purpose of on-board training
- describes the preparation needed before the start of a training session
- states why training should be relevant to the trainees' work and duties aboard ship
- demonstrates how to conduct a training session for a given topic
- describes how to maintain interest in routine training such as fire drills and abandon ship drills
- describes methods for training
  - in attitude
  - in skills
  - in knowledge
- lists the areas in which training is required and areas in which it is desirable
- delivers a training session to other members of the class
- states that training in the use of life-saving appliances and on the best method of survival should be based on the training manual on the ship and should include the following:
  - donning of lifejackets and immersion suits, as appropriate
  - muster at the assigned stations
  - boarding, launching and clearing the survival craft and the rescue boats
  - method of launching from within the survival craft
  - release from launching appliances
  - methods and use of devices for protection in launching areas, where appropriate
  - illumination in launching areas
  - use of all survival equipment
  - use of all detection equipment
  - with the assistance of illustrations, the use of radio life-saving appliances

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

- use of drogues
- use of engine and accessories
- recovery of survival craft and rescue boats, including their stowage and securing
- hazards of exposure and the need for warm clothing
- best use of survival craft facilities in order to survive

- methods of retrieval, including the use of helicopter rescue gear (slings, baskets, stretchers), breeches
- buoy, and shore life-saving apparatus and ship's line-
- throwing apparatus
- all other functions contained in the muster list and emergency instructions
- instructions for emergency repair of the life-saving appliances
- states that abandon ship drills must be carried out monthly on cargo ships and weekly on passenger ships states that each member of the crew must be given instructions, which must include:
  - operations and use of the ship's inflatable lifeerafts
  - problems of hypothermia, first-aid treatment of hypothermia and other appropriate first-aid procedures
  - special instructions necessary for use of the ship's life-saving appliances in severe weather and severe sea conditions
- states that:
  - instructions in the use of the ship's life-saving appliances and in survival at sea should be given at the same interval as the drills
  - individual instructions may cover different parts of the ship's life saving system
- all of the ship's life-saving equipment and appliances must be covered within any period of 2 months.

Emergency Drills

- states that drills should be carried out as follows;
  - routine exercises
  - essential tasks should be repeated at each drill, including:
    - operation of emergency bilge pump
    - operation of remote shut-off valves and remote stop switches
    - checking for ingress of air when handles of fire flaps are in 'closed position
- lists essential tasks as:
  - donning compressed-air breathing apparatus (CABA)

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

- preparing hoses and nozzles
- collecting foam compound
- collecting fire extinguishers
- collecting first-aid gear
- collecting evacuation equipment

- states that emergency teams are assembled in accordance with the muster list

- states that it may be necessary to improvise when persons are absent from emergency teams

- describes examples of fire drills as:
  - sending teams into cabins, lockers, access hatches and machinery spaces
  - attacking fires with appropriate equipment in cabin, lockers, hatches, galley and machinery spaces
  - evacuating a wounded or unconscious person from the above spaces
  - starting the emergency generator
  - starting the emergency bilge pump

- describes examples of boat drills as:
  - collecting additional survival gear
  - using different disciplines to prepare for launching and to launch survival craft

- states that departmental training may include:
  - in the deck department:
  - steering the ship and function of the automatic pilot
  - operation of windlass and mooring winches
  - operation of cargo winches, cranes or derricks
  - securing of cargo or containers
  - operation of bridge control of the main engines
  - operation of the speed log, depth sounder, and gyro-compass and their repeaters
  - operation of the navigation lights and other ship's lights and signals
  - operation of the ship's whistle or siren
  - the recording and care of spares and stores

- in the engine department:
  - operation of the main engine and auxiliaries
  - operation of electrical alternators and other electrical equipment
  - operation of boilers
  - operation of steering gear
  - operation of oily-water separators

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

- operation of control and automation equipment
- tracing of pipe lines for the various services such as lubricating oil, fuel oil and fresh and sail water

- the compiling of methodical inspections
  - the recording and care of spare gear and stores

- in the catering department:
  - operation of galley equipment
  - the recording and care of provisions and other materials
  - the loading of provisions and dry stores

- states that departmental training may include:
  - in the deck department:
  - maintenance of cargo covers and hatch equipment
  - painting hull, deck and superstructure
  - planned maintenance procedures maintenance of cargo-securing equipment
  - gyro-compass and repeaters
  - fire extinguishers and fireman’s outfits
  - survival craft and launching equipment

- in the radio department:
  - radar scanners and communications aerials
  - radars and communication equipment
  - emergency radio equipment for survival craft

- in the engine department:
  - planned maintenance of machinery
  - preservation and painting of structures and pipe work
  - maintenance of fixed fire-extinguishing systems
  - methods and details of servicing and repairing selected items of equipment,
  - e.g. changing piston rings and repairing pumps, altemator engines and fuel
  - injectors
  - methods and details of testing and repairing electrical and electronic equipment
  - making proper use of drawings and of instruction and maintenance manuals

- in the catering department:
  - painting of galley, storerooms (not refrigerated) and alleyways, where required
  - keeping galley stove and other equipment in good clean condition

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

- keeping filters and trunks of the galley air extractor fans clean and free of any build-up of grease, to avoid fires

3.5.2 RELATED INTERNATIONAL CONVENTIONS AND RECOMMENDATIONS, AND NATIONAL LEGISLATION — STCW Code Table A-II/2

Textbooks / Bibliography:

Teaching aids: A1, V1 4, V15

Required performance:

2.1 Related International Maritime Conventions and National Legislation (2 hours) — R1

The ISM Code

- explains the principles underlying the ISM Code
- describes the content and application of the ISM Code

STCW Convention

- explains the principles underlying the STCW Convention
- describes the content and application of the STCW Convention
- explains how to implement the regulations for controlling and monitoring to minimum hours of rest for watchkeepers
- states that seafarers new to a particular type of vessel require ship specific shipboard familiarization
- describes what shipboard familiarization may involve for watchkeeping officers
- describes what tasks or duties elementary basic safety familiarization involves for a watchkeeping officer
- describes how to organize shipboard training and how to maintain records
- states that penalties are prescribed for breaches of STCW 95 requirements and that these are determined by the flag state
- states that national legislation is required to implement the provisions of an international convention
- states that for STCW 1978, as amended, national legislation is subject to scrutiny and checking by IMO appointed persons
- states national legislation may differ from one flag to another — Reg I/14

3.5.3 APPLICATION OF TASK AND WORKLOAD — STCW Code

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

MANAGEMENT Table A-II/2

Textbooks / Bibliography: T27

Teaching aids: A1

Required performance:

3.1 Planning and co-ordination (1 hour)

- explains how to recognize an overload situation
- describes how fatigue can be identified
- explains the importance of identifying signs of fatigue
- explains the causes of fatigue, that can be experienced on board the ships
- explains the results, if fatigue is overlooked and / or allowed to develop
- explains what can be done to increase workload during an underload situation
- states that the holding of regular meetings is a good method of keeping staff informed and providing liaison on matters relating to:
  - the general operation of the ship With special Reference to safety, Safety Management System (SMS) and maintenance
- states that, preferably, safety meetings should be held monthly and management meetings weekly
- states that the chairman and composition of committees should be agreed with the master except where stipulated by national rules, e.g. election of representatives to the safety committee
- states that the basics on which the meetings are run should include:
  - producing an agenda which will limit the scope of a meeting
  - the keeping of minutes and their confirmation by the committee concerned
  - restricting the duration of a meeting to about one hour
- states that the minutes of meetings should be sent to those persons who attended the meeting and, after confirmation, to others as required by the master
- describes the influence of training on meeting technique and on how a person must conduct himself
- describes:
  - the ideal size of a group
  - the duration of a group meeting
- states the situations when:
  - meetings are convenient

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

- other methods of communication can be used
- describes the types of meeting
- prepares a meeting agenda and timetable
- makes preparation for and conducts a meeting
- deals successfully with disagreements
- explains the steps taken to follow-up conclusion of a meeting
- describes the most common pitfalls concerning:
  - the subjects
  - the arrangement
  - the disregarding of meeting techniques
- defines, for the requirements of on-board ship administration:
  - the types of meeting that are necessary
  - the objectives of the meetings
  - the preferred sequence of the meetings

3.2 Personnel Assignment (1 hour)

- states that the organization on board depends on ship design and manning arrangements, including:
  - whether or not the ship has unattended machinery space (UMS) and bridge control of main engines
  - how the hatch covers are operated and how labour-intensive this is
  - whether or not an automatic pilot is fitted
  - how labour-intensive is the operation of cargo valves on a tanker
  - how labour-intensive is tank cleaning on a tanker whether special paints have been used, to reduce the need for painting by the crew
  - to what extent hydraulic spanners are used for speedy removal and replacement of nuts, especially in the engine-room
  - which manning arrangement is adopted:
  - conventional departmental system
  - general-purpose (GP) crew
  - inter-departmental flexibility (IDF)
- which systems are acceptable to an Administration
- states that, at least, the following actions are required:
  - appointment of a safety officer, who may be chosen from the list of officers
  - appointment of a fire officer, who would normally be the chief officer
  - appointment of the chief engineer as technical adviser to the fire officer for fires in machinery spaces
  - preparation and display of the muster list and the

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

distribution of muster cards to all staff
- checking that all fire-fighting and emergency equipment, including survival craft, is serviceable
- holding fire and abandon ship drills as soon as is practicable after the crew joins the ship, in accordance with SOLAS requirements

- draws up watchkeeping, security and other rotas for use while at sea and in port, with regard to fitness for duty including those:

for deck:
- watchkeeping officers and their duties
- helmsmen's duties
- gangway duties

for radio room, and GMDSS
for engine-room:
- watchkeeping officers on their duties in UMS condition, officers in charge
- day-work officers and staff, with their duties

- for catering staff:
  - galley duties
  - saloon duties
  - accommodation duties

3.3 Time and resource constraints (1hour)

- explains how can the work be planned, allocated, delegated, keeping in mind the time and resource constraints
- explains the importance of using all the available resources, with proper planning to obtain optimum results

3.4 Prioritization (1 hour)

- explains how to prioritize the work, in different day – to - day scenarios

3.5.4 EFFECTIVE RESOURCE MANAGEMENT — STCW Code Table A-II/2

Textbooks / Bibliography: T27
Teaching aids: A1, V103, V104, V106, 107

Required performance:

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

4.1 Allocation, assignment and prioritization of resources (1 hours)

- explains the effective methods of allocation
- explains the methods of assigning tasks to shipboard personnel
- explains how to prioritize all available resources

4.2 Effective communication on board and ashore (1 hours)

- states the principles of good communication: Setting the climate, interactive, closed loop
- explains the importance of briefings, in particular a good master - pilot information exchange and a change of watch briefing
- explains the importance of debriefings
- explains that the debriefing should:
  - be a whole team affair,
  - cover positive and negative points
  - not blame individuals
  - be a positive learning experience
  - result in a plan for future improvements in early detection and correction of errors
- explains the importance of effective communication when dealing with shore authorities and personnel

4.3 Decisions reflect consideration of team experiences (1 hours)

- explains the factors that will be taken into consideration to decide the allocation and delegation of tasks to crew on board
- explains the effective resource management taking into account the experience of the team
- explains the benefits of effective disposition of manpower on the bridge
- gives examples of error chains and explains how they can be avoided
- draws up contingency plans for routine manoeuvres
- explains the importance of effective internal and external communication
- explains the need for adequate information flow between team members
- explains that failure to monitor the ship's position and communicate effectively has lead to casualties

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

4.4 Assertiveness and leadership, including motivation
(1 hour)

- defines Authority and Assertiveness
- explains the examples of Too High Authority are;
  - total command expected
  - lacks communication skills
  - can't delegate
  - performance oriented
  - needs to prove himself
- explains the examples of Too Low Assertiveness are:
  - silenced by superior's authority
  - unaware of what's expected
  - lacks communication & management skills
  - personality clash
- explains the need for a balance between authority and assertiveness
- states possible reasons for extremes
- states the dangers of the four extreme combinations
- explains corrective management actions when an imbalance occurs
- explains the methods of motivation
- explains the importance of motivating the crew to obtain the optimum result

4.5 Obtaining and maintaining situational awareness
(1 hour)

- explains the importance of obtaining and maintaining situational awareness

3.5.5 DECISION MAKING TECHNIQUES

STCW Code Table A-II/2

Textbooks / Bibliography: T27

Teaching Aids:A1

Required performance:

5.1 Situation and risk assessment (1 hour)

- explains the method to carry out situation and risk assessment to assist in making decisions

5.2 Identify and Generate Options (1 hour)

- identify and generate all possible options which will assist in making decisions

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

5.3 Selecting Course of Action (1 hour)

- explains the method of selecting course of action in making decisions

5.4 Evaluation of outcome effectiveness (1 hour)

- explains how to carry out the evaluation of outcome effectiveness and the importance of doing it

3.5.6 DEVELOPMENT, IMPLEMENTATION AND OVERSIGHT OF STANDARD OPERATING PROCEDURES

Textbooks / Bibliography:

Teaching Aids: A1

Required performance:

6.1 Development, implementation and oversight of standard operating procedures (1 hour)

- describes how to develop standard operating procedures (SOP's)
- explains the methods to implement the SOP's
- explains the reason of over sighting of SOP's and
- explains the dangers associated with it

COMPETENCE 3.6	**IMO Reference**
TRAINING OUTCOME: Demonstrates a knowledge and understanding of: 3.6.1 INTERNATIONAL MEDICAL GUIDE FOR SHIPS MEDICAL SECTION OF INTERNATIONAL CODE OF SIGNALS - MEDICAL FIRST AID GUIDE FOR USE IN ACCIDENTS INVOLVING DANGEROUS GOODS	STCW Code Table A-II/2

COMPETENCE 3.6	IMO Reference

3.6.1 THE USE AND CONTENT OF THE FOLLOWING PUBLICATIONS:
- INTERNATIONAL MEDICAL GUIDE FOR SHIPS
- MEDICAL SECTION OF INTERNATIONAL CODE OF SIGNALS
- MEDICAL FIRST AID GUIDE FOR USE IN ACCIDENTS INVOLVING DANGEROUS GOODS

Textbooks / Bibliography: T13, T26, T33

Teaching aids: A1, A2, V108

Required performance:

1.1 International Medical Guide for Ships (0.5 hour)

- describes the content and application of the above publication
- extracts and applies information for given situations

1.2 International Code of Signals (Medical Section) (0.5 hour) R32

- describes the content and application of the above publication constructs and interprets messages

1.3 Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (3 hours)

- describes the content and application of the above publication
- extracts and applies information for given situations

Part D3: Instructor's Manual

■ GUIDANCE NOTES

The following notes are intended to highlight the main objectives or training outcomes of each part of the function. The notes also contain some material on topics which are not adequately covered in the quoted references.

On completion of training for this function officers will have knowledge of the principal structural members of a ship and methods of construction. They will understand the theory of stability and trim and be able to use tables, diagrams and stress calculators to plan loading and ballasting so as to maintain satisfactory stability and trim (taking account of applicable IMO recommendations concerning intact stability) and to ensure that hull stresses remain within acceptable limits.

The effects of damage to, and the consequent flooding of, a compartment on the trim and stability of a ship and the counter-measures to be taken will be understood.

Officers will also be thoroughly conversant with the certificates required to be on board, their periods of validity and the procedures for their renewal.

The officers will also be aware of their legal obligations and responsibilities concerning international provisions for the safety of the ship, crew, passengers and cargo and for the prevention of pollution from the ship.

They will also be able to follow the correct procedures for all matters concerning the crew; their engagement and discharge, treatment of wages and deductions, discipline and dealing with disciplinary offences, the discharge of a sick seaman abroad, repatriation, deceased seamen and engagement of substitutes.

Officers will have sufficient knowledge of shipping documents related to cargo and the shipowner’s liabilities and obligations in respect of charter parties and the carriage of cargo to enable them to protect the ship’s interests.

Officers will be capable of organizing and managing the crew for the safe and efficient operation of the ship and be able to draw up an organization for dealing with emergencies. Officers will also know the requirements for training in the operation and maintenance of safety equipment and be able to implement that training on board.

On completion of training for this function officers will be able to use plans and tables or diagrams of stability and trim data to calculate the ship’s initial stability, draughts and trim for any given disposition of cargo and other weights!! They will also be able to determine whether stresses on the ship are within permitted limits by the use of stress data, calculating equipment or software,. The fundamental actions to take in the event of partial loss of intact buoyancy will be understood.

Training concerned with fire prevention and firefighting is covered in IMO model course 2.03.

Training concerned with proficiency in medical care on board ship is covered in IMO model course 1.15.

Function 3: Controlling the Operation of the Ship and Care for Persons on Board at the Management Level

3.1 Control Trim, Stability And Stress

3.1.1 Fundamental Principles of Ship Construction, Trim and Stability (102 Hours)

Shipbuilding Materials (3 Hours)

It is not the intention that officers have knowledge of ship design practice or a detailed knowledge of materials!! The focus of teaching should be so that they can explain why various kinds of steel are used in different areas of a ship and understand the advantages and disadvantages of alloys in common use, and how they are maintained.

High tensile steel (HTS) has a low corrosion margin and poor resistance to fatigue failures. However, due to a lighter weight of material, compared with mild steel, for the equivalent strength it has been widely used in ship construction.

Brittle fracture occurs when a normally elastic material fractures without any sign of deformation before failure. The structure may not even be highly stressed at the time. The fracture is often initiated at a small notch in a plate edge or at a small fault in a weld. The tendency to brittle fracture is much greater at low temperatures and there is a temperature, depending upon the particular properties of the steel, above which it will not occur. The classification societies specify the use of grade E steel, which has high notch ductility, for those parts of ships above a certain length where thick plates subject to high stresses are found.

Welding (3 Hours)

If the training institute has an engineering department with welding facilities, the opportunity to use their expertise and equipment should be taken.

Bulkheads (4 Hours)

The subdivision of passenger ships is dealt with in subject area 3.4.2.1, Ship construction and Damage Control.

Watertight and Weather Tight Doors (3 Hours)

The provisions of SOLAS for drills and inspections of watertight doors and related damage- control devices have been included with the details of construction and operation.

Corrosion and Its Prevention **(4 Hours)**

Trainees should not be required to remember the galvanic series for seawater. It should be used for reference when dealing with corrosion cells and the suitability of metals as anodes for sacrificial anodes.

Many paints contain poisonous substances and release toxic fumes as solvents evaporate. The vapours of most paint solvents will produce flammable or explosive mixtures with air in poorly ventilated spaces.

The risks are greatest when using spray equipment in enclosed spaces. Personnel must wear breathing apparatus, sources of ignition must be excluded and ventilation must be provided while work is in progress. Precautions for entering enclosed spaces should be taken after painting has been completed until the paint has thoroughly dried and no risk of release of vapour remains. Manufacturers' instructions regarding protective clothing and safety precautions should be followed.

Surveys and Dry-Docking **(2 Hours)**

This section deals with the surveys and inspections required by classification societies. The requirements for survey under international conventions are dealt with in subject module 3.2, Maritime Law. The annual inspection required by the International Convention on Load Lines, 1966, is usually carried out by a classification society surveyor, acting on behalf of the flag State Administration. The inspection is similar to that required for the classification society's annual survey.

The hardeners that are used in two-pack (or bi-pack) polyurethane and epoxy paints are toxic and may also cause allergic reactions following contact with skin. Protective clothing and disposable gloves should always be worn when working with these paints!.

Stability **(83 Hours)**

Calculations on box-shaped vessels have been introduced at a number of places in this syllabus. They are included to illustrate basic principles and to aid trainees' understanding of actual ships' data. The appendix to this instructor manual contains stability data and capacity tables for use in the preparation of exercises!! Instructors should make a collection of data for other ships as the opportunity arises. The application of the principles of stability to determining the final draught, trim and initial GM for a given complete distribution of cargo is included in the function, Cargo Handling and Stowage.

Approximate Calculation of Areas and Volumes

This section covers the use of the trapezoidal rule and Simpson's rules for the calculation of areas. The derivation of Simpson's rules and their use for finding moments or second moments of area has not been included. The calculation of volume where the given ordinates are areas is covered.

The use of Simpson's rules is required for finding areas under a GZ curve, for checking compliance with recommendations on intact stability. Trainees should also be able to apply them for calculating areas of decks and volumes of compartments aboard ship.

Effects of Density

In tidal estuaries the density of the water may vary considerably according to the state of the tide. When checking draughts or freeboard near completion of loading it is essential to check the density at the same time: using a density obtained earlier in the day could lead to appreciable error.

The term 'inertia' and the abbreviation 'I' are used in keeping with common practice!! They may also appear in a ship's hydrostatic data. Strictly, it is the transverse second moment of area of the tank which is involved. Trainees should understand the concept of second moments of area but the method of determining them in general is not required. The formula for a rectangular surface should be known.

Stability at Moderate and Large Angles of Heel

The equation BM=I/V has been quoted partly to show that the BM is a function of the ship's dimensions and state of loading and partly to explain the typical behaviour of KM as the draught is increased from light ship conditions. Use is also made of the equation in the treatment of damage stability. The proof of the equation is not required.

GZ curves will normally be constructed from KN curves, but trainees should be able to correct a GZ curve when the value of KG differs from that used in drawing the curve, either by drawing a new curve or by superimposing the curve of GG_1sin (angle of heel) on the GM should be used as an aid to constructing the curve at small angles should not be expected to deduce the GM from a given curve.

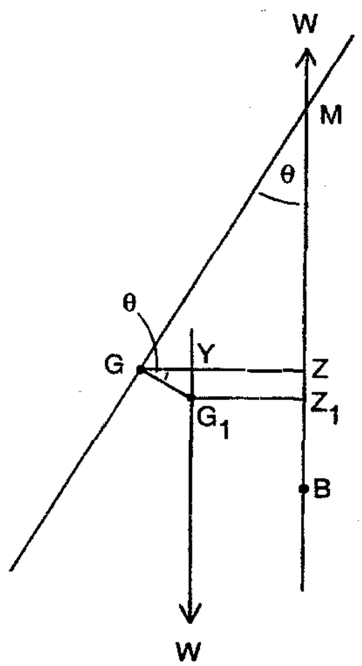
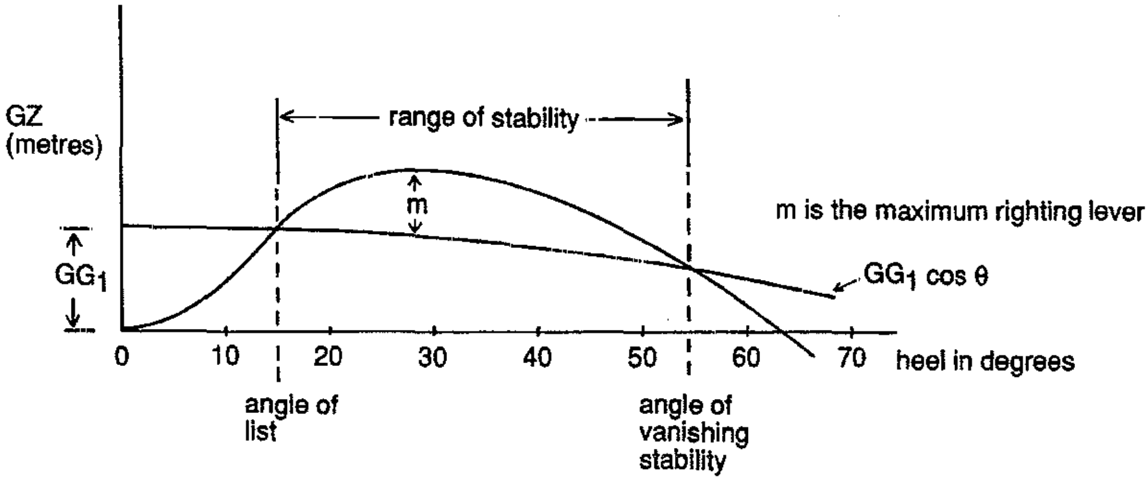


Figure 1

Figure 1 shows a ship with its centre of gravity, G_1, at a distance GG_1 horizontally from the centreline. When inclined to an angle θ, the righting lever is G_1Z_1.

$$G_1Z_1 = GZ - GY$$
$$= GZ - GG_1 \cos\theta$$

The values of GZ derived from KN curves can be reduced to GG1 cos θ before plotting or the curve GG1 cos θ can be superimposed on the GZ curve, as shown in Figure 2.



A list reduces the righting levers and the range of stability when heeled towards the listed side!! When heeled in the opposite direction, righting levers are increased.

Simplified Stability Data

Simplified stability data were originally intended for use in small ships, but data in that form may also be found in some larger ships. Each of the several different presentations shows the ship's stability as adequate or inadequate to meet the recommended criteria for intact stability for passenger and cargo ships under 100 metres in length or, in the case of larger ships, the criteria laid down by the Administration.

Data necessary to maintain sufficient intact stability under service conditions to enable the ship to withstand the critical damage assumptions of SOLAS would be provided in passenger ships.

Trim and List

Trim calculations using moments about the centre of flotation or trimming tables were covered in IMO Model Course, Officer in Charge of a Navigational Watch. These methods are suitable only in cases where the change in displacement is sufficiently small so that there are no large changes in the position of the centre of flotation or the value of MCT. When large changes in displacement are involved, as, for example, in planning the loading of a ship, the following method should be used.

Figure 3 shows a ship on an even keel with longitudinal centres of buoyancy and gravity indicated. The weight and buoyancy forces form a couple, called the trimming moment, equal to the product of the displacement and the horizontal separation between B and G, in this case acting to trim the ship by the stem. The ship will trim until the centre of buoyancy of the new underwater volume is in the same vertical line as G, which is fixed.

The trim is given by trimming moment/MCT 1cm where the MCT is taken for the displacement of the ship.

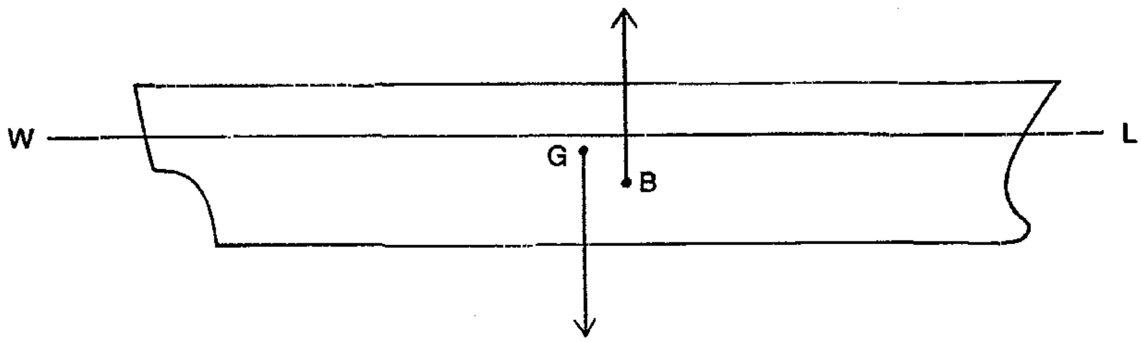


Figure 3

The position of the longitudinal centre of buoyancy (LCB), for an even-keel condition, depends upon the ship's draught and is given in the hydrostatic data as a distance, either from the after perpendicular or from amidships.

The position of the longitudinal centre of gravity is found by taking moments of mass, about the after perpendicular or about amidships, of the light ship and all of its contents., The LCG for the light ship is included in the hydrostatic data, LCG's of tanks and holds are given in the capacity plans or can be measured from the profile plan.

To find the draughts at each end, the trim is divided in the usual way, according to the proportionate distances of the perpendiculars from the centre of flotation, and applied to the ship's true mean draught.

When a ship is hogged or sagged there is a difference between the mean draught calculated from the draughts at the ends and the draught amidships. The difference is the amount of hog or sag. Taking the case of a ship with a sag, the draught amidships is greater than the mean draught. The ship's displacement lies between the values obtained for the two draughts and corresponds to some intermediate draught.

A weighted average of the mean draught and draught amidships is used. The commonly used values are:

corrected draught = 3/4 x draught amidships + 1/4 x mean draught;

or corrected draught = 2/3 x draught amidships + 1/3 x mean draught.

These amount to applying 1/4, in the first case, or 1/3, in the other, of the hog or sag to the amidships draught.

A method known as the mean of mean of means is sometimes used. The mean of the forward and after draughts is found, the mean of that and the draught amidships is found and the mean of that with the draught amidships again gives the required draught, The result is the same as for the first equation above.

Nemoto's Formula

When utmost accuracy is required, as in draught surveys for quantity loaded or discharged, a second correction for trim, using Nemoto's formula, may be applied to the displacement. It is usually only applied when the trim exceeds 1% of the ship's length.

$$\text{correction (tonnes)} = \frac{t^2 x 50}{L} = \frac{dM}{dZ}$$

where: t is the trim in metres
L is the length between perpendiculars in metres
d is the mean draught

$$\frac{dM}{dZ} = \text{MCT 1cm at } (d + 0.5)\text{m} - \text{MCT 1cm at } (d\text{-O.5})\text{m}$$

The correction is always added to the displacement.

Dynamical Stability

In calculating the area under a GZ curve to a given angle, using Simpson's rules, the interval between ordinates may be expressed in degrees.

The calculated area would be expressed in metre-degrees, which can be converted to metre-radians, if required, by dividing by 57,3. The dynamical stability is the area under the curve in metre-radians multiplied by the ship's displacement in tonnes. The result is expressed in metre-tonnes, the radians being omitted since they are dimensionless. Usually, it is areas under the GZ curve which are required for checking stability criteria which, depending upon the ship's data, may be expressed in metre-degrees or metre-radians.

The area under the GZ curve to a given angle represents not only the work done in heeling the ship to that angle but also the potential energy available to return the ship to the upright. By the principle of conservation of energy, the potential energy is converted into rotational energy as the ship moves towards the upright. When upright, all of the energy is in the form of rotational energy, so the ship continues to roll until an angle is reached where the area under the curve is equal to that rotational energy. The energy used in overcoming friction between hull and water and in creating turbulence reduces the angle to which the ship will roll.

The wind exerts a horizontal force on the above-water area of the ship and deck cargo which can be considered to act at the centre of the projected area. That force is resisted by the water acting on the underwater area on the other side, usually considered to act at about half the draught. The two forces form a couple inclining the ship until the righting moment is equal to the inclining couple. In the Recommendation on a Severe Wind and Rolling Criterion for the Intact Stability of Passenger and Cargo Ships of 24 metres in Length and Over, no allowance is made for a reduction in the projected lateral area or the vertical separation between the centres of areas, above and below the waterline, as the ship heels. The wind pressure used in the recommendation corresponds approximately to storm force 10 on the Beaufort scale.

List should always be removed before sailing and cargo should be adequately secured to prevent a shift producing a listed condition while on passage.

Approximate GM by Means of Rolling Tests

The method is described in appendix III of the Recommendation on Intact Stability for Passenger and Cargo Ships under 100 metres in Length, in reference R43.

Inclining Test

The purpose of the inclining test is to determine the displacement and position of the ship's centre of gravity in an accurately known condition. It is usually carried out when the ship is as nearly complete as possible, small corrections being made for any components still to be fitted or shipyard stores aboard at the time to obtain values for the light ship condition.

The draughts and water density are carefully measured for use with the ship's lines plan to calculate the displacement, the height of the transverse metacentre above the base (KM) and the position of the longitudinal centre of buoyancy.

The test consists of moving weights across the deck under controlled conditions and measuring the resultant angle of list. The angles are deliberately kept small and are measured by long pendulums suspended down holds or engine-room skylights.

The mean value of GM calculated from the deflections is subtracted from the KM to give the vertical height of the centre of gravity. Since the centre of gravity and centre of buoyancy are in the same vertical line for a ship in equilibrium, the position of the LCG can be calculated from the previously determined LCB.

Recommendations on Intact Stability for Passenger and Cargo Ships Under 100 Metres in Length

The recommendations are contained in R43. Instructors should refer to the stability requirements of the Administration for ships of 100 metres in length and over.

Intact Stability Requirements for the Carriage of Grain

The SOLAS Convention deals with the carriage of grain. The intact stability requirements are laid down, and the loading information required for determining the stability. The method of calculating intact stability is illustrated.

Rolling of Ships

A mathematical treatment of rolling is not required. Trainees should know that the natural rolling period is inversely proportional to the square root of the GM. Rolling in a seaway is a forced oscillation, the period depending upon the period of encounter of the waves or swell as well as the natural rolling period, when the period of wave encounter equals the natural rolling period, synchronization occurs. Very heavy rolling can be induced by a moderate sea. An alteration of course or speed, or both, changes the encounter period of the sea and breaks the synchronization.

The equation in this objective produces a result in force units (kilonewtons in this case), hence the balancing heeling couple must be expressed in the same units in the equation in the objective relating to the righting moment equaling the heeling couple, by multiplying the usual mass moment by g, the acceleration due to gravity.

In the unusual event of the centre of gravity falling below half draught the heel would be towards the turn.

In the unusual event of the centre of gravity falling below half draught the heel would be towards the turn.

Dry-Docking and Grounding

When dealing with stability during dry-docking, it is simplest to consider the righting moment when heeled by taking moments about the centre of buoyancy, which produces the equation:

$$\text{righting moment} = \Delta \times GM \sin\theta - P \times KM \sin\theta$$

directly.

The righting lever, GZ, is given by the equation:

$$GZ = \left(GM - \frac{P \times KM}{\Delta}\right) \sin\theta,$$

which is the righting lever for the ship with its GM reduced by $\frac{P \times KM}{\Delta}$.

By making use of KM = KG ÷ GM, the alternative expression for righting lever can be obtained.

This approach has the advantage of showing that, although different values of GM are obtained, the value of the righting moment is the same in each case. The value of P for which

GM — 0 is also the same for both expressions.

The stability of a ship grounded at a point on the centreline is treated in exactly the same way as the dry-docking problem. A ship grounded forward, say, on a falling tide, would experience a reducing righting lever and the point could be reached at which it became zero. Providing the ship did not touch bottom elsewhere, it would flop over to an angle of loll or possibly capsize.

When grounded at a point off the centreline, a heeling moment is also produced. Considering the case where only heeling moment is involved, at the point of capsize the upthrust from the bottom becomes zero, therefore the ship would not capsize until heeled to its angle of vanishing stability when afloat. In most circumstances, cargo would have shifted, water entered through non-watertight openings or the ship would have slid off before reaching that angle. When the grounding force causes trim as well as heel the angle of vanishing stability may be much smaller.

It should be recalled that buoyancy is provided by the vertical component of water pressure on the ship's hull,, When a ship is grounded on firm sand or a bottom of similar nature, water is unable to exert any pressure on the grounded portion and there is a loss of buoyancy compensated by an increased upthrust from the ground!. If a ship is grounded over the whole of its bottom there is a large loss of buoyancy for any drop in water level, however small. Stability is not a problem in that circumstance but the fact that nearly all the weight of the ship is supported by the ground must be considered when deciding how to refloat her.

3.1.2 Effect on Trim and Stability in the Event of Damage and Stability

The methods of calculating transverse stability, list and trim in a damaged condition are based upon the principles used in the textbook T4 but the problem has been approached in a way more applicable to the use of a ship's hydrostatic data, although still confined to compartments with roughly rectangular waterplanes.

Flooding of Compartments

The requirements for the watertight subdivision of passenger ships are set put in SOLAS. Depending upon the type of service and its size, the ship will be required to withstand the flooding of one, two or three adjacent main compartments.

The International Convention on Load Lines, lays down requirements for the survivability of ships of type 'A', if over 150 metres in length, and for ships of type 'B' which are over 100 metres in length and are assigned freeboards less than the tabular freeboards for type 'B' ships.

Classification society rules stipulate the minimum number of bulkheads to be fitted in dry cargo ships, depending upon length, but do not specify that they should be fitted in such a way that the ship could withstand flooding of a main compartment.

Proposed amendments to the SOLAS Convention will provide regulations governing the subdivision and damage stability of cargo ships. They will apply to ships over 100 metres in length intended primarily for the carriage of dry cargoes, but will exclude those ships already covered by other damage stability regulations in IMO instruments.

The proposed regulations are based on consideration of the probability of the location and extent of damage and the probability of survival after damage. The probabilities of survival conditional upon each possible damage configuration for compartments, singly or in adjacent groups, are summed for the summer draught and for a draught intermediate between light and loaded. The average of the two sums gives a value known as the "attained subdivision index, A" which must not be less than the "required subdivision index, R", which is a function of the length.

Effect of Flooding on Transverse Stability

When a space is flooded without free communication with the sea, the stability can be calculated by taking account of the mass of water and the free surface effect. Examples would be the accumulation of water in 'tween-decks as a result of fire fighting, or flooding through a crack in the hull or through a fractured pipe. The ship's hydrostatic data for the increased displacement are applicable for the calculations.

If a compartment is holed so that water can flow freely in and out of it, that compartment can be considered as part of the sea and no longer part of the ship. The buoyancy of the space up to the water level before damage is lost and the waterplane area of the ship is reduced by the waterplane area of the damaged compartment. These changes give rise to changes in the hydrostatic data needed to calculate the transverse stability and trim. The mass of the ship and its centre of gravity remain unaltered. Such a treatment is known as the 'lost buoyancy method' and is the one used in this course and in the textbook T4.

The lost buoyancy, expressed in tonnes, is the mass of water which could enter the space up to the original waterplane, i.e. the volume x permeability x density of water in which the ship is floating.

The lost waterplane area is the area of the bilged compartment at the original waterplane. If the compartment is completely contained below the waterline, e.g. a double-bottom tank, there is no loss of waterplane area provided the tank top remains intact. The original waterplane area may be given in the ship's data or it can be calculated from

$$\text{waterplane area} = \frac{100 \times TPC}{1.025}$$

Of the two corrections in this objective, the first is the second moment of lost waterplane area about its own centroid, the second a correction to give the loss about the new centroid of the intact waterplane. In the case of symmetrical flooding, the second correction is zero. For wing compartments, the second correction is very much greater than the first, even for compartments extending half the breadth of the ship.

Generally, the displacement of the ship and the position of the centre of gravity will remain unchanged after bilging. However, if a tank containing a liquid is bilged, the weight of the tank contents is lost, causing a reduction in displacement and a shift in the position of the ship's centre of gravity. The lost buoyancy would be comparable with the lost weight, causing a similar shift in the centre of buoyancy with the result that there would be little change of draught, trim or list,. The loss of waterplane area would result in a reduction of GM.

Permeability

The permeability of a space is the percentage or fraction of the space which could be occupied by water. The lost buoyancy equals the permeability x the volume. If a cargo was stowed solidly, with no space for water in infiltrate, it would occupy

$$\frac{1}{density} m^3/t$$

The space occupied in the hold by one tonne is its stowage factor, so the space available to water = stowage factor – $\frac{1}{density} m^3/t$

The proportion of the stow which could be occupied by water, i.e. the permeability, equals

$$\frac{\text{stowage factor} - \frac{1}{density}}{\text{stowage factor}}$$

For example, a cargo has a stowage factor of 1.2 m^3/t and a density of 2.5 t/m^3.

$$\frac{1}{density} = \frac{1}{2.5} = 0.4 m^3/t$$

$$permeability = \frac{1.2 - 0.4}{1.2} = \frac{0.8}{1.2} = 0.67$$

Notice, if a cargo has a permeability of 0.4 but only occupies half of the compartment, the permeability of the whole compartment is 0.4 x 0.5 + 0.5 = 0.7.

The loss of waterplane area is taken to be permeability x waterplane area of the compartment, but if the water level is above the top of the cargo the whole area is lost.

Angle of Heel

Buoyancy is lost at the damaged compartment and an equal amount of buoyancy is gained at the position of the new centre of flotation. The transverse shift in the ship's centre of buoyancy is, therefore, lost buoyancy x transverse distance from centre of flotation divided by the displacement. On the assumption that the centre of gravity is still on the centreline, the shift in buoyancy is the heeling arm.

The angle of heel would be given by the intersection of the GZ curve for the damaged ship with the heeling-arm curve $BB_1 \cos \theta$. Since KN curves for the damaged condition are not available, the GZ curve has to be constructed, using values for the intact ship at a displacement corresponding to the damaged draught and a KG chosen to give the modified value of GM. The angle of heel read from the curve will be approximate. If the angle is small it can be calculated from, $\tan \theta = BB_1 / GM$

Effect of Flooding on Trim **(9 Hours)**

Similar calculations are necessary to find the longitudinal position of the centre of flotation after damage, and the reduction of BM_L. The change in GM_L is used to calculate the change in MCT 1cm.

Buoyancy has been lost at the damaged compartment and replaced at the centre of flotation, hence the trimming moment is the product of lost buoyancy and the distance from the centre of the damaged compartment to the new centre of flotation. The change of trim and the draught at each end are then calculated in the usual way.

Flooding of a compartment near an end of the ship causes a large shift in the centre of flotation away from the damaged end and a large reduction in MCT 1cm. Combined with the sinkage due to lost buoyancy, this may produce a large increase in draught at the damaged end. The original trim of the ship will influence the chances of the ship surviving the damage.

A ship already trimmed towards the damaged end is more vulnerable than one on an even keel or trimmed the other way.

Measures to Improve Stability or Trim when Damaged

The immediate action should be to restrict the flooding and, if possible, to stop it. In the event of collision or stranding damage, it will not be possible to stop the flooding or reduce it significantly by the use of pumps. Even a comparatively small hole below the waterline admits water at a much higher rate than the capacity of bilge or ballast pumps. All watertight doors, valves, dampers in ventilation shafts and access hatches should be closed to prevent flooding progressing to other compartments. Where cross-flooding arrangements are required, they should be put into operation at once to restrict the resulting list.

In passenger ships, the guidance in the damage control booklet should be followed. The same applies to cargo ships where damage control information is provided.

In nearly all cases, damage will result in sinkage, list and trim, loss of stability and loss of longitudinal strength. Corrective action for one condition will affect the others.

Excessive list or trim should be corrected by moving weights, fuel, water or liquid cargoes, when possible. If ballast is added, it increases the sinkage. In some cases it may be possible to pump out ballast to improve list or trim and lighten the ship at the same time. If the ballast is taken from double-bottom tanks, however, the stability will be further reduced.

Stability may be improved by transferring fuel from wing or cross bunker tanks to double bottoms if suitable tanks are empty. Efforts should be made to reduce free surface to a minimum. Water accumulating in upper decks as a result of fire fighting should be drained to the lowest level possible if means of pumping it out of the ship cannot be arranged.

After collision or stranding damage, particularly near the middle length of the ship, the longitudinal strength will be impaired and account should be taken of that when deciding on the transfer or addition of weights.

Cases have occurred where a slow leakage of water has been absorbed by a cargo, such as grain, with no water reaching the drain wells. The added weight, high on one side of the hold, has led to a steadily increasing list and eventual capsizing. As the source of the leakage was inaccessible, nothing could be done. Cargo spaces should be thoroughly inspected whenever they are empty for signs of leakage, indicating cracks or damage to overside discharge valve covers.

3.1.3 Knowledge of IMO Recommendations Concerning Ship Stability (2 Hours)

Instructors should refer to the IMO publications referenced in the detailed teaching syllabus.

3.2 Monitor and Control Compliance with Legislative Requirements and Measures to Ensure Safety of Life at Sea and the Protection of the Marine Environment

3.2.1 International Maritime Law Embodied in International Agreements and Conventions (36 Hours)

This area covers those international conventions, regulations and recommendations which directly affect the master in carrying out his obligations and responsibilities.

Those parts of the Geneva Conventions on Law of the Sea of 1958 and the United Nations Convention on the Law of the Sea, 1982, which are relevant to the conduct of a voyage have already been covered at the operational level, however, in order to reinforce previously covered topic, some points have been mentioned in the detailed teaching syllabus, for the Instructor. Some brief revision may be necessary with an emphasis placed on the master's legal obligations concerning the requirements for certificates and other documentation, the survey requirements, the provision for inspections by the master or an officer delegated by him, the maintenance of equipment and the records that are required to be kept.

The technical details, where appropriate, are mainly dealt with under other relevant subjects. The International Regulations for Preventing Collisions at Sea are covered entirely in the function Navigation.

We also deal with the necessary basic knowledge of law concerning carriage of cargo and marine insurance. Those subjects, together with a few others, are supplementary to the STCW 2010 requirements and are indicated as such below and in the Detailed Teaching Syllabus in Part C with an asterisk, *.

Instructors should note that the following areas are covered in the training at the operational level. Some areas are covered again with emphasis on the master's responsibilities.

1. An introduction to Maritime Law

2. Law of the Sea
   - 2.1 Conventions on the law of the sea
   - 2.2 Territorial sea and the contiguous zone
   - 2.3 International straits
   - 2.4 Exclusive economic zone and the continental shelf
   - 2.5 Highseas
   - 2.6 Protection and preservation of the marine environment

3. Safety
   - 3.1 International Convention on Load Lines, 1966, as amended

3.2 International Convention for the Safety of Life at Sea, 974, as amended (SOLAS) — General Provisions
3.3 SOLAS — Subdivision and stability, machinery and electrical installations
3.4 SOLAS — Fire protection, fire detection and fire extinction
3.5 SOLAS — Life-saving appliances and arrangements
3.6 SOLAS — Radiotelegraphy and radiotelephony
3.7 SOLAS — Radio communications (amended Chapter IV)
3.8 SOLAS — Safety of navigation
3.9 SOLAS — Carriage of grain
3.10 SOLAS — Carriage of dangerous goods
3.11 International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978
3.12 ITU Radio Regulations

4. Passengers
4.1 Special Trade Passenger Ships Agreement and Rules, 1971
4.2 Protocol and Rules on Space Requirements for Special Trade Passenger Ships, 1973
4.3 Athens Convention relating ft the Carriage of Passengers and their Luggage by Sea, 1974

1.1 Certificates and Other Documents Required to be Carried on Board Ships by International Conventions and Agreements (1 Hour)

The master must be familiar with all the certificates and other documents required by the vessel and by the crew. These will be subject to inspection by both the flag state and by port State control officers. Documents found not to be in order can cause delays on detentions to the voyage.

Relatively new requirements include the Safety Management Certificate denoting that the company and its shipboard management operate in accordance with the approved safety- management system. A copy of the Document of compliance shall also be kept on board the ship in order that the master can produce it for verification.

A complete list of certificates and documents, with reference to which convention it is required, is provided in the detailed teaching syllabus.

The requirements for their issue and renewal are dealt with under the appropriate conventions, except for those mentioned below.

A certificate of nationality, often called the ship's register, is required by the Geneva Convention on the High Seas, 1958, and by the UNCLOS, 1982. The form of certificate and the conditions for its issue are determined by each national government. In some cases it remains valid until the ship is scrapped or changes ownership or nationality, in others it is subject to regular renewal.

The Panama and Suez Canal Tonnage Certificates are included for completeness; they are not required by international conventions. Any ship wishing to traverse either canal must be measured and obtain the appropriate certificate before doing so. In general, they remain valid until alterations to the ship's structure or in the use of spaces are made.

Tonnage

The International Tonnage Certificate remains valid until alterations in construction or the use of spaces are made, the subdivision load line is changed or the ship is transferred to the flag of another State.

The licence for the ship radio station is required by the radio regulations of the ITU. The form of the licence is determined by the national government which issues it.

There are no international agreements requiring a ship to be classed by a classification society, but practically all ships are. Loss of class would be an indication to a port State control officer that a thorough inspection of the ship should be made. Maintenance of class is a condition for the continuance of insurance in many cases.

The form of the official log-book, the entries made in it and its eventual disposal are decided by each Administration.

The documents listed as a minimum additional documents required at arrival or departure are those mentioned in the Convention on Facilitation of international traffic, the international health regulations and the dangerous goods manifest required by SOLAS.

1.2 Responsibilities Under the Relevant Requirements of the International Convention on Load Lines (1 Hour)

Instructors should note that the Load Lines Protocol of 1988 entered into force in February 2000. The 1988 Protocol has been modified by the 2003 Amendments which were adopted by MSC.143(77) in June 2003 and entered into force in January 2005.

1.3 Responsibilities Under the Relevant Requirements of the International Convention for the Safety of Life at Sea (2 Hours)

Of all the international conventions dealing with maritime safety the most important is the International Convention for the Safety of Life at Sea, better known as SOLAS which covers a wide range of measures designed to improve the safety of shipping.

The convention is also one of the oldest of its kind: the first version was adopted in 1914 following the sinking of the SS Titanic with the loss of more than 1,500 lives. Since then there have been four more versions of SOLAS. The present version was adopted in 1974 and entered into force in 1980. Some recent additions are covered in and the 1996 Amendments in R2.

Reference should be made to the International Safety Management (ISM) Code in Chapter IX, which sets out the master's responsibility with regard to safety and environmental protection, see and

1.4 Responsibilities Under the International Convention for the Prevention of Pollution From Ships, 1973, and the Protocol of 1978 Relating Thereto (MARPOL 73/78) (3 Hours)

Relatively new additions to maritime law should be noted including MARPOL 73/78 Annex 1, regulation 26 that requires every oil tanker of l50gt and above and every ship other than a tanker of 400gt and above to have a shipboard oil pollution emergency plan (a SOPEP), and amendments to MARPOL Annex V that require garbage management plans to be in place!.

Under Annex IV ships are not permitted to discharge sewage within a specified distance of the nearest land, unless they have in operation an approved treatment plant. Between 4 and 12 miles from land, sewage must be comminuted and disinfected before discharge.

Annex VI, entered into force on 19 May 2005. It sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances. The instructors should use the topics included in the detailed teaching syllabus, in order to prepare the lesson. The local regulations which may be more stringent then as laid down by Annex VI, pertaining to SECA and ECA, should be pointed out to the trainees.

Pollution

Tanker officers who have had responsibility for loading, discharging and handling cargo will have completed an approved specialized training programme. This includes instruction in pollution prevention relevant to tankers, V2, V79.

Examples of checklists can be found in the references. More extensive checklists are used at many oil installations and include, amongst other things, a list of equipment on board and ashore, whether it is fully operational or not, the communications to be used and emergency procedures. The completed checklists are signed by the responsible persons from the ship and the installation when it is agreed to start the operation.

It is recommended that, whenever possible, disposal of garbage should be made to port facilities. Disposal at sea is strictly regulated by the provisions of the appropriate legislation. Records of waste and garbage disposed of at sea must be kept. These records are subject to inspection and checking by port State control officers.

The annexes to the Convention contain the applicable technical regulations!! These are:
Annex I —Oil
Annex II — Noxious liquid substances in bulk
Annex III — Harmful substances carried by sea in packaged forms
Annex IV — Pollution by sewage from ships
Annex V — Pollution by garbage from ships
Annex VI — Air pollution from ships and NO_x technical code

1.5 Maritime Declarations of Health and the Requirements of the International Health Regulations (4 Hours)

Arrival Documents and Procedures: these are all very practical requirements that have to be followed.

Officers should be aware that many states will require forms and declarations in addition to those mentioned in the FAL and in the International Health Regulations. The ship's agents should be consulted for the current requirements at any port.

Noting and extending protests: the need to note or extend protests varies from country to country. In many countries it is essential to do so to protect the interests of the ship. For example, failure to do so could debar the master from collecting general average contributions from the cargo .The owner's agent should be able to advise the master regarding the procedure and the number of crew members required as witnesses, if any. Letter of protest is also included in the detailed teaching syllabus, and should be explained to the trainees.

1.6 Responsibilities Under International Instruments Affecting the Safety of the Ship, Passengers, Crew and Cargo (23 Hours)

Ballast water Convention 2004 has been added in the detailed teaching syllabus, all 5 sections should be explained to the trainees. Ballast water exchange must be conducted in accordance with the ship's ballast water management plan, taking into account the recommendations adopted by the IMO.

A new paragraph, 4, has been added with effect from July 1, 2010 to SOLAS Chapter V, Regulation 22 – Navigation bridge visibility, some changes are operational and others introduce new requirements applicable to navigation records.

The Instructors should emphasize that as a consequence of this amendment, any increase in blind sectors or reduction in horizontal fields of vision resulting from ballast water exchange operations is to be taken into account by the Master before determining that it is safe to proceed with the exchange.

The instructor should also point out to the trainees that an additional measure, to compensate for possible increased blind sectors or reduced horizontal fields of vision, the Master must ensure that a proper lookout is maintained at all times during the exchange.

Maritime Labour Convention2006 has been added.

The MLC was adopted on 23rd February 2006 at International Labour Organization, Geneva, Switzerland but at the time of writing this book, is still awaiting full ratification. Ratification has crossed the minimum gross tonnage requirement of 33% of the world tonnage but the minimum number of counties is pending. As of December 2010, 11 counties having 48% of world gross tonnage have ratified the convention, 19 more are required to ratify the same, 12 months after which MLC will become applicable internationally. MLC is the result of a joint resolution in 2001 by the international seafarers' and shipowners' organizations, later supported by governments.

They pointed out that the shipping industry is "the world's first genuinely global industry" which "requires an international regulatory response of an appropriate kind – global standards applicable to the entire industry".

The Maritime Labour Convention, 2006, aims to establish a continuous "compliance awareness" at every stage, from the national systems of protection up to the international system starting with individual seafarers.

It sets out their rights to decent conditions of work and helps to create conditions of fair competition for shipowners. It is intended to be globally applicable, easily understandable, readily updatable and uniformly enforced. The MLC will be another pillar of the international regulatory regime for quality shipping, complementing the key Conventions of the IMO.

The rather large number of the existing maritime Conventions, many of which are not even ratified by several Governments, some totally out of date and not in line with present day situations make it difficult for governments to ratify or enforce them.

MLC is a comprehensive set of global standards, based on 68 existing maritime labour instruments (Conventions and Recommendations), adopted by the ILO since 1920. MLC brings almost all these requirements together incorporating present day conditions and language.

Conventions addressing the seafarers' identity documents which were recently revised in 2003 (Nos. 108 and 185) are not incorporated in the MLC. The Seafarers' Pension Convention, 1946 (No. 71) and one Convention (The Minimum Age [Trimmers and Stokers] Convention, 1921 {No. 15}), which is no longer relevant to the sector, are also not included in the MLC.

MLC should help eliminate substandard ships and it would work within the well-established international system for enforcement of the international standards for ship safety, security and environmental protection that have been adopted by the IMO, in other words fall under PSC inspection systems.

Existing ILO maritime labour Conventions will be gradually phased out as ILO Member States that had ratified those Conventions ratify the MLC, but there will be a transitional period when some parallel Conventions will remain in force. Countries that ratify the MLC will no longer be bound by the existing Conventions when MLC enters into force since it incorporates the requirements of all these old conventions. Countries that do not ratify MLC will remain bound by the existing Conventions they have ratified, but these will be closed to any further revisions.

Ships flying the flags of countries that do not exercise effective jurisdiction and control will have no choice but to observe the minimum criteria enshrined in the MLC and prevent seafarers from having to work under unacceptable conditions, to the detriment of their well-being, health and safety and the safety of the ships on which they work.

MLC is designed on the principle of being "firm on rights and flexible on implementation". This is in line with the Constitution of the ILO and most ILO instruments that seek to take account of national circumstances and provide for some flexibility in their application. The ILO view is to gradually improve protection of workers by taking into account the specific situation in some sectors and the diversity of national circumstances. ILO addresses flexibility on the principles of tripartism, transparency and accountability. When a government exercises flexibility it usually involves consultation with the workers' and employers' organizations concerned, with any determinations that are made reported to the ILO.

Ships of 500 gross tonnage and above, engaged in international voyages or voyages between foreign ports, will be required to carry a 'Maritime Labour Certificate' (MLC) and a 'Declaration of Maritime Labour Compliance' (DMLC) on board. However, most other vessels will also be subject to inspections under MLC, this will get clear on studying the requirements of MLC in detail.

MLC also incorporates the "no more favourable treatment" concept similar to that adopted in the IMO conventions. That is, ships of all countries (irrespective of ratification) will be subject to inspection in any country that has ratified the Convention, and to possible detention if they do not meet the minimum standards of the new Convention.

- Convention on Limitation of Liability for Maritime Claims, 1976 (LMC 1976)
  Classification Societies
- Cargo
  International Convention for the Unification of Certain Rules of Law Relating to Bills of Loading, as Amended by the Protocol of 1968 (Hague-Visby rules)
  Charter Parties
- Hamburg Rules
- General Average and Marine Insurance
  The York-Antwerp Rules, 1974
  Marine Insurance

In covering the Maritime Labour Convention 2006 and recommendations, the relevant national laws and regulations or collective bargaining agreements, where applicable, should be dealt with. The administrative procedures involved, e.g. the correct procedures for signing off a sick seaman abroad, the disposal of a deserter's wages and effects or the engagement of replacements abroad and similar procedural mailers, should be included in detail. Reference should also be made to arrangements to safeguard the shipmaster in the proper discharge of his responsibilities in regard to maritime safety and protection of the marine environment.

The International Medical Guide for Ships, 3rd edition upholds a key principle of the Maritime Labour Convention, 2006: to ensure that seafarers are given health protection and medical care no less favourable than that which is generally available to workers ashore, including prompt access to the necessary medicines, medical equipment and facilities for diagnosis and treatment and to medical information and expertise. By ensuring that this guide is carried on board ships entitled to fly their flags, and following its instructions, countries can fulfil their obligations under the terms of the Maritime Labour Convention, 2006, and ensure the best possible health outcomes for their seafaring population. The Guide was prepared jointly by ILO and WHO.

Collision

The master's responsibilities under the Convention on the International Regulations for Preventing Collisions at Sea, 1972, are fully covered in the function, Navigation at the Management Level

Assistance and Salvage

At the request of IMO, the CMI drew up a new draft convention on salvage at Montreal in 1981 to update and revise the 1910 convention., The main new features relate to damage to the environment.

Masters and shipowners would have a duty to arrange salvage assistance and to co-operate with the salvors to prevent or minimize damage to the environment.

The draft Convention also made provision for special compensation to a salvor in cases where the salvor has carried out salvage operations in respect of a ship or cargo which threatened the environment but has failed to earn a reward for physical salvage. The International Convention on Salvage, 1989, was adopted by a diplomatic conference in March 1989 and entered into force on 14 July 1996.

Lloyd's Standard Form of Salvage Agreement (LOF) is widely used throughout the world. LOF 2000 superseded LOF 95 and where a salvor offers services on LOF 95 or some other terms, the master of the vessel in difficulties should attempt to get agreement to LOF 2000 terms takes account of the main changes included in the 1989 Salvage Convention and incorporates certain of the Convention Articles, including Article 14, which makes provision for the award of special compensation in cases where the salvor, by his salvage operations, has prevented or minimized damage to the environment. Personnel effects of Master, crew and passengers including any car accompanying a passenger are excluded from reward for salvage as per the LOF 2000. The currency of award as per the LOF 2000 is USA $. The Instructor should point out to the trainees that , as compared to the old LOF 1995, the duty to co-operate as per the new LOF 2000 is extended to provide information about nature of cargo, plans, stability data etc. As per LOF 2000, the salvors have right to terminate when "no longer any reasonable prospects of useful result". In the LOF 2000, SCOPIC clause is introduced as an alternative to Art 14 set out in the convention. As per LOF 2000, the Master is authorized to sign on behalf of cargo. LOF 2000 defines the conditions under which a casualty is in a safe condition for redelivery to the owner (which can be of crucial importance in the closing stages of a salvage operation. Since a large proportion of the world's salvage is undertaken under the LOF, the use of LOF 2000will give effect to the main provisions of the 1989 Salvage Convention, see Appendix.

Special Compensation P and I Club (SCOPIC) Clause, has been added in the detailed teaching syllabus, which is supplementary to any Lloyd's Form Salvage Agreement "No Cure - No Pay" ("Main Agreement") which incorporates the provisions of Article 14 of the International Convention on Salvage 1989 ("Article 14").

The instructors should point out to the trainees that as per SCOPIC the Contractor have the option to invoke by written notice to the owners of the vessel the SCOPIC clause at any time of his choosing regardless of the circumstances and, in particular, regardless of whether or not there is a “threat of damage to the environment”. A non binding code of practice has been agreed between the International Salvage Union (ISU) and the International Group of Clubs.

Proceedings in the Event of a Collision

Instructors should explain that in the event of a collision or of any other incident of navigation concerning a ship on the high seas involving the penal or responsibility of the master or of any other person in the service of the ship, no penal or disciplinary proceedings may be instituted against such persons except before the judicial or the administrative authorities either of the flag State or of the State of which such a person is a national.

Need to Render Assistance

Also that every State must require the master of a ship sailing under its flag, in so far as he can do so without serious danger to the ship, the crew or the passengers, to render assistance to any person found at sea in danger of being lost, to proceed with all possible speed to the rescue of persons in distress if informed of their need of assistance, in so far as such action may be reasonably expected of him, and, after a collision, to render assistance to the other ship, her crew and her passengers and, where possible, to inform the other ship of the name of his own ship, her port of registry and the nearest port at which she will call.

Submarine Cables

In the event that a ship breaks or injures a submarine cable so as to interrupt or obstruct telegraphic or telephonic communications, or similarly the breaks or injures submarine pipeline or high-voltage power cable it must be understood that this is, except for the purpose of saving lives or ships, a punishable offence.

However, owners of ships who can prove that they have sacrificed an anchor, a net or any other fishing gear in order to avoid injuring a submarine cable or pipeline should be indemnified by the owner of the cable or pipeline, provided that the owner has taken all reasonable precautionary measures beforehand.

*** Convention on Limitation of Liability for Maritime Claims, 1976 (LLMC 1976)**

The LLMC Convention sets global limits to liability. For example, the limit in respect of death or injury of passengers in Article 7 is the global limit for all claims. Each individual claim is subject to the limitation in the Athens Convention.

Classification Societies

Classification societies are independent, normally non-commercial organizations. They were originally established to designate minimum standards on which underwriters could rely before insuring a vessel but have, over the years of their existence, developed into standard-setting institutions for every section of the shipping community. Through their rules for construction and a regime of periodical surveys they are in a position to enhance ship construction and operation. They supervise all stages of the construction or major repairs of a ship, even to the extent of ensuring that the right materials are used. A ship so constructed is assigned a class in accordance with some code.

In order to retain its class, the vessel must be presented for survey at periodical intervals as specified in the rules. Failure to meet these terms or to comply with recommendations issued may result in the suspension or cancellation of its class.

Although it is not a legal requirement to be classed, practically all ships are. It is usually a condition for marine insurance or a maritime mortgage that the ship is classed and is maintained so as to retain her class.

The large classification societies have surveyors stationed at the major ports round the world who, in addition to classification work, carry out statutory surveys required by international conventions under authority delegated to them by national maritime Administrations.

*** Cargo**

A brief description of the use of documentary credit has been included to show how the bill of lading is involved as security for the sale of goods and how important it is that the description of the goods shown in the bill of lading is correct.

*** 'Hamburg Rules' Maritime Legislation**

*** General Average and Marine Insurance**

The role of the York-Antwerp Rules in the adjustment of general average is covered in the Marine Claims Handbook, see below. The rules are also included.

Non-disclosure does not include circumstances which the shipowner could not know about. However, it has been held that non-disclosure of circumstances which should have been known but were not, possibly due to the master's failure to keep the owner informed, would be grounds for the insurer to avoid the insurance contract.

The "duty of assured" clause is intended to encourage the assured to take all reasonable measures to avert or minimize the damage or loss which will form a claim on the policy. Claims under this clause are treated separately from others and are payable in addition to other claims, even in the event of total loss. It is said that the assured should behave as if uninsured.

Protection and Indemnity Associations and the cover provided by them are dealt with in references below:

Use of maritime transport. A guide for shippers, freight forwarders and ship operators, Volume 2, UN Economic and Social Commission for Asia and the Pacific (ST/ESCAP/51 6).

Hudson, NG and Allen, JC Marine Claims Handbook 5th ed. London, LLP Limited, 1996 (ISBN 1 85978 048 2)

Aragon, James R., Shipmaster's handbook on ship's business, 2nd ed (Centreville, Maryland, Cornell Maritime Press, 1988 (ISBN 0-87033-378-X). This book is based on United States laws and regulations but contains much sound general advice for masters on legal mailers and procedures.

Hill C, Robertson B. and Hazelwood S.J. An introduction to P&I, 2nd ed. LLP Limited, London, 1996 (ISBN 1-850440883-3)

Stowaways, Ship's Agents and Agency, Port state control, Port of refuge and the Master/pilot relationship are also included in the detailed teaching syllabus. Instructors should refer to these, which will assist them in preparing their lessons.

1.7 Methods and Aids to Prevent Pollution of the Marine Environment by Ships Pollution (2 Hours)

This covers the following IMO conventions:
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention)
International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969
International Convention on Civil Liability for Oil Pollution Damage, 1969

The International Convention for the Prevention of Pollution from Ships, 1973, and the Protocol of 1978 relating thereto (MARPOL 73/78) has been covered earlier.

1.8 National Legislation for Implementing International Agreements and Conventions

Instructors should develop their own objectives here to ensure that national legislation, that is the flag state laws are covered to an extent that meets or exceeds the standards laid down in the international conventions, codes and agreements. Emphasis should be on monitoring compliance, identifying areas where there may be potential for non-compliance or differences compared to international standards.

3.3 Maintain Safety and Security of Crew and Passengers and the Operational Condition of Safety Systems

3.5.1 Life-Saving Appliance Regulations (2 Hours)

The requirement of the STCW Convention is covered by IMO Model Course 1.23, Proficiency in Survival Craft and Rescue Boats other than Fast Rescue Boats. Trainees who have successfully completed that course and have been issued with a certificate of proficiency in survival craft have demonstrated the ability and knowledge necessary to satisfy the requirements of the regulations concerning life saving.

The obligations and responsibilities of the master under the requirements of the life-saving appliance regulations of the International Convention for the Safety of Life at Sea, 1974, as amended, are dealt with in the subject, Maritime Law, of this course.

SEARCH AND RESCUE

The syllabus for training in search and rescue is contained in IMO Model Course, Maritime Search and Rescue Co-ordinator Surface Search. That course provides a thorough knowledge and understanding of the IAMSAR MANUAL and satisfies the requirements of the STCW Convention.

3.3.4 ACTIONS TO BE TAKEN TO PROTECT AND SAFEGUARD ALL PERSONS ON BOARD IN EMERGENCIES (4 HOURS)

SOLAS Regulations list the duties related to passengers which must be assigned to members of the crew. These duties would usually be so arranged that each member of the catering staff would be responsible for a group of rooms. A small party would be charged with taking additional supplies to the lifeboats.

Rescue of Persons from a Vessel in Distress or from a Wreck

Unless the situation is critical, conditions should be assessed carefully and a plan prepared before initiating. Unless the situation is critical, conditions should be assessed carefully and a plan prepared before initiating rescue action. If the survivors are in no immediate danger and existing conditions makes rescue hazardous, consider waiting until conditions have improved or until daylight. Try to establish communications with the survivors to obtain information about their condition and to inform them of the intended method of rescue.

Direct transfer of survivors from a wreck to the ship requires nearly calm conditions and, normally, rescue boats or motor lifeboats will be used.

It is unlikely that the disabled ship or wreck will be drifting at the same rate as the rescue ship so, if time permits, it is a good idea to try to get an estimate of their relative drift rates before launching the boats. At the same time, the rescue ship should reconnoitre the area around the wreck to see if there are any obstructions which might hamper the boats.

During the launching of boats, lifelines, lifebuoys, ladders and nets should be ready in case somebody falls overboard or a boat overturns.

Going alongside a wreck may be difficult. On the lee side the approach may be obstructed by wreckage, and if the wreck is drifting quickly the boat will have difficulty getting away from the side. Sea conditions may make it impossible to approach from the weather side and, since the wreck will probably drift faster than the boat, it will be difficult to remain close enough to transfer survivors. An approach from the weather side is the only possibility when the wreck is on fire or releasing toxic fumes, in which case survivors may have to lump into the water to be picked up by the boats.

If weather conditions make the use of boats too hazardous, and it is not possible to wait for conditions to moderate, a liferaft on a stout line may be towed or floated to the wreck or may be hauled out to the wreck after making connection by line-throwing apparatus. The painter fitted to the liferaft is not heavy enough to be used in this manner.

At the rescue ship, preparations for the transfer of survivors include the provision of a boat rope, nets, ladders, lines and crew standing by to assist. The use of a liferaft alongside as a landing stage releases the boat quickly if it is necessary to make several journeys. Survivors who have been in the sea or survival craft for some time may be suffering from cold, fatigue and sea-sickness and be unable to do much to help themselves.

MAN-Overboard Procedures

The standard man-overboard manoeuvres were dealt with in Model Course 703, Officer in Charge of a Navigational Watch.

The standard full-speed man-overboard manoeuvres, such as the Williamson turn, are not possible in very heavy weather. Turning at speed into, a heavy see and swell could cause serious damage to the ship. The turn should be made in the safest way possible in the conditions and the ship manoeuvred into a position to windward of the person in the water. The ship will quickly drift down to him. A few fit crew members, wearing immersion suits, lifejackets and lifelines, should be standing by to help the person on board. Use may also be made of the line-throwing apparatus, with a buoyant head, to drift a line to the person in the water. It is essential to keep the person in sight throughout the operation, and this is difficult in a heavy sea and swell, so any crew not otherwise occupied in the rescue should be posted as look-outs.

When a person is reported to the master as missing, it may reasonably be assumed that efforts have already been made to find him. A final call on the public address system should be made and if there is no response the ship should be turned into its wake and a search along the reciprocal course made. At the same time, a thorough search of the ship should be organized and the time at which the missing person was last seen should be established. The track should be searched back to the position where it is known the person was still on board. An urgency call requesting other ships in the vicinity to keep a look-out for the person should be made.

3.3.5 Actions to Limit Damage and Salve the Ship Following a Fire, Explosion, Collision or Grounding (4 Hours)

Means of Limiting Damage and Salving the Ship Following a Fire or Explosion

No definite procedures can be laid down as each occurrence will be unique Trainees should consider the measures which could be taken in a variety of situations, using materials to be found aboard ship.

It is important to keep observation on damaged areas and temporary repairs, to ensure that there is immediate warning of a worsening situation.

Procedure for Abandoning Ship

A ship should not be abandoned prematurely. It is generally safer to remain aboard a wreck, to await the arrival of assistance, for as long as possible. This is particularly true in severe weather conditions, when abandoning ship is very hazardous and the condition of the crew will deteriorate rapidly in survival craft. Also, in those conditions, craft are likely to become widely dispersed, making rescue more difficult.

When the condition of the ship is such that sinking or breaking up is inevitable, the ship should be abandoned in time to get clear of her before she sinks or before wreckage makes the launching of survival craft dangerous. In the event of fire or explosion or of the release of toxic fumes it may be essential to get clear of the ship as quickly as possible.
Consideration should be given to the method of passing the ‘abandon ship’ signal. It should be distinctive, so that it is not confused with other signals or instructions which may be given in an emergency. The instruction to abandon ship may have to be given by word of mouth if other communication systems have broken down.

The duties of the emergency party should include provision for the shutting down of any machinery, as required.

3.4 DEVELOP EMERGENCY AND DAMAGE CONTROL PLANS AND HANDLE EMERGENCY SITUATIONS

3.4.1 Preparation of Contingency Plans for Response to Emergencies (9 Hours)

CONTINGENCY PLANS FOR RESPONSE TO EMERGENCIES

Given a brief description of a ship and a crew list, trainees should be able to divide the crew into appropriate emergency teams and draw up the muster list and emergency instructions. Instructions should cover general emergency and fire stations separately

Plans for dealing with fires in specific areas should be considered. Actual plans would depend upon the construction and arrangement of a particular ship, but principles such as containment of a fire, escape routes, access for fire fighters and the medium to be used can be dealt with. Trainees should be reminded that drills at sea should put these plans into action and that a different location for the fire should be chosen at each practice!! It may be found that the plans need revising in the light of practice drills (V29).

Similarly, boat drills should sometimes be organized on the assumption that certain survival craft have been destroyed or are not usable for some reason.

The ship safety committee should be involved in the organization of emergency drills and the evaluation of the plans in the light of those drills. Representatives can bring any difficulties or deficiencies to the attention of the committee and suggest solutions to the problem. The committee can increase awareness of the actions required from crew members through their representatives.

The control centre for the command team in port should normally be at main deck level, at a location suitable for liaison with shore authorities. It should have a shore telephone connection and have emergency equipment and information stored there ready for use.

3.5 Use of Leadership and Managerial Skills

3.5.1 Shipboard Personnel Management and Training

Officers will have different experiences of personnel management. As officers in charge of a watch they will also have had to exercise their authority. They will therefore recognize and understand many of the learning objectives. It should be possible to build on this and use their prior experience to the maximum to improve their knowledge and ability to cope with seagoing and other personnel such as pilots, ship agents, ship repairers and other shore staff.

There should also be a good opportunity to establish useful facts on the varying conditions of employment experienced by the group of trainees and perhaps to learn something of the advantages and disadvantages of the various systems which the trainees might find to be helpful in the course of their duties.

If time permits, the trainees should be given group assignments to recreate and learn how to deal with some of the typical arguments and problems which occur on board ship, (V111).

Training

Organisation and management skills are best learnt through teamwork activities and case studies. As much time as possible should be devoted to this aspect. Role playing exercises may be designed in communications, meetings, organising drills and training sessions, to name but a few areas, (T37). This is an important part of the course as it involves teaching various subjects to the trainees so that they, in due course, have the capability to train staff on board in the same subjects in order to improve safety and operational standards. There is scope in this section to use role playing and group assignments for some aspects of this training.

Nearly all of the training undertaken aboard ship will be on-the-job training, i.e. the trainee uses the normal ship's tools, equipment and materials during the ordinary running of the ship. Off-the-job training will probably be restricted to the use of video cassettes.

For trainee watchkeepers the STCW Convention requires that an approved programme of on board training is supervised and monitored and is adequately documented in a training record book (STCW Code Section A-II/1, paragraph 6). An example of one such book is that produced by the International Shipping Federation Extensive guidance regarding training is given in the STCW Code Section B-II/1.

The Purpose of Training

All training is intended to modify attitudes, to increase skills or to provide knowledge which can be applied by the trainee in carrying out his work. The desired outcomes include a reduction in accidents, less need for supervision, greater productivity and improved quality of work. A thorough mastery of a task and a knowledge of its relevance to other tasks in the running of the ship also increase the job satisfaction of the crew member concerned.

Preparation

Before starting training, the instructor should prepare what he wishes to teach, decide the order of the instruction and make a note of the important points to be emphasized. Any tools or materials which are needed should be ready to hand and equipment, such as video players, should be tested to ensure that it is working.

Methods of Training

For training to be effective, the trainee must be able to see that it is relevant to him and his work or duties on the ship. The instructor should question the trainees before starting to establish what they already know and can do and to explain why the task is necessary.

Nearly all on-board training is of an informal nature, often one-to-one, so trainees should be encouraged to ask questions or have demonstrations repeated, if necessary, during the training. The instructor should also question or test the trainees at suitable intervals to make sure that they have understood, or are able to perform the skill being taught, up to that point. Where appropriate, provide the trainee with a written note to support the tuition.

Changing Attitudes

An attitude is an individual’s habitual mode of responding to an object or situation!! Attitudes are developed by experience within social groups, including those of the work place, and may become firmly implanted. To produce a change of attitude by training is therefore difficult and cannot be done quickly.

A crew member may know the correct safe working practice to adopt for a particular task and yet ignore it when not being directly supervised. The necessary insistence on following safe working practices will not necessarily change a careless attitude to safety. A discussion of the consequences to himself and his family of an accident resulting in permanent disablement might be more effective. Officers should remember that their own attitudes and behaviour help to form those of trainees and new entrants, who will not develop desirable attitudes to required standards if their seniors do not adopt them or if they ignore breaches of them by others.

Training in Skills

On-the-job training usually consists of pulling the trainee to watch and work with an experienced person (e.g. a cadet, watchkeeping with a qualified officer). This arrangement fails if the experienced person uses incorrect methods in his work.

In teaching a particular skill, such as a manual task, the instructor should divide the task into self-contained stages, each of which can be taught as a unit. He should identify any critical points at each stage. The job is demonstrated and explained to the trainees in stages, with emphasis on the critical points. The trainee then carries but the job under the supervision of the instructor. Stages are repeated as necessary until the trainees’ performances are satisfactory.

Training in Knowledge

In the majority of cases aboard ship this will involve an officer or petty officer describing equipment or a particular task to others, for example, instruction in how to launch an inflatable liferaft and board it, and how to survive when in it. Trainees should be encouraged to participate in the instruction by asking questions or making suggestions. Sufficient questions should be directed to trainees to test that the necessary knowledge is being transferred.

Knowledge which is not often used (how to survive in a liferaft, for example) is forgotten with the passage of time, hence the necessity for repeating such instruction at intervals.

Each trainee should deliver a short training session (about 10 minutes would be sufficient) to the other members of the class. Subjects, which should be drawn from those which would be undertaken aboard ship, should be assigned to the trainees well in advance to allow them ample time for preparation.

3.5.2 **Related International Maritime Conventions and National Legislation (2 Hours)**

It is suggested that where national legislation implementing an international agreement or convention exists, both the national legislation and the international requirements are taught together. For example, a topic could be treated by dealing with the national legislation, including the administrative details necessary for the master to carry out his duties effectively, and making reference to the relevant sections of the international agreement or convention on which the national regulations are based.

In addition to the national laws implementing the international conventions and agreements, the following areas of concern to a ship's master, not touched upon in the syllabus, are mentioned:
- a review of the national system of courts, hearings and appeals
- the procedures for preliminary enquiry and formal investigation of accidents
- contracts of towage
- the carriage of the official log-book, entries and surrender of the log-book at the completion of a voyage
- crew disciplinary procedures, powers and obligations of the master
- the master's disciplinary powers concerning passengers
- calculation of crew wages, rules concerning allotment of wages, deductions of tax and social security contributions, advances, fines, forfeitures, other deductions and payment of the balance
- collective bargaining agreements between seafarers' and shipowners' organizations affecting the employment of crew

3.5.3 **Application of Task and Workload Management** **(4 Hours)**

Planning and Co-Ordination **(1 Hour)**

The importance of identifying fatigue should be emphasized by the instructors. Overload situation can catastrophic results, the instructors should include case studies involving fatigue, as the major reason for the accident / incident.

Personnel Assignment, time and resource constraints and prioritization should be explained to the trainees.

3.5.4 **Effective Resource Management** **(5 Hour)**

Allocation, Assignment and Prioritization of Resources **(1 Hour)**

Methods of allocating, assigning and prioritizing resources should be explained to the trainees.

Effective Communication an Board and Ashore **(1 Hour)**

The importance of effective communication should be highlighted, case studies, role pay can be introduced to point out the underlying methods of interactive, closed looped communication, when allocating, delegating tasks, passing orders and reporting or communicating with shore authorities and personnel.

Decisions Reflect Consideration of Team Experiences **(1 Hour)**

The importance of allocating, delegating tasks according to the experience of the person carrying out the job/tasks should be highlighted by the instructors.

Assertiveness and Leadership, Including Motivation **(1 Hour)**

The instructors should explain the difference of authority and assertiveness. There have been lot of accidents involved , especially involving junior officers, during navigating under pilotage, where the advise /orders of the pilot were never been questioned / challenged, even though it raised a doubt in their minds. The instructors should point out the correct method of using challenge and response, either using case studies or role play methods.

Obtaining and Maintaining Situational Awareness **(1 Hour)**

There have been cases involving ships on fixed routes, where owing to the regular frequent trips to same, known destinations, creates a situation termed as “IQ dumb”, where the mind shuts and the officers lose situational awareness. Carrying out non important tasks, especially during navigation watch has also been repeatedly found to be the underlying cause of distraction and losing of situational awareness, with, at times, ending with catastrophic results.

3.5.5 **Decision Making Techniques** **(4 Hours)**

Situation and risk assessment, Identifying and Generating Options, Selecting Course of Action and evaluating the outcome effectiveness are covered under this topic.

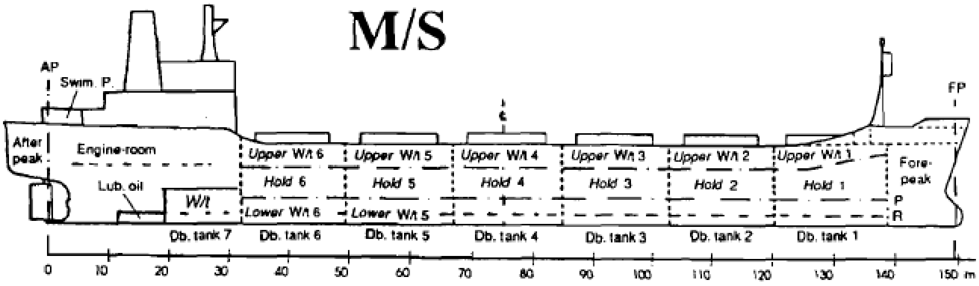
3.5.6 **Development, Implementation and Oversight of Standard Operating Procedures** **(1 Hour)**

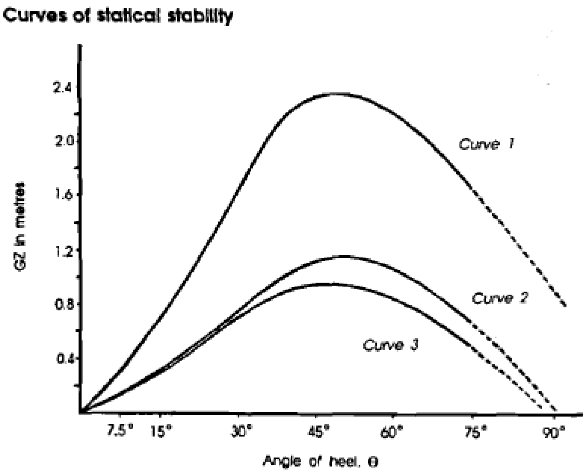
Instructors should explain the methods of developing, implementing standard operating procedures (SOP's) and the reason and dangers of oversighting these procedures. Case studies should be used by the Instructors, highlighting these topics.

3.6 Organise and Manage the Provision of Medical Care on Board (4 Hours)

The standards of competence required by the STCW Convention are covered by IMO Model Course 1.15, Medical Care, T33, and V91. However, officers need to know where to get appropriate advice and how to apply it correctly. The three main sources of information are the publications mentioned in this section.

Appendix – Stability Data





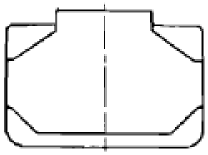
Curve	Condition	Cargo	H.O.	D.O.	Stores
1	Ballast	–	695.6	155.3	150
2	Load 1	14 894.3	250.0	53.5	150
3	Load 2	16 040.0	200.0	51.2	150

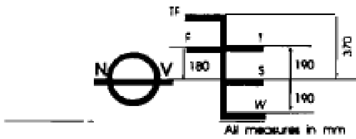
Curve	F/W	Ballast	L/S	Δ
1	263.3	5070.5	4895	11 229.7
2	104.8	672.4	4895	21 020
3	104.8	–	4895	21 441

Curve	KG	GG_1	Corrected KG	GM
1	6.54	–	6.54	2.56
2	7.113	0.043	7.156	1.484
3	7.320	0.043	7.363	1.307

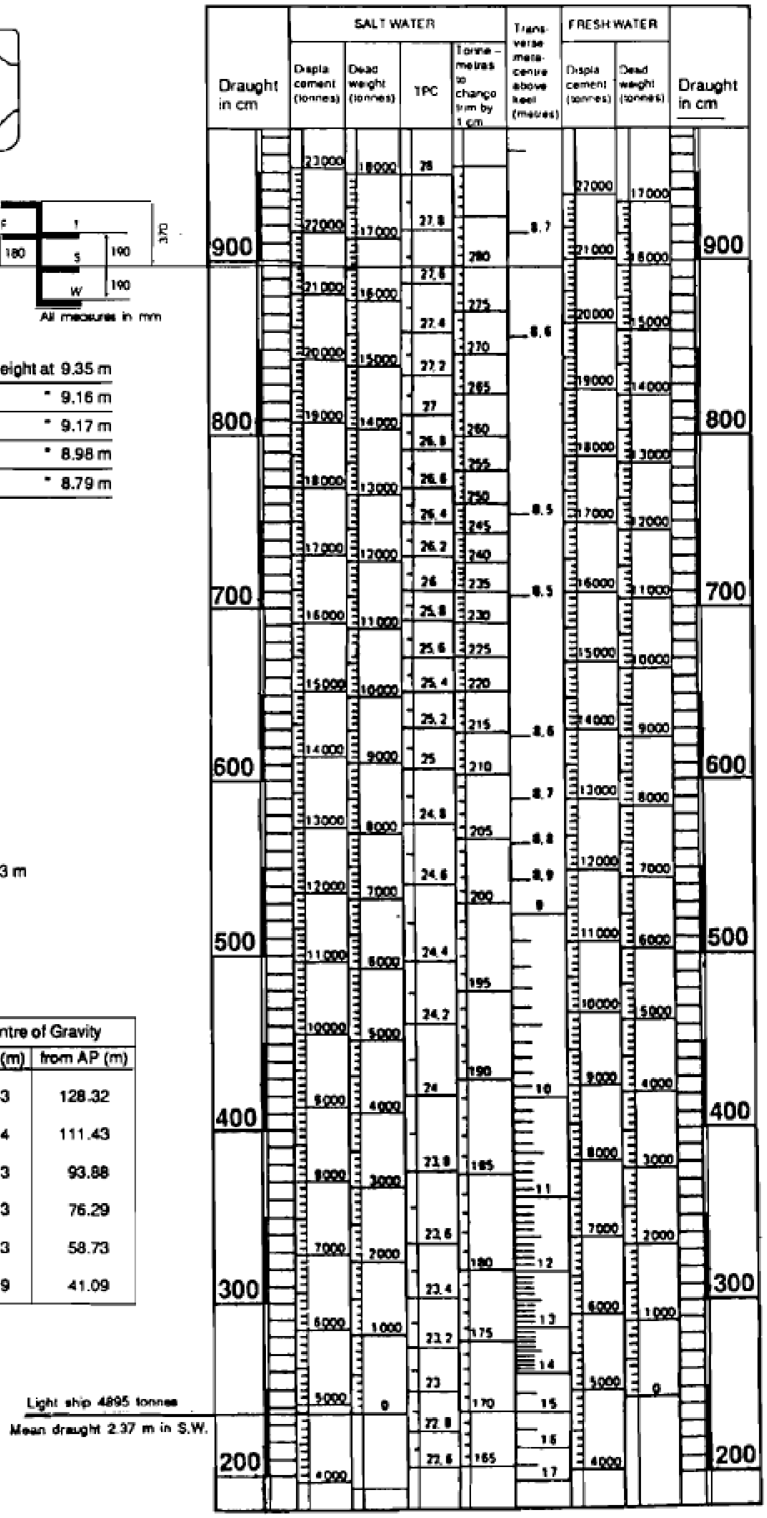
Capacities in tanks	Volume in m^3	Weights in tonnes					Centre of Gravity		Free surface
		Lub. oil (ρ = 0.9)	Diesel oil (ρ = 0.9)	Fuel oil (ρ = 0.95)	Fresh w. (ρ = 1.0)	Ballastw. (ρ = 1.02)	VCG (metres)	From AP (metres)	$i = \frac{l \times b^3}{12}$ m^4
Forepeak	268.4					275.1	7.28	142.77	67
Db. tank No. 1	2 × 214.0					438.7	1.49	128.44	495
Db. tank No. 2	2 × 296.0					606.8	1.19	110.64	2757
Db. tank No. 3	2 × 328.0					672.4	1.13	93.39	2936
Db. tank No. 4	2 × 328.0					672.4	1.13	75.80	2936
Db. tank No. 5	2 × 191.3			363.5		392.2	0.76	58.22	1094
Db. tank No. 6	2 × 174.8			332.1		358.3	0.76	40.78	785
Db. tank No. 7	2 × 86.3		155.3				1.34	24.69	81
Lower W/t. No. 5	2 × 136.1					279.0	1.76	58.46	81
Lower W/t. No. 6	2 × 100.8			191.5		206.6	1.89	40.63	55
W/t. Eng. Room	2 × 145			275.5			4.88	26.79	120
Upper W/t. No. 1	2 × 149.5					306.1	11.67	127.41	152
Upper W/t. No. 2	2 × 204.8					419.8	11.25	110.98	393
Upper W/t. No. 3	2 × 204.8					419.8	11.25	93.39	393
Upper W/t. No. 4	2 × 204.8					419.8	11.25	75.80	393
Upper W/t. No. 5	2 × 204.8					419.8	11.25	58.22	393
Upper W/t. No. 6	2 × 204.8					419.8	11.25	40.60	393
After-peak	158.5				158.5		7.98	3.44	206
Swim. pool	32				30	30.8	21.86	2.20	24
Freshw. tank	2 × 52.4				104.8		11.40	5.27	83
Daily diesel tank	52.2		47.0				10.76	15.00	39
Daily fuel oil tank	71.1			67.5			10.82	11.22	102
Diesel oil tank	6.0		5.4				13.99	28.53	1
Lub. oil tank	40.0	36.0					10.76	29.81	4
Lub. oil tank	2 × 20.8	37.4					0.67	20.60	20
Total:			207.7	1230.1	293.3	6307.1			

Loading scale





TF	17039 tonnes deadweight at	9.35 m
F	16538 " "	" 9.16 m
T	17057 " "	" 9.17 m
S	16546 " "	" 8.98 m
W	16037 " "	" 8.79 m



Ships data

LOA = 159.4 m
LBP = 149.35 m
B = 20.4 m
D = 12.5 m
Gross = 11 182 tonnes
Net = 5 971 tonnes
Δ (s) = 21 441 tonnes
C_b (s) = 0.765

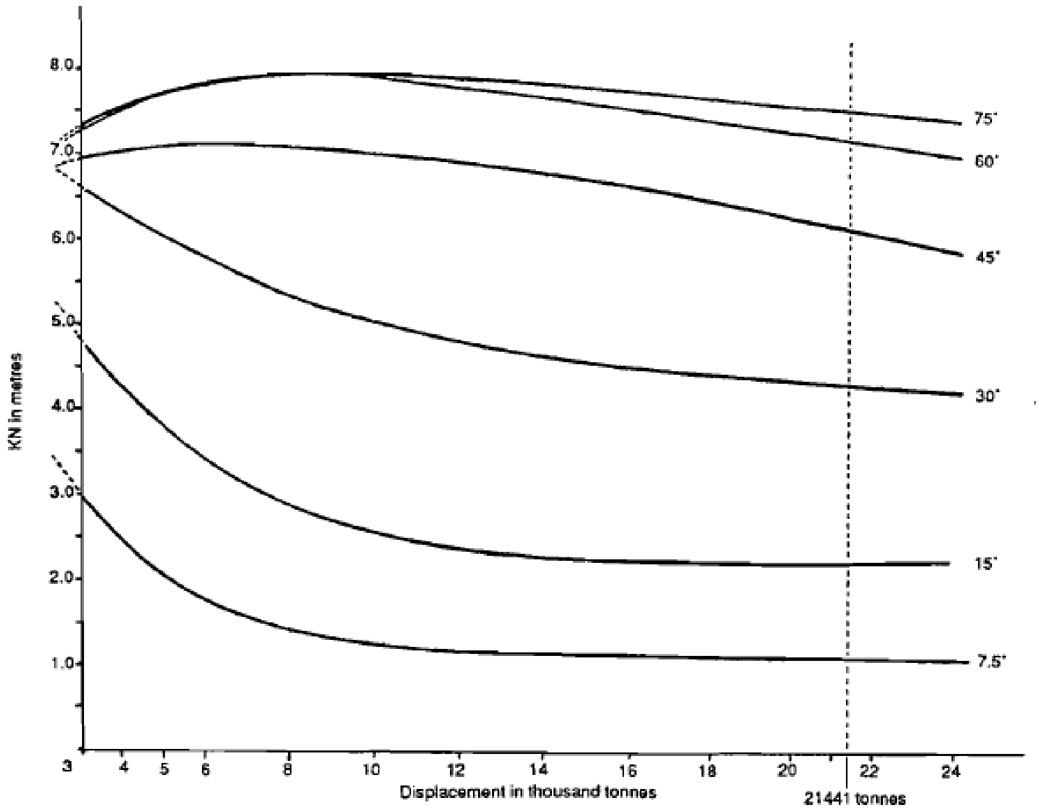
Light ship:

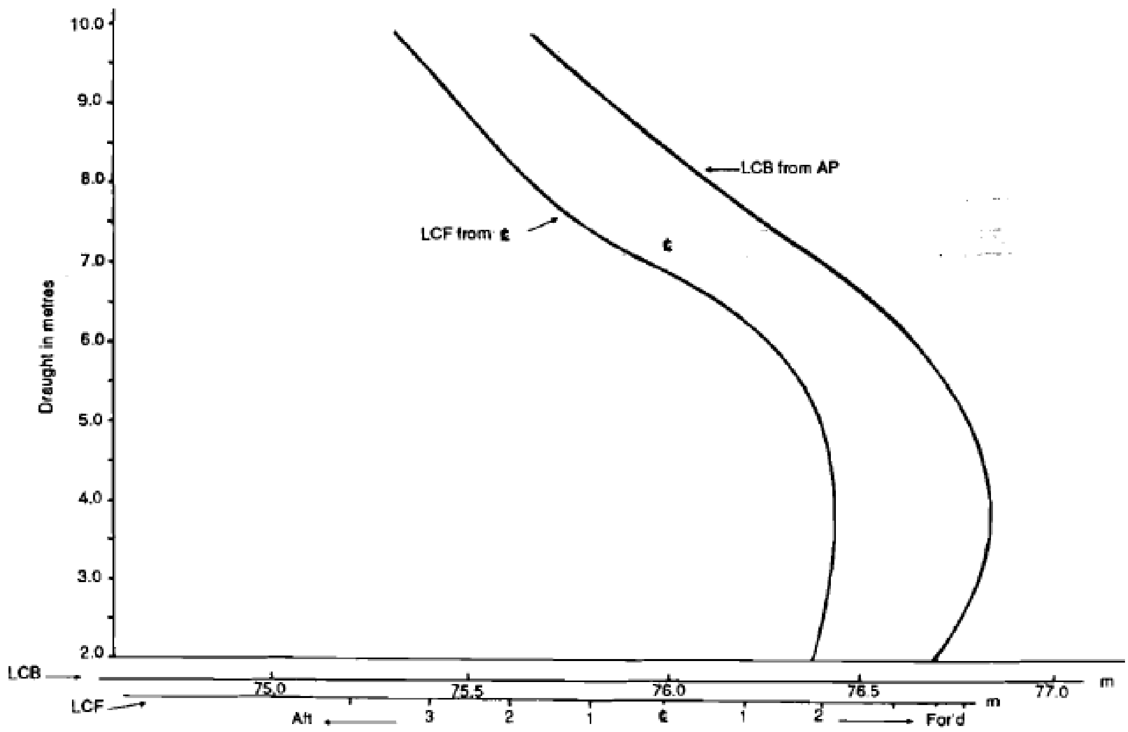
Displacement 4 895 tonnes
Draught F 0.25 m, A 4.62 m, M 2.43 m
VCG 7.8 m
LCG from AP 61.587 m

Cargo holds:

Hold No.	Volume (m^3) Grain	Volume (m^3) Bales	Centre of Gravity VCG (m)	Centre of Gravity from AP (m)
1	2 919	2 761	7.83	128.32
2	3 577	3 435	7.14	111.43
3	3 607	3 465	7.13	93.88
4	3 607	3 465	7.13	76.29
5	3 603	3 460	7.13	58.73
6	3 539	3 430	7.19	41.09
Total:	20 852	20 017		

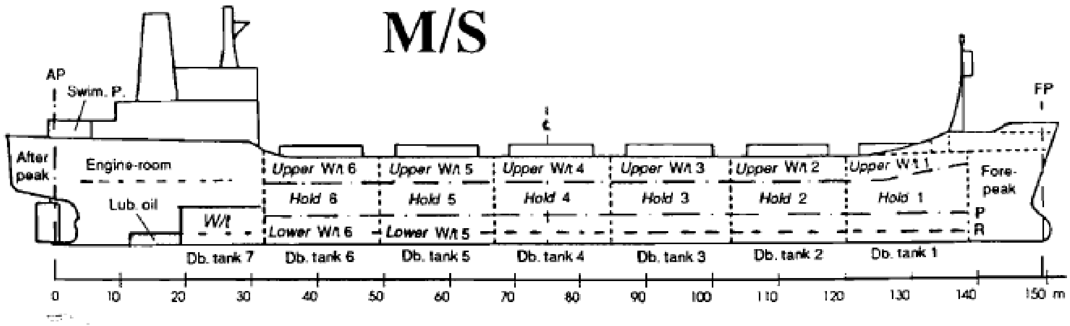
KN Curves


8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
KN in metres
75°
60°
45°
30°
15°
7.5°
3
4
5
6
8
10
12
14
16
18
20
22
24
Displacement in thousand tonnes
21441 tonnes


10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
Draught in metres
LCB from AP
LCF from ℄
℄
LCB
LCF
75.0
75.5
76.0
76.5
77.0
m
m
Aft
3
2
1
℄
1
2
For'd

Appendix – Trim Table

Tables of changes in centimetres of draught forward and aft for each 100 tonnes loaded.



3.0m Draught

F	-16	-13	-10	-6	-1	+4	+9	+14	-18	+23	F
A	+26	+22	+19	+15	+10	+5	0	-6	-11	-15	A

6.0m Draught

F	-15	-10	-8	-4	0	+4	+8	+12	+16	+20	F
A	+23	+19	+17	+13	+8	+4	0	-4	-9	-12	A

9.0m Draught

F	-9	-7	-5	-2	+1	+4	+7	+11	+14	+17	F
A	+15	+13	+12	+9	+6	+3	0	-3	-6	-9	A

Example – Find the draughts after loading 250 tonnes in No. 2 hold.

Initial draught	forward 5.76 m	aft 6.38 m	
Correction	+0.30	–0.10	$\left(\frac{250}{100} \times \text{tabulated values}\right)$
New draught	6.06 m	6.28 m	

Notes 1. Interpolation can be used for intermediate draughts.

2. Reverse the signs of the corrections for discharged weights.

Part E: Evaluation

The effectiveness of any evaluation depends to a great extent on the precision of the description of what is to be evaluated. The detailed teaching syllabus is thus designed to assist the Instructors with descriptive verbs, mostly taken from the widely used Bloom's taxonomy.

Evaluation/Assessment is a way of finding out if learning has taken place. It enables the assessor (Instructor) to ascertain if the learner has gained the required skills and knowledge needed at a given point in a course or in working towards a qualification.

The purpose of evaluation/assessment is:

- to assist student learning;
- to identify students' strengths and weaknesses;
- to assess the effectiveness of a particular instructional strategy;
- to assess and improve the effectiveness of curriculum programs;
- to assess and improve teaching effectiveness.

The different types of evaluation/assessment can be classified as follows:

Initial / Diagnostic assessment

This should take place before the trainee commences a course to ensure the trainee is on the right path. Diagnostic assessment is an evaluation of a trainee's skills, knowledge, strength and areas for development. This can be carried out in an individual or group setting by the use of relevant tests.

Formative assessment

An integral part of the teaching/learning process and is a "Continuous" assessment. It provides information on the trainee's progress and may also be used to encourage and motivate.

The purpose of formative assessment is:

- to provide feedback to students;
- to motivate students;
- to diagnose students' strengths and weaknesses;
- to help students to develop self-awareness.

Summative assessment

It is designed to measure the trainee's achievement against defined objectives and targets. It may take the form of an exam or an assignment and takes place at the end of a course.
Purpose of summative assessment:

- to pass or fail a trainee;
- to grade a trainee.

Evaluation for Quality assurance

Evaluation can also be required for quality assurance purposes.

Purpose of assessment with respect to quality assurance:

- to provide feedback to Instructors on trainee's learning;
- to evaluate a module's strengths and weaknesses.
- to improve teaching.

Assessment Planning

Assessment planning should be specific, measurable, achievable, realistic and time-bound (SMART).

Some methods of assessment that could be used depending upon the course/qualification are as follows and all should be adapted to suit individual needs:

- observation (In oral examination, simulation exercises, practical demonstration);
- questions (written or oral);
- tests;
- assignments, activities, projects, tasks and/or case studies
- simulation (also refer to section A-I/12 of the STCW code 2010);
- computer based training (CBT).

Validity

The evaluation methods must be based on clearly defined objectives, and must truly represent what is meant to be assessed; e.g. against only the relevant criteria and the syllabus or course guide. There must be a reasonable balance between the subject topics involved and also, in the testing of trainees' KNOWLEDGE, UNDERSTANDING AND PROFICIENCY of the concepts.

Reliability

Assessment should also be reliable (if the assessment was done again with a similar group/learner, would similar results be achieved). Different group of learners may have the same subject at different times. If other assessors are also assessing the same course/qualification, there is need to ensure all are making the same decisions.

To be reliable an evaluation procedure should produce reasonably consistent results, no matter which set of papers or version of the test is used.

If instructors are assessing their own trainees, they need to know what they are to assess and then decide how to do this. The, what, will come from the standards/learning outcomes of the course/qualification they are delivering. The, how, may already be decided for them if it is in assignments, tests or examinations.

The instructors need to consider the best way to assess the skills, knowledge and attitudes of their learners, whether this will be formative and/or summative and the validity and reliability of the assessment.

All work assessed should be valid, authentic, current, sufficient and reliable; this is often know as VACSR – “valid assessments create standard results”:

- valid – the work is relevant to the standards/criteria being assessed;
- authentic – the work has been produced solely by the learner;
- current – the work is still relevant at the time of assessment;
- sufficient – the work covers all the standards/criteria;
- reliable – the work is consistent across all learners, over time and at the required level.

It is important to note that no single method can satisfactorily measure knowledge and skill over the entire spectrum of matters to be tested for the assessment of competence.

Care should therefore be taken to select the method most appropriate to the particular aspect of competence to be tested, bearing in mind the need to frame questions which relate as realistically as possible to the requirements of the officer's tasks at sea.

STCW 2010 Code

The training and assessment of seafarers required under the Convention are administered, supervised and monitored in accordance with the provisions of section A-I/6 of the STCW Code.

Column 3 - Methods for demonstrating competence - and Column 4 - Criteria for evaluating competence - in Table A-II/2 (Specification of minimum standard of competence for masters and chief mates on ships of 500 gross tonnage or more) of the STCW Code, set out the methods and criteria for evaluation.

Instructors should refer to this table when designing the assessment.

Assessment is also covered in detail in IMO Model Course [3.12], however to assist instructors some extracts from the Model course are used to explain in depth.

Calculations

To carry out their duties, masters and chief mates must be able to solve technical problems by performing calculations in various subject areas such as cargo work, ship stability and navigation.

Ability to perform such calculations and to resolve such problems can be tested by having the candidates carry out the calculations in their entirety. Since a large variety of technical calculations is involved and the time necessary for their complete solution is considerable, it is not possible to completely test the abilities of candidates within a reasonable examination time.

Resort must therefore be made to some form of sampling technique, as is the case with the assessment of knowledge, comprehension and application of principles and concepts in other subject fields.

In examinations conducted on a traditional essay-type basis, the sampling technique that is applied in respect of calculation requirements is to attempt to cover as much of the subject area as possible within the examination time available. This is frequently done by using questions involving shorter calculations and testing in depth on one or two topics by requiring the completion of more complex calculations. The employment of this 'gross sampling' technique reduces the reliability of the examination as compared with what can be achieved with a more detailed sampling technique.

A greater breadth of sampling can be achieved by breaking down calculations into the various computational steps involved in their solution. This technique can only be applied to calculations in which the methodology is standardized. Fortunately, most calculations follow a standard format; where alternative methods of solution exist. The examination can be developed so as to allow candidates an appropriate freedom of choice. Such freedom of choice must be a feature of examinations of all types.

In order to develop a series of 'step test items', covering an entire calculation, it is necessary to identify each intermediate step in each calculation involved, by all methods which are accepted as being correct in principle. These questions, after they have been reviewed for clarity and conciseness, form the standard 'step test items' in that calculation topic.

This approach allows questions to be posed which sample the candidate's knowledge and ability to perform parts of various calculations, which process takes up less time than having him or her perform entire calculations. The assumption is made that if the candidate can or cannot correctly complete a calculation step leading to the solution, then he or she can or cannot successfully carry out the entire calculation. Such detailed sampling allows a larger number of questions to be answered by the candidate within the time allotted for the examination, thus allowing a broader sampling of the candidate's knowledge and abilities and thereby increasing the reliability of the examination.

It must be pointed out that because of the greater number of test items used more time will be spent by candidates in reading the questions and in appreciating the precise step which each question involves.

However, the ability to answer correctly questions that are based on each intermediate step leading to the solution does not necessarily indicate competence in the application of the calculation methodology nor in the interpretation of the intermediate or final results. Further questions must therefore be developed which are of a 'procedural' and principle nature.

Such 'step test' and 'procedural' items may be drawn up as 'essay-type' items, supply-type items or multiple-choice items. Marking or scoring is easier if multiple-choice test items are used, but in some cases difficulties may arise in creating plausible distracters.

Detailed sampling can allow immediate identification of errors of principle and those of a clerical nature. It must be emphasized that this holds true, in general, only if the test item is based on a single step in the overall calculation. Multiple-choice items involving more than one step may, in some cases, have to be resorted to in order to allow the creation of a sufficient number of plausible distracters, but care must be exercised to ensure that distracters are not plausible for more than one reason if the nature of the error made (and hence the distracter chosen) is to affect the scoring of the test item.

Compiling tests

Whilst each examining authority establishes its own rules, the length of time which can be devoted to assessing the competence of candidates for certificates of competency is limited by practical, economic and social restraints. Therefore a prime objective of those responsible for the organization and administration of the examination system is to find the most efficient, effective and economical method of assessing the competency of candidates. An examination system should effectively test the breadth of a candidate's knowledge of the subject areas pertinent to the tasks he is expected to undertake. It is not possible to examine candidates fully in all areas, so in effect the examination samples a candidate's knowledge by covering as wide a scope as is possible within the time constraints and testing his depth of knowledge in selected areas.

The examination as a whole should assess each candidates comprehension of principles, concepts and methodology; ability to apply principles, concepts and methodology; ability to organize facts, ideas and arguments and abilities and skills in carrying out the tasks to perform in the duties he or she is to be certificated to undertake.

All evaluation and testing techniques have their advantages and disadvantages. An examining authority should carefully analyse precisely what it should be testing and can test. A careful selection of test and evaluation methods should then be made to ensure that the best of the variety of techniques available today is used. Each test shall be that best suited to the learning outcome or ability to be tested.

Quality of test items

No matter which type of test is used, it is essential that all questions or test items used should be as brief as possible, since the time taken to read the questions themselves lengthens the examination. Questions must also be clear and complete. To ensure this, it is necessary that they be reviewed by a person other than the originator. No extraneous information should be incorporated into questions; such inclusions can waste the time of the knowledgeable candidates and tend to be regarded as 'trick questions'. In all cases, the questions should be checked to ensure that they measure an objective which is essential to the job concerned.

SCORING TESTS

Scoring subjective tests

The assessment of seafarers is concerned with judging whether they are competent, in terms of meeting sufficient specified learning objectives, to perform the tasks required by the qualification they are seeking. That is, they should be tested against predetermined criteria rather than against the performance of other examinees or the norm for the group as a whole, as is the case in many examinations.

To achieve that end in subjective tests, an analytical scoring scheme should be draw up in which a complete model answer, which would attract full marks, is produced for each question. The model answer is then analysed for the definitions, facts, explanations, formulae, calculations, etc., contained in it and marks are allocated to each item, the aim being to make the scoring as objective as possible. A subjective element will still exist in the original allocation of marks to the various sections and, to some extent, in the scoring of incomplete or partially correct sections.

Either credit scoring or deductive scoring may be used. In credit scoring, marks are awarded, in accordance with the scoring scheme, for each correctly completed part of the answer, no marks being credited for incorrect parts or omissions. With deductive scoring, marks are deducted for errors and omissions from the total mark for the question or part question (where a question has been divided into two or more sections). When applied to essay questions, the two methods should produce virtually the same score. Deductive scoring is usually confined to the marking of calculations.

Deductive scoring can be weighted to take account of the relative seriousness of different types of error. Errors are commonly classed and weighted as follows:

.1 errors of principle; for example, using the formula for righting moment in a calculation of list; deduct 50% of the mark for the question or part question;

.2 major errors; for example, extracting data for the wrong day or time from the Nautical Almanac; deduct 30% of the mark for the question or part question; and

.3 clerical errors; for example, transposition of numbers from tables or question paper, careless arithmetic; deduct 10% of the mark for the question or part question for each error.

In the case of clerical errors, only one deduction for a single error should be made. No deductions are made for incorrect answers which follow through from the original error. If deductions exceed the total mark for a question or part question it is given a zero score; negative scores are not carried over to other parts.

The different types of error can be taken into account in credit scoring schemes by suitably weighting the marks allocated to method, to the extraction of data and to clerical accuracy at each step of the calculation. The steps need to be smaller and more detailed than the division into parts used in deductive marking. As a result, the marks lost for errors of principle tend to be smaller in credit scoring than in deductive scoring.

A small percentage of the total mark, to be credited only for the correct final answer, is sometimes included in a credit scaring scheme. The answer must lie within stated accuracy limits to qualify for that credit. In deductive schemes, an answer that has otherwise been correctly calculated but which falls outside the accuracy limits is treated as a clerical error.
Where tests are to be marked locally at more than one test centre, a well-defined scoring scheme, which will give the same score when applied to the same paper by different markers, is essential for the uniform and fair treatment of candidates. To aid in

any subsequent review of marks, possibly resulting from an appeal, the marker should make brief marginal notes on the paper to indicate, the reasons for deductions.

Guidance on the treatment of answers produced by pocket calculators is needed. Examination rules usually warn candidates that all working must be shown to gain full marks for a question. The marks to deduct when insufficient working is shown but a correct answer is produced, or when all working is correctly shown but the answer is wrong, need to be known by the marker

In papers in which all questions are to be answered, the marks may be weighted to reflect the importance or difficulty of individual questions or the length of time which will be needed to answer them. When this is done, it is usual to indicate: the mark for each question on the question paper. Optional questions should all be of similar standard and carry equal marks, so that the standard of the complete test is the same regardless of the questions chosen.

Use can be made of a compulsory and an optional section in the same paper. Questions on which it is felt that all candidates should be tested can be placed in the compulsory section and suitably weighted, while the remainder of the paper offers a choice of questions each of similar standard.

A problem that arises with optional papers is how to deal with cases where more than the required number of questions is answered. Various solutions are adopted by different examining boards. Many mark all questions and discard the lowest marked question or questions, although that fact is not generally advertised as it may encourage candidates to attempt extra questions. Others take the requisite number of answers in the order in which they are on the question paper and ignore the remainder. A similar problem arises in papers in which candidates are required to answer a given number of questions, including at least some stated number from each of several sections.

The pass mark should be set at the lowest score for which sufficient skills and knowledge are demonstrated for competency in each subject. In practice, that score is difficult to determine exactly for an individual paper and could vary slightly from one examination to another. Such an arrangement would be difficult to administer and would be considered unfair by candidates, so the pass mark is fixed and published in the examination regulations. It is, therefore, essential when preparing papers to maintain as constant a standard as possible, such that the pass mark is an appropriate measure of competency.

The following instructions are typical of those produced for guidance of examiners on the marking of examinations:

In order to achieve uniformity in marking between the Examiners in various centres and to facilitate the review of papers, the following guidelines are to be used at all centres:

.1 When several candidates write the same examination, papers, other than multiple choice, should be marked question by question, that is to say, question 1 of paper 1 should be marked for all applicants before proceeding to question 2, etc. This gives more uniform marking.

.2 All questions should be marked even if it becomes apparent that the candidate cannot achieve the pass mark.

.3 Neatness and Orderly Layout of Work:

Where work is not properly laid out or is not neat, marks should be deducted without regard to correctness of the answer. The number of marks deducted should vary according to the quality of the work up to a maximum of 10% where the correct answer is obtained.

.4 Important Nautical and Technical Terms:

Where, in general calculations or general questions, an incorrect term is used and such a term is incidental to the work, the Examiner should exercise his judgment as to whether or not marks should be deducted, but in any case, a deduction should not exceed 10% of the allotted marks. This does not apply to direct answers involving definitions or in answers involving the naming of parts.

.5 Types of Errors:

Errors can be divided into 3 types:

(a) P - error in principle; 50% of marks allotted for the whole or part of the question should be deducted.

(b) C - clerical error; 10% of the marks allocated should be deducted for each such error.

(c) M - major error, 30% of the marks allotted for the question or part of the question should be deducted.

NOTE: Large mark questions should be considered in their main sections and percentages of the sections deducted. Candidates should be given the benefit of any doubt which may exist.

.6 Drawings:

Too much importance should not be attached to elaborate drawings. Often a simple sketch with captions is very explanatory and indicative of a good understanding.

.7 Incomplete Answers:

Where a problem or distinct section of a large problem is only partly worked and a step of principle remains to be made, marks allotted should not exceed 50% of the total marks or the split marks allotted as the case may be.

MARKING PAPERS:

.8 When marking papers, Examiners should enter appropriate marginal notes in brief showing why marks have been deducted, using abbreviations in Paragraph 5. The actual error should be ringed and marked with a brief statement of the reason for the error, e.g., 'wrong day'. A paper should be so marked that any reviewing Examiner can see at a glance just what has happened, including a marginal note to indicate award of a 'benefit of doubt'.

Accuracy:

The following is a general rule to Examiners of the degree of accuracy expected:

(a) in calculating a ship's position, ±0.5 minutes of arc and to the nearest second of time;
(b) for a position line, to within 0.5 of a mile of the true result;
(c) in calculating compass errors, bearings and courses, ±0.5 of a degree;
(d) distances within 0.5 of a mile and times of meridian passage, to the nearest minute;
(e) tidal prediction, to ± 15 cm.

.9 In the case of marginal failure, the paper concerned should be carefully reviewed.

This review is not to be regarded as having the purpose of passing the candidate, it is to ensure that the foregoing marking standards have been correctly applied and are consistent with those of other responses to the same examination. It may result in either an increase or a decrease jn marks assigned. This review having been completed, the examiner should issue a fail result if it is still below the pass mark.

.10 Use of Calculators:

When a pocket, non-programmable calculator is used by a candidate in an examination, all necessary formulae and transpositions must be shown for full marks to be allotted. In the case of a correctly set out answer, or partial answer, which has an incorrect final result, 30% of the whole or part should be deducted on the major error rule.

When the evaluation consists of oral and practical tests, which many topics in the table A-II/2, column 2, Knowledge, understanding and proficiency, require, the following should be taken into consideration.

Advantages and disadvantages of oral and practical tests

It is generally considered advisable that candidates for certificates of competency should be examined orally. Some aspects of competency can only be properly judged by having the candidate demonstrate his ability to perform specific tasks in a safe and efficient manner. The safety of .the ship and the protection of the marine environment are heavily dependent on the human element. The ability of candidates to react in an organized, systematic and prudent way can be more easily and reliably judged through an oral/practical test incorporating the use of models or simulators than by any other form of test.

One disadvantage of oral/practical tests is that they can be time-consuming. Each test may take up about 1 to 2 hours if it is to comprehensively cover the topics concerned.

Equipment must also be available in accordance with the abilities that are to be tested. Some items of equipment can economically be dedicated solely for use in examinations.

Few example of calculations are provided for the assistance of Instructors, when designing the evaluation procedure.

Position determination by Celestial Observations

Sample calculation: (Longitude by chronometer)

On 12th February 1998, in DR position 17º22'N 065º48'E, the sextant altitude of Sun's UL east of the meridian was 32º11.0'. The GMT showed 04h 31m 40s at the time of the observation. If the height of eye was 12 meters and Index error was 2.3 off the arc, calculate the direction of the position line and the position through which it passes.

GHA Sun (12d 04h):		236º 26.5'
Increment (31m 40s):	(+)	7º 55.0'

GHA Sun:		244º 21.5'
Dec (12d 04h):		S 13º 46.4'
d (0.8):	(-)	00.4'

Dec:		S 13º 46.0'
Lat:		N 17º 22.0'

Sext alt:		32º 11.0'
IE (off):	(+)	02.3'

Obs alt:		32º 13.3'
Dip (12m):	(-)	06.1'

App alt:		32º 07.2'
Tot corn UL:	(-)	17.3'

T alt:		31º 49.9'
TZD:		58º 10.1'

$$\text{Cos P} = \frac{\text{Sin T.alt} + (\text{Sin lat. Sin dec})}{(\text{Cos lat. Cos dec})}$$

If lat and dec are same name (-), opposite name (+)

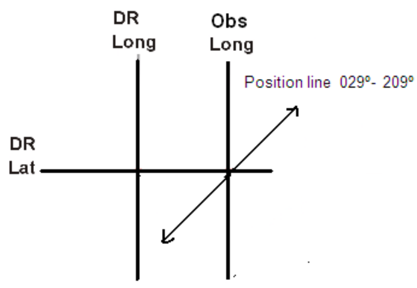
$$\text{Cos P} = \frac{\text{Sin } 31^\circ\, 49.9' + (\text{Sin } 17^\circ\, 22' * \text{Sin } 13^\circ\, 46)'}{(\text{Cos } 17^\circ\, 22' * \text{Cos } 13^\circ\, 46')}$$

Cos P= 0.645585539
P=49º 47.4'
LHA= 360- P
LHA= 310º 12.6'
GHA= 244º 21.5'
Obs Long: 065º51.1'E

DR Lat: 17º22'N
A: 0.26 S
B: 0.32 S

C: 0.58 S
Az: S61ºE
Az: 119º

Answer: Position line 029º- 209º drawn through DR latitude 17º22'N and observed longitude 065º51.1'E



Rough sketch- Not necessarily to scale

Position determination by Celestial Observations

<u>Sample calculation</u>: (Marc St. Hilaire / Intercept Method)

On 12th February 1998, in DR position 17º22'N 065º48'E, the sextant altitude of Sun's UL east of the meridian was 32º11.0'. The GMT showed 04h 31m 40s at the time of the observation. If the height of eye was 12 meters and Index error was 2.3 off the arc, calculate the direction of the position line and the position through which it passes.

GHA Sun (12d 04h):		236º 26.5'
Increment (31m 40s):	(+)	7º 55.0'

GHA Sun:		244º 21.5'
Dec (12d 04h):		S 13º 46.4'
d (0.8):	(-)	00.4'

Dec:		S 13º 46.0'
Lat:		N 17º 22.0'

Sext alt:		32º 11.0'
IE (off):	(+)	02.3'

Obs alt:		32º 13.3'
Dip (12m):	(-)	06.1'

App alt:		32º 07.2'
Tot corn UL:	(-)	17.3'

T alt:		31º 49.9'
TZD:		58º 10.1'

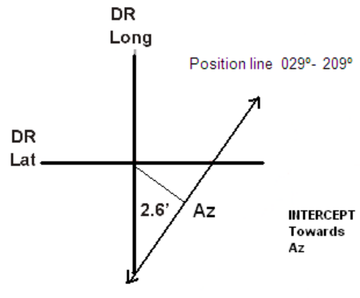
GHA Sun: 244º 21.5'
Long (E): +065º 48.0'

LHA Sun: 310º 09.5'

Cos CZD = (Cos P. Cos lat. Cos dec)- (Sin lat. Sin dec)
If lat and dec are same name (+), opposite name (-)
If LHA lies between 0 and 180, P= LHA
If LHA lies between 180 and 360, P= 360- LHA
P= 360- 310º 09.5'
P= 49º 50.5'
Cos CZD= (Cos 49º 50.5' X Cos 17º 22') X (Cos 13º 46' - Sin 17º 22' X Sin 13º 46')
Cos CZD= 0.5267919
CZD= 58º 12.7'

TZD= 58º 10.1'
Intercept: 2.6' TOWARDS
A: 0.26 S
B: 0.32 S

C: 0.58 S
Az: S61ºE
Az: 119º



Rough sketch- Not necessarily to scale

Voyage Planning and Navigation

Example (Mercator sailing)
Find the course and distance from 04°10'S 040°50'E to 18°50'N 072°30'E.

Lat.	04°10'S	Long.	040°50'E	MP	0248.52
Lat.	18°50'N	Long.	072°30'E	MP	1143.36
d'lat	23°00'N	d'long	31°40'E	DMP	1391.88

Therefore, d'lat =1380'   d'long = 1900'

D'long / DMP = tan co. = 1900 / 1391.88 = 1.36506
Course = N53°46.5'E

Distance = d'lat x sec co. = 1380 x sec 53°46.5' = 2335.17 miles.

Course and distance between the above two positions:

Course: N53°46.5'E
Distance: 2335.17 miles

Hence course = **054° T** and distance = **2335.2 miles**

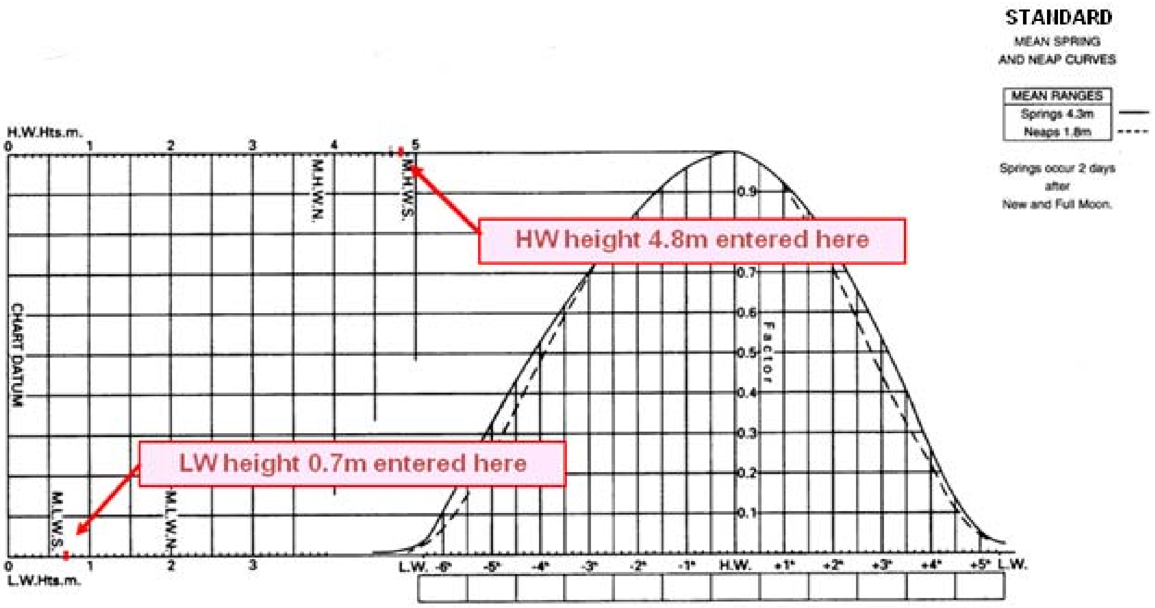
Tides

Sample calculation: (Standard ports)

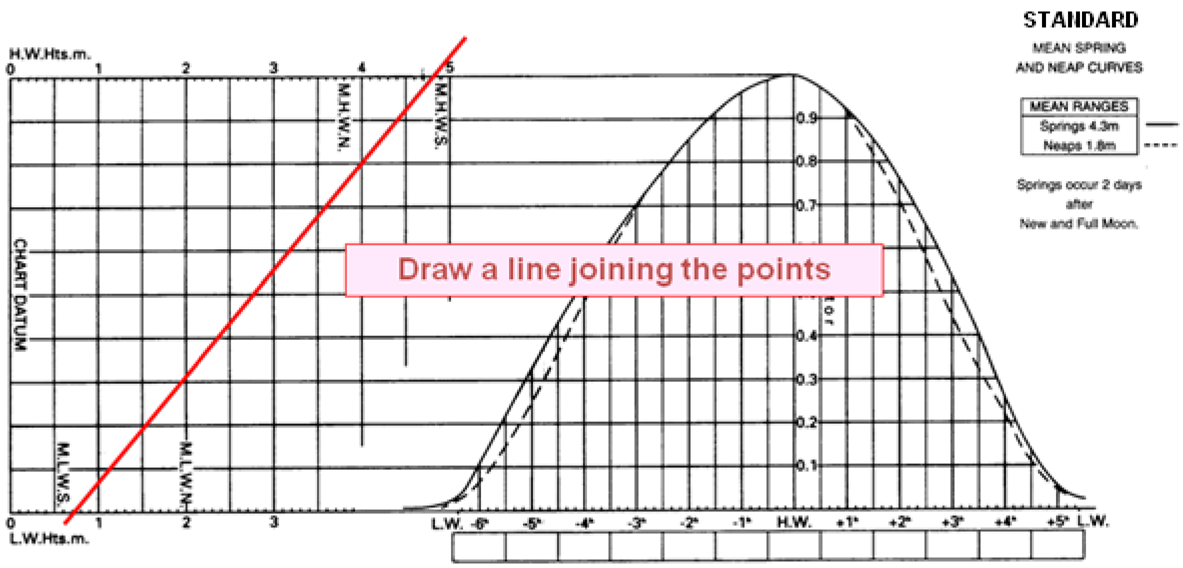
Find the height of tide at Standard port at 1415 hours on 10th January (The data used in the example is for the sake of calculation only)

Extract from ATT: Heights: HW: 4.8 m, LW: 0.7 m, Time of HW- 1815 hours

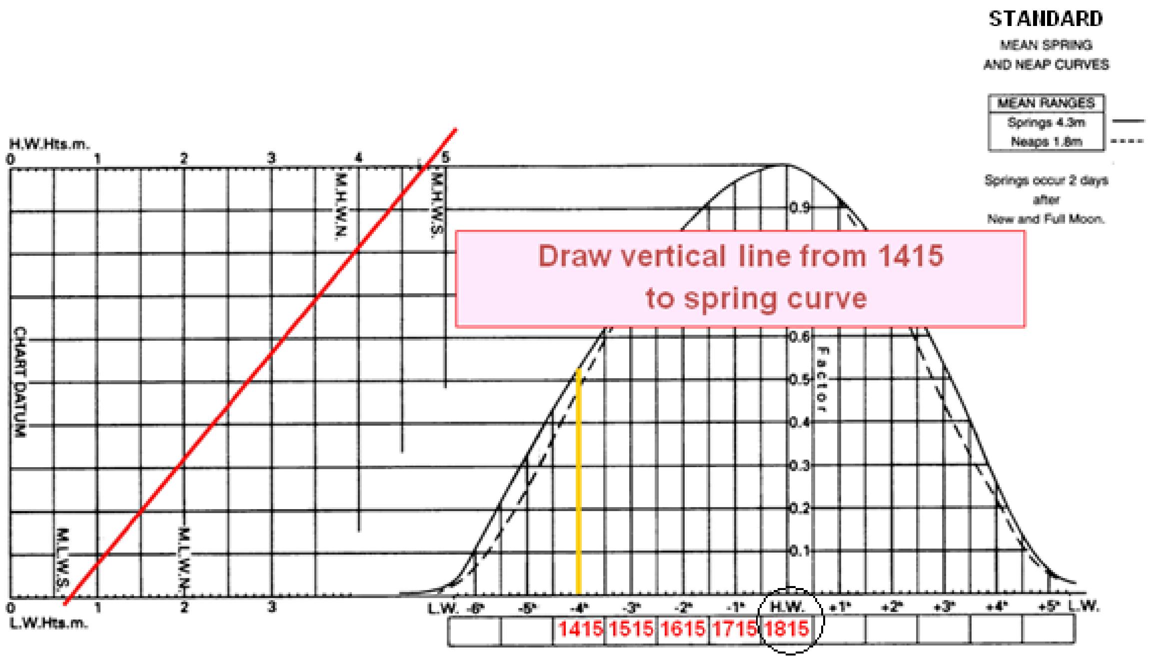
Step 1- On standard curve diagram, plot heights of HW and LW, occurring either side of required time.



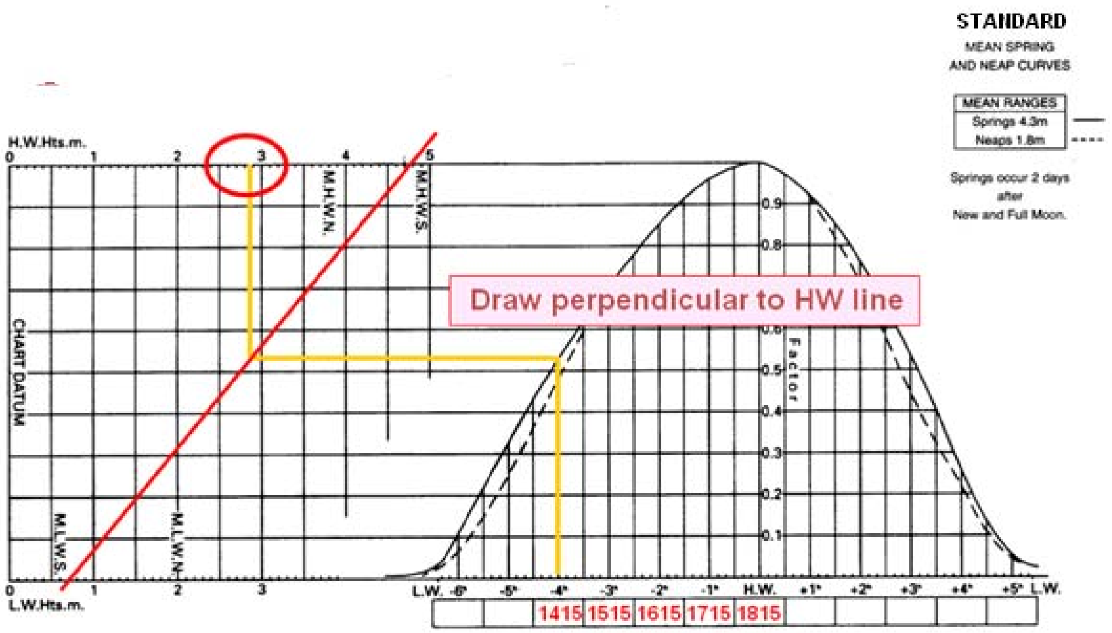
Step 2- Join these heights by a sloping line.



Step 3- Enter HW time and other timings to embrace required time. From the required time, draw vertical line to the curves.



Step 4- Proceed horizontally to sloping line, thence vertically to height scale to read the required heght.



Height of tide at 1415 hours: 2.9 meters

Find the times and heights of high and low waters at "Secondary Port" on 10th April, using the following extracts from ATT. (The data used in the example is for the sake of calculation only)								
	Mean Time Differences		Mean Spring, Neap and Sea Level Heights (metres)					Range Ratio
Port	HW	LW	MHWS	MHWN	MLWN	MLWS	MSL	
STANDARD PORT	hhmm	hhmm	3.1	2.7	0.7	0.5	1.6	
SECONDARY PORT	-0020	+ 0030	2.2	2.0	0.5	0.3	1.2	0.6

EXTRACT FROM STANDARD PORT		
	APRIL	
	Time	m
10 MON	0315	0.3
	0940	3.2
	1545	0.5
	2206	3.0

Standard Port	(1) Times		(2) Heights		(3) MSL	
	HW	LW	HW	LW		
	0940	0315	3.2	0.3	1.6	
	2206	1545	3.0	0.5		
(4) Predicted Height - MSL			1.6	-1.3		
(2) - (3)			1.4	-1.1		
Secondary Port Data	(5) Time Differences				(6) MSL	(7)Range ratio
	HW	LW				
	-0020	+0030			1.2	0.6
(8) Calculations			1.0	-0.7		
(4) x (7)			0.8	-0.7		
Secondary Port Results	(9) Times		(10) Heights			
	(1) + (5)		(6) + (8)			
	HW	LW	HW	LW		
	0920	0345	2.2	0.5		
	2146	1615	2.0	0.5		

CALCULATED SECONDARY PORT		
	APRIL	
	Time	m
10 MON	0345 0920 1615 2146	0.5 2.2 0.5 2.0

■ Guidance notes:

1. Obtain values of predicted heights and times of high and low waters of the Standard Port.
2. Enter these values in box 1 (Times) and box 2 (Heights).
3. From the Secondary Port data provided, obtain the MSL value for the Standard Port and enter it in box 3 (MSL).
4. Subtract the MSL value for the Standard Port in box 3 from the heights in box 2 and enter results in box 4.
5. Obtain data for the Secondary Port and enter time differences in box 5, MSL in box 6, and range ratio in box 7.
6. Multiply the figures in box 4 by the range ratio in box 7, and enter the result obtained in box 8.
7. Add the time differences for the Secondary Port algebraically in box 5 to the predicted times for the Standard Port in box 1 and enter the results in box 9.
8. These are the high and low water times for the Secondary Port.
9. Add the values in box 8 algebraically to the MSL value for the Secondary Port in box 6 and enter the results in box 10.

These are the heights of high and low water for the Secondary Port.

In case a specific time or height is required then after this step, the values obtained of high and low water (Times and Heights) go to the standard port tidal curve. The calculation is exactly as a standard port calculation.

Note:-

Seasonal corrections are not considered in this example. If applicable, they will have to apply for both standard port and secondary ports.

ANNEX 1

Sample Lesson Plan

Lesson Plan

Course : Meteorology for Mariners		**Lecturer's Name :** XXXX	
Topic: Surface water circulation of the ocean and principle adjoining seas. Required performance 1.8.3.1 of Model Course 7.01-Function 1		**Date :**	
Week No. / Session No :		**No of students :** 24	
Duration : 3 hours		**IMO references : A1, A12, A19, A43, A44, A45, A46, B28, B41**	
Teaching method : Lecture	**Textbooks : T23, T24**		**IMO Reference : R1**

Aim : To comprehend, analysis, synthesis and evaluate oceanographic data and to forecast the conditions that may be encountered during a voyage	
General Learning Objectives : **At the end of the session the students will be able to :** **1.** Construct a chart of surface water circulation of the ocean and principle adjoining seas **2.** Explain the classification of individual currents as warm or cold where appropriate **3.** Explain qualitatively the use of – Predominant, Vector Mean, and Current Rose charts **4.** Synthesize the information obtained from all the data available on board the ship and use it in planning a ocean passage **Recap of the previous session / class / topic :** Tropical revolving storms (TRS) **Link to the next session / class / topic :** Calculation of Tidal Conditions	**Preparation checklist for session resources (References, instructional aids, materials, or tools needed):** 1. Course syllabus 2. Scheme of work 3. Lesson plan 4. Time table 5. Attendance sheet 6. Participant's handout 7. Instructor manual 8. Textbooks / Reference books / charts 9. Power point presentation(s) 10. Loose printouts of all Activity sheet 11. Transparencies and blank paper 12. OHP 13. OHP Markers 14. White board Pens / Blackboard chalks (different colours) 15. Quiz sheets for recapping previous learnt topic 16. Answers for above quiz 17. Internet connection in classroom available **18.** Web links identified

Lesson Plan

Time From - To	Content	Objectives	Lecturer Activity	Student Activity	Resources / References	Assessment
0900 – 0910 (10 minutes)	Attendance and Introduction to the Topic	Identifies the topics that will be covered in this session	Register and Introduce the topic by verbal or powerpoint presentation, List and outline the main topics on the board. Answer to queries raised by students.	Respond to attendance call and listen to the Lecturer. Question if there is any doubt.	Attendance register / Online register	N.A
0910 – 0925 (15 minutes)	Quiz to recall the previously covered topic	Reinforces and recalls previously learnt topic.	If verbal quiz is carried out, questions put forward to random students. Discuss the right answers. Identify weak students or analyse if learning was achieved for previously taught subject for future reference, and conclude. If written quiz is given, distribute the quiz sheets. Once completed, let the students interchange the papers among each other and read the right answers, collect the answer papers for future reference to gauge group and individual learner's knowledge. Discuss the answers with the class. Answer to question raised by students.	Answer questions of the quiz, mark the papers and discuss with lecturer. Note the right answers.	Quiz sheets	Verbal / Written
	Distribute Participant's handout. Ocean Currents, Causes of current, Coriolis effect, characteristic of current,	- relates the general pattern of surface water circulation to the atmospheric pressure distribution - constructs a chart showing	Explain and demonstrate using white board, black board, interactive board, show power point presentation on the content. Answer to question raised by students. Demonstrate, Discuss, Illustrate the diagrams, show the animation, video and summarize. Links given below: **Global wind circulation- Animation** slide 9 of the power point presentation : http://www.meted.ucar.edu/oceans/currents/wind_circ1-5.htm			

Time From - To	Content	Objectives	Lecturer Activity	Student Activity	Resources / References	Assess ment
	and summary	global surface water circulation applicable to the above	**Explanation of coriolis effect – short video** slide 12 of the power point presentation **:** http://www.shorstmeyer.com/msj/geo165/2009/movies/coriolis.mov			
0925 – 0935 (10 minutes)				Collect the handouts. Listen to the Lecturer. Watch the power point presentation with the illustration and animation in it. Note down points if necessary. Discuss.	Participants handouts, Power point presentation, White board, blackboard, coloured pens, Internet connection, web links to animation and video as suggested in the power point presentation (slide 9 for Global wind circulation, slide 12 for short video on explanation of coriolis effect)	Q & A session
0935 – 1015 (40 minutes)	Drift currents or	- defines qualitatively	Explain and demonstrate using white board, black board, interactive board, show power point	Listen to the	Participants handouts,	Q & A session.

Time From - To	**Content**	**Objectives**	**Lecturer Activity**	**Student Activity**	**Resources / References**	**Assess ment**
	wind driven currents, currents of different oceans, Geostrophic current and summary	the effect of geostrophic force on surface currents - discusses the generation of drift currents by prevailing winds - discusses the generation of gradient currents from differences in water temperature and salinity - identifies the principal individual currents by name - analyses the causes of individual currents where explicitly stated in Meteorology for Mariners	presentation on the content. Answer to question raised by students. Illustrate the diagrams of the Activity 1- 6 (the labelled diagrams are in the power point presentation, however it can be illustrated to elucidate the topic for better understanding, by the activity sheets provided, on either transparencies, placing on the OHP and marking the currents by erasable coloured pens, or if Interactive boards are in use then blank activity sheets(black and white or colour) same provided, can be inserted in the power point presentation, and currents can be drawn on them, in front of the class, for the students to understand and copy on to their blank sheets in the handouts. Discuss, show the animation, and summarize. Links given below: **Origin of Geostrophic current- Animation** slide 32 of the power point presentation : http://www.meted.ucar.edu/oceans/currents/geo_current.htm	Lecturer. Watch the power point presentation with the illustration and animation in it. Label and produce the Activities 1 - 6 Note down points if necessary. Discuss	Power point presentation, White board, blackboard, coloured pens, Internet connection, web links to animation as suggested in the power point presentation (slide 32 for Origin of Geostrophic current-Animation)	Produce the Activities 1 - 6
1015 – 1025 (10 minutes)			**Break**			
1025 – 1115	Warm and		Explain and demonstrate using white board, black	Listen to	Participants	Q & A

Time From - To	Content	Objectives	Lecturer Activity	Student Activity	Resources / References	Assess ment
(50 minutes)	Cold currents, Geostrophic current summary, Ekman spiral, Tidal currents, currents caused by off-shore and on-shore winds, Inertial currents, Upwelling, Density driven currents, summarising surface currents, Deep Ocean currents (thermohaline circulation)		board, interactive board, show power point presentation on the content. Answer to question raised by students. Demonstrate, Discuss, Illustrate the diagrams, show the animation, and summarize. Links given below: **EKMAN spiral conceptual - Animation** slide 47 of the power point presentation : http://www.meted.ucar.edu/oceans/currents/ekman_deepwater.htm **Ekman spiral for shallow water - Interactive animation** slide 49 of the power point presentation **:** http://www.meted.ucar.edu/oceans/currents/ekman_shallow.htm **Currents caused by off shore winds- Animation** slide 51 of the power point presentation **:** http://www.meted.ucar.edu/oceans/currents/met_tide1.htm **Currents caused by coast-parallel winds – Animation** slide 51 of the power point presentation **:** http://www.meted.ucar.edu/oceans/currents/met_tide2.htm **Inertial Current- Animation** slide 53 of the power point presentation **:** http://www.meted.ucar.edu/oceans/currents/inertial_currents.htm **Upwelling – Animation** slide 58 of the power point presentation **:** http://www.classzone.com/books/earth_science/terc/content/visualizations/es2405/es2405page01.cfm?ch	the Lecturer. Watch the power point presentation with the illustration and animation in it. Note down points if necessary. Discuss.	handouts, Power point presentation, White board, blackboard, coloured pens, Internet connection, web links to animation as suggested in the power point presentation (slide 47 for Ekman spiral conceptual – Animation, slide 49 for Ekman spiral for shallow water - Interactive animation, slide 51 for Currents caused by off shore winds and coast-parallel winds – Animation, slide 53 for	session

Time From - To	Content	Objectives	Lecturer Activity	Student Activity	Resources / References	Assess ment
			apter_no=visualization or / and http://www.whoi.edu/oceanus/viewVideo.do?fileid=3803&id=3692 **Density current concept – Animation** slide 59 of the power point presentation **:** http://www.meted.ucar.edu/oceans/currents/density_current_concept.htm **Geostrophic flow with density driven currents-Animation** slide 59 of the power point presentation **:** http://www.meted.ucar.edu/oceans/currents/geostrophic_flow.htm **Thermohaline circulation – Animation** slide 62 of the power point presentation **:** http://www.meted.ucar.edu/oceans/currents/global_thermo.htm		Inertial Current-Animation, slide 58 for Upwelling – Animation, slide 59 for Density current concept and Geostrophic flow with density driven currents – Animation, slide 62 for Thermohaline circulation)	
1115 – 1150 (35 minutes)	Chart BA5310: The World – general surface current distribution, current rose, the predominant current and the vector mean current and	describes the form in which surface current data is presented in current atlases and on routeing charts - evaluates qualitatively the use of this data in passage	Explain and demonstrate using white board, black board, interactive board, show power point presentation on the content. Answer to question raised by students. Demonstrate, Discuss, Illustrate the diagrams, show the samples of current rose, the predominant current, the vector mean current and Chart BA5310: The World – general surface current distribution. Summarize.	Listen to the Lecturer. Watch the power point presentation with the illustration and animation in it. Note down points if necessary.	Participants handouts, Power point presentation, White board, blackboard, coloured pens, Chart BA5310, Admiralty Sailing Direction, Routeing chart, vector	Q & A sessions

Time From - To	Content	Objectives	Lecturer Activity	Student Activity	Resources / References	Assess ment
	summary	planning - explains the derivation of the current rose - explains the derivation of the predominant current - shows the meaning of the term constancy when applied to predominant currents - explains the derivation of the vector mean current - compares qualitatively the values of the information given by the current rose, the predominant current and the vector mean current as aids to passage planning		Discuss.	mean current chart,	

Time From - To	Content	Objectives	Lecturer Activity	Student Activity	Resources / References	Assessment
1150 – 1200 (10 minutes)	Recap and review of the session	Summarize all the main points covered in this session	Summarize all the main points covered in this session and discuss knowledge gained by this lecture and conclude.	Listen to the Lecturer. Q & A and discuss.	Participants handouts, Power point presentation, White board, blackboard, coloured pens.	Q & A sessions .

Sample Lesson Plan for **1.8.3.1 Ocean Current Systems** – Function 1 - IMO Model Course 7.01 Master and Chief Mate – Revision 2 (VR 230111)

Additional useful References:

NOAA Ocean Service Education
http://oceanservice.noaa.gov/education/
NOAA's Tides and Currents Web Site
http://tidesandcurrents.noaa.gov
Bowditch -The American Practical Navigator
The Bridge
http://www.vims.edu/bridge
Ocean Motion and Surface Currents
http://oceanmotion.org/
Ocean World
http://oceanworld.tamu.edu

Ocean Surface Currents
http://oceancurrents.rsmas.miami.edu/index.html

Dive and Discover – Deep Ocean Circulation
http://divediscover.whoi.edu/circulation/infomod.html
The National Earth Science Teachers Association – NASA-
www.windows2universe.org

Columbia University - Department of Earth and Environmental Sciences
http://eesc.columbia.edu

RealClimate
http://realclimate.org

***Regional Oceanography: An Introduction* by Tomczak, Matt, and J. Stuart Godfrey.**

Water Encylopedia, science and issues
http://www.waterencyclopedia.com

NASA – Ocean Motion and surface currents
http://oceanmotion.org

The University of Miami Rosenstiel School of Marine and Atmospheric Science (RSMAS), and NOAA's Cooperative Institute for Marine and Atmospheric Sciences (CIMAS)
http://oceancurrents.rsmas.miami.edu

Science News, Technology, Physics, Nanotechnology, Space Science, Earth Science
http://www.physorg.com

Cooperative Institute for Meteorological Satellite Studies
http://cimss.ssec.wisc.edu

McDougal Littell – Classzone On line resources for books
http://www.classzone.com

Kennesaw State University – College of Science and Mathematics
http://science.kennesaw.edu

MetEd – Operated by the COMET program
http://www.meted.ucar.edu

Steve Horstmeyer Chief Meteorologist, WXIX TV, FOX19, Cincinnati, OH, USA
http://www.shorstmeyer.com
The Fundamentals of Physical Geography **(*2nd Edition*) online textbook - Dr. Michael Pidwirny & Scott Jones University of British Columbia Okanagan**
http://www.physicalgeography.net

US National Science Foundation
http://www.nsf.gov/

The Earth Institute, Columbia University
http://www.earth.columbia.edu

NOAA Geophysical Fluid Dynamics Laboratory
http://www.gfdl.noaa.gov

Woods Hole Oceanographic Institution
http://www.whoi.edu/

NOAA- National Oceanographic Data Center (NODC)
http://www.nodc.noaa.gov/

DataStreme Ocean – American Meteorological Society
http://www.ametsoc.org/amsedu/DS-Ocean/home.html

NOAA – Ocean explorer
http://oceanexplorer.noaa.gov/welcome.html

NASA – Science
http://science.nasa.gov/earth-science/oceanography/ocean-earth-system/climate-variability/

NASA – Jet propulsion Laboratory – California Institute of Technology
http://www.jpl.nasa.gov/

The Centers for Ocean Sciences Education Excellence, work supported by the National Science Foundation. COSEE Coastal Trends, University of Maryland Center for Environmental Science, Cambridge, Maryland
http://www1.coseecoastaltrends.net/modules/?CFID=2735871&CFTOKEN=53823351

ANNEX 2

"PARTICIPANTS' HANDOUT"

OCEAN CURRENT SYSTEMS

(MODEL COURSE 7.01
REQUIRED PERFORMANCE – 1.8.3.1)

Table of Contents

SURFACE CURRENTS

The interaction between the ocean's surface and the circulation of the lower atmosphere (that is, surface winds) is the primary cause of the surface currents in the oceans. A current generally refers to the horizontal movement of water.

Ocean currents can be classified based on water depth.

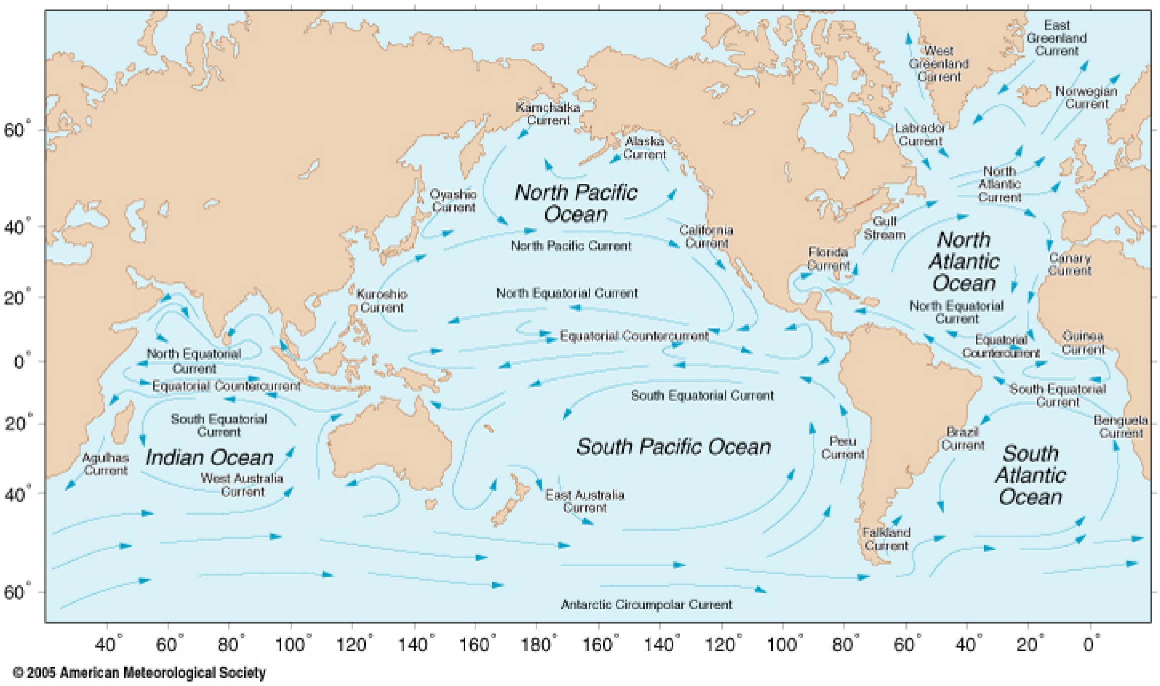
- Open-ocean currents occur in water deeper than 200 m.
- Coastal currents occur in water shallower than 200 m.

In deep water (open-ocean currents):

- Wind drives surface currents.
- Density differences drive deep currents.

In shallow water (coastal currents):

- Tides become important.
- Friction and bathymetry more strongly affect currents.
- Fresh water runoff changes water density.



<u>Picture courtesy: American Meteorological Society</u>

CAUSES OF OCEAN SURFACE CURRENTS

The causes of Ocean surface currents are:

Sun's energy

- Closer to the equator at low latitudes the oceans and atmosphere receive more energy from the Sun and receive less energy near the poles.
- The oceans and atmosphere gets heated by the sun producing winds. Which we have already covered while discussing the causes of winds. When the

winds blow over the oceans, they experience friction due to the ocean surface roughness. This frictional interaction results in transfer of energy to the sea surface and produces waves and currents.

– This Energy from the sun strikes Earth most directly near the equator. The same amount of energy is spread out over a larger area near the poles,

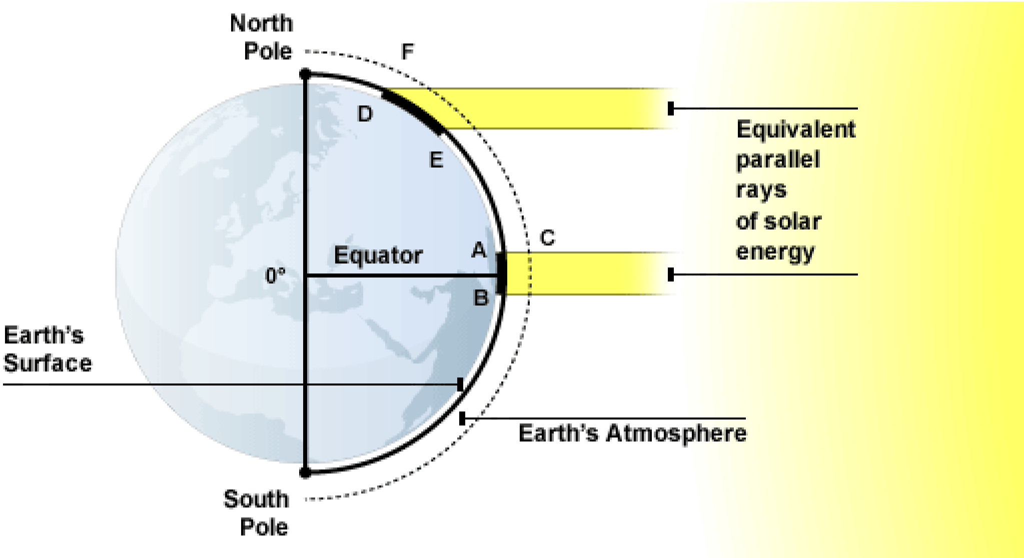


Figure 1:- Sun's energy

Picture courtesy
http://www.bbc.co.uk/scotland/learning/bitesize/higher/geography/physical/quiz/atmosphere/

Earth's rotation

– Due to the rotation of the earth, a virtual force is created which is known as the Coriolis force.
– An object moving on a straight path on the surface of the earth is apparently deflected due to the rotation of the earth because of the Coriolis Effect.
– In the northern hemisphere this forces moving air and water to move towards the right in a clockwise spiral.
– In the southern hemisphere, this forces moving air and water to move towards the left in a counter clockwise spiral.

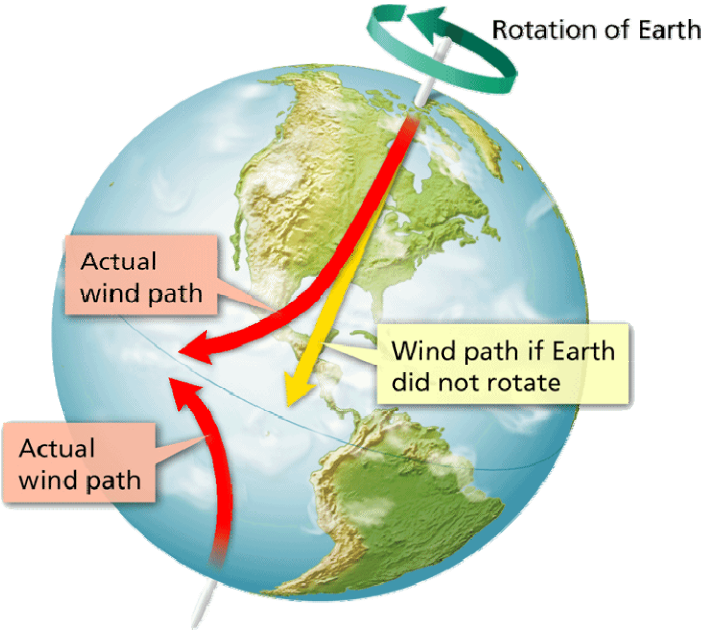


Figure 2 : Coriolis effect on the wind

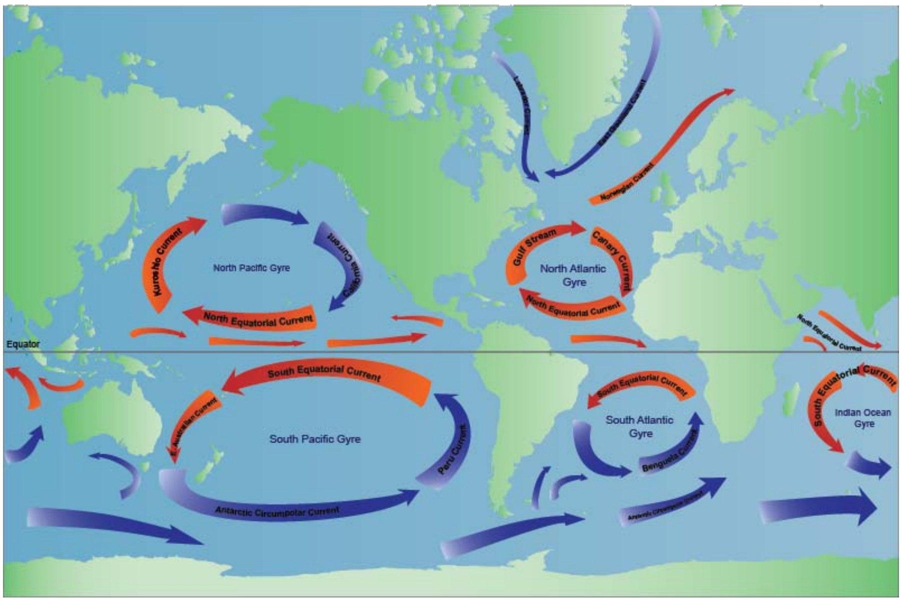


Figure 3: Coriolis effect on the Ocean surface currents

Picture courtesy: The Centers for Ocean Sciences Education Excellence.
COSEE Coastal Trends, University of Maryland Center for Environmental Science
Cambridge, Maryland

CURRENTS DUE TO EARTH'S ROTATION

Northern Hemisphere	Circle clockwise
Southern Hemisphere	Circle counter clockwise
Warm water	Flow away from the equator
Cold water	Flow towards the equator
Western	Have warm water (Gulf Stream)
Eastern	Have cold water (California)

Summarising:

Surface currents in deep water are driven by large-scale wind circulation patterns.

- This wind circulation is driven by global temperature gradients: hot at the equator and cold at the poles.
- In response to these temperature gradients, three convective cells form between the equator and each pole.
- Due to the Coriolis effect, this convective circulation creates trade winds at tropical latitudes and westerlies at mid-latitudes.
- When we combine the trade winds and westerlies over the ocean with the Ekman spiral, which we will learn later on, we develop westward-flowing equatorial currents and eastward-flowing currents at mid latitudes.
  Where continents block equatorial currents, subtropical gyres develop

While subtropical gyres dominate surface currents in the deep ocean, other currents also play an important role in global circulation. These include:

- Subpolar gyres that form in the Greenland and Weddell Seas
- Monsoon currents in the northern Indian Ocean, where the equatorial currents reverse direction during the monsoon
- Undercurrents that underlie many surface currents, but flow in the opposite direction

CHARACTERISTICS OF CURRENTS

Currents are referred to by their "drift" and "set". Usually the currents are strongest near the surface and may attain speeds over five knots. At depths, currents are generally slow with speeds less than 0.5 knots.

We refer to the speed of a current as its "drift." Drift is measured in terms of knots. The current's "set" refers to the direction in which the current is moving (toward). The current off the California coast flows from north-to-south at about 2 knots. So, we can say that, the California Current sets southward at a drift of 2 knots. The strength of a current refers to the speed of the current also. A fast current is considered strong. A current is usually strongest at the surface and decreases in strength (speed) with depth. Most currents are less than or equal to 5 knots.

DRIFT CURRENTS OR WIND DRIVEN CURRENTS

Drift currents are caused by winds blowing continuously across the surface of the sea. Friction between the surface level of the wind and the sea surface drags the water in the same direction as the wind.

The movement of the surface layer of water is initially in the same direction as the wind, but as water moves, the Coriolis force deflects the flow between 30° to 45°to its right in the Northern Hemisphere, and between 30° to 45°to its left in the Southern Hemisphere.

The speed of the drift current is greatest at the surface and diminishes rapidly with depth.

Two important drift currents are the North and South Equatorial Drift Currents travelling to the west near to and parallel to the equator.

The Northeast Trade Winds blow continually from the permanent highs in the North Atlantic, the North Pacific, and the North Indian Oceans (except during the South West Monsoon), carrying the North Equatorial Current in each ocean to the west. It is deflected about 45° to the right of the wind direction, by Coriolis force.

The Southeast Trade Winds blow continually from the permanent highs in the South Atlantic, the South Pacific, and the South Indian Oceans, carrying the South Equatorial Current in each ocean to the west. It is deflected about 45° to the left of the wind direction, also by Coriolis force.

The water that moves is the surface layer. Only the top few metres of the oceans are affected by wind friction, and it is this friction that causes the surface water to move. It is also this layer that is deflected to its right or left, depending on the hemisphere.

The speed of water movement is about 2 percent of the wind speed in high latitudes, and about 4 percent of the wind speed in low latitudes.

Typical drift current speeds are about 1 to 2 knots.

The charts on the next pages show the world's main ocean currents, as well as their directions and names. The direction of currents is the direction that they flow in, which is not the same as the direction given to winds.

Note how the main circulation around the oceans follows the general wind circulation around the permanent high-pressure areas.

Application of the Knowledge for Ship officers

As a senior officer, the names of all major currents should be known, whether they are drift or stream currents, and whether they are warm or cold. It should also be known in which direction the currents are setting.

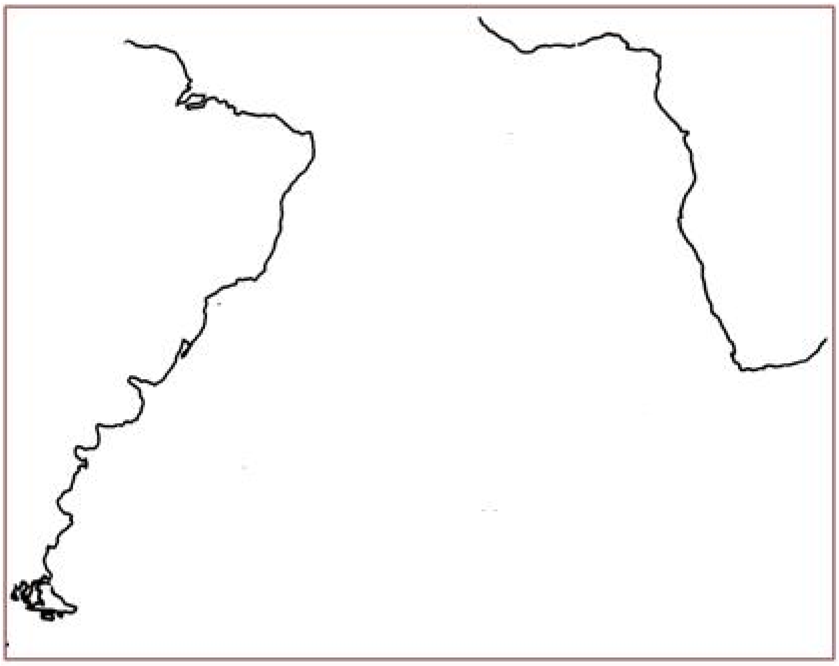
Knowledge of these currents is important for determining fog areas, ice movements, and in weather-routeing the vessel.

CURRENTS OF THE NORTH ATLANTIC OCEAN

Activity 1*:-* Draw and label the currents of the North Atlantic Ocean on the chart provided below as shown by the Lecturer.

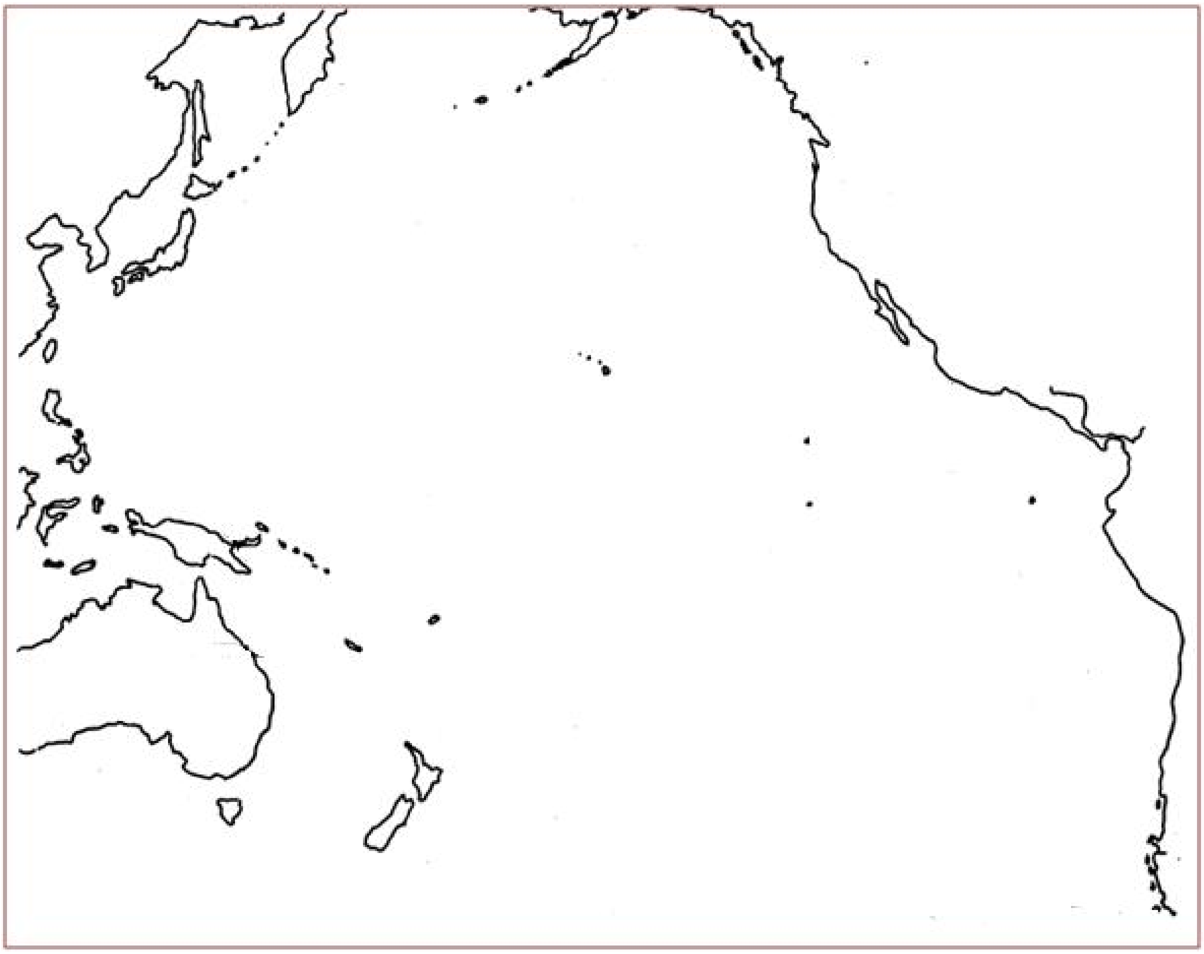
CURRENTS OF THE SOUTH ATLANTIC OCEAN

Activity *2*:- Draw and label the currents of the South Atlantic Ocean on the chart provided below as shown by the Lecturer.



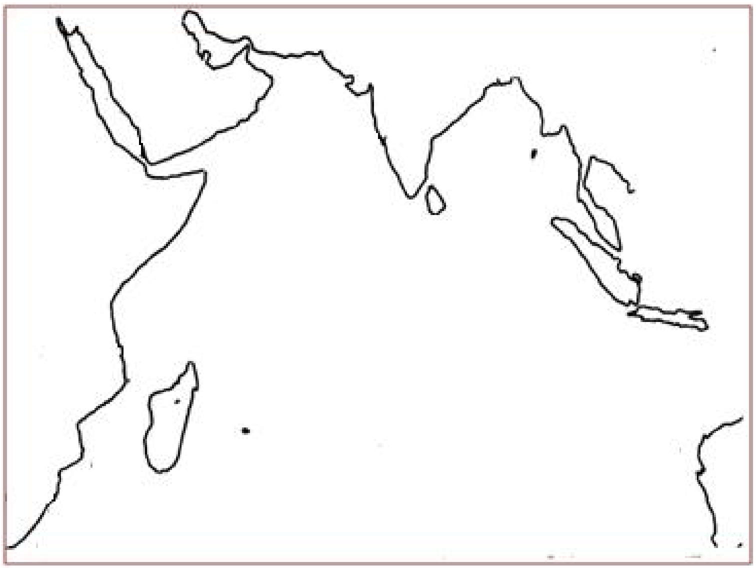
CURRENTS OF THE PACIFIC OCEAN

Activity 3:- Draw and label the currents of the Pacific Ocean on the chart provided below as shown by the Lecturer.



CURRENTS IN THE INDIAN OCEAN

In the North Indian Ocean, including the Bay of Bengal and the Arabian Sea, surface currents are determined by the prevailing monsoon winds, and they reverse direction at the change of the monsoon seasons. The China Sea currents are also affected by this seasonal change in wind direction.



CURRENTS OF THE INDIAN OCEAN DURING THE NE MONSOON

Activity 4:- Draw and label the currents of the Indian Ocean during the NE Monsoon on the chart provided below as shown by the Lecturer.
During the Northeast Monsoon, the currents tend to be mainly anti-clockwise in the Arabian Sea, i.e. they set towards the west.

The North Equatorial Current reappears, because of the change of the prevailing winds. This means that there is a large body of surface water being driven towards Africa, and as a result the Equatorial Counter Current removes some of the surplus. The remainder flows southwards.

Note also that the strong Somali Current of the South West Monsoon turns southwards in the North East Monsoon, and has considerably decreased in intensity.

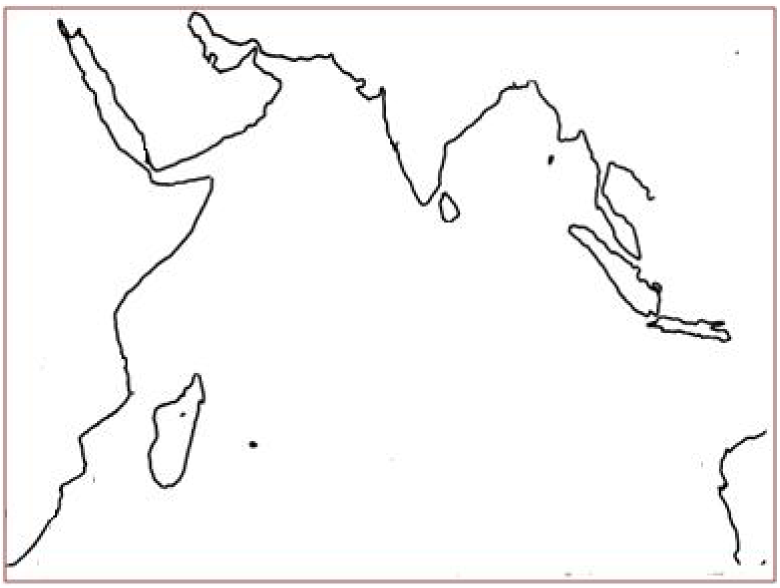
CURRENTS OF THE INDIAN OCEAN DURING THE SW MONSOON

Activity 5:- Draw and label the currents of the Indian Ocean during the SW Monsoon on the chart provided below as shown by the Lecturer.

During the South West Monsoon, the currents set generally in a clockwise direction within the Arabian Sea, i.e. in a north easterly to easterly direction. The North Equatorial Current disappears beneath the general easterly flow of water, called the South West Monsoon Current. This current is essentially a drift current, caused by the southern hemisphere southeast trade winds being deflected to their right by Coriolis force and blowing from the southwest as they are drawn across the equator.
The Somali Current sets up the East Coast of Africa, north of the equator during this Monsoon. It reaches speeds of up to seven knots in the vicinity of Socotra Island, making it the strongest known in the world.
Mariners need to proceed with caution in this region, as the current has been known to set vessels onto the unlit shores of the island.

NORTH ATLANTIC AND NORTH PACIFIC WEST WIND DRIFT CURRENTS

These drift currents set eastward across their respective oceans, blown by the prevailing Southwest winds. They are warm currents taking the warm waters of the Gulf Stream and the Kuro Shio Currents and transporting them to the eastern side of the Atlantic and Pacific Oceans.



SOUTHERN OCEAN WEST WIND DRIFT CURRENT

The Roaring Forties create the West Wind Drift Current of the Southern Oceans. This current sets to the east.

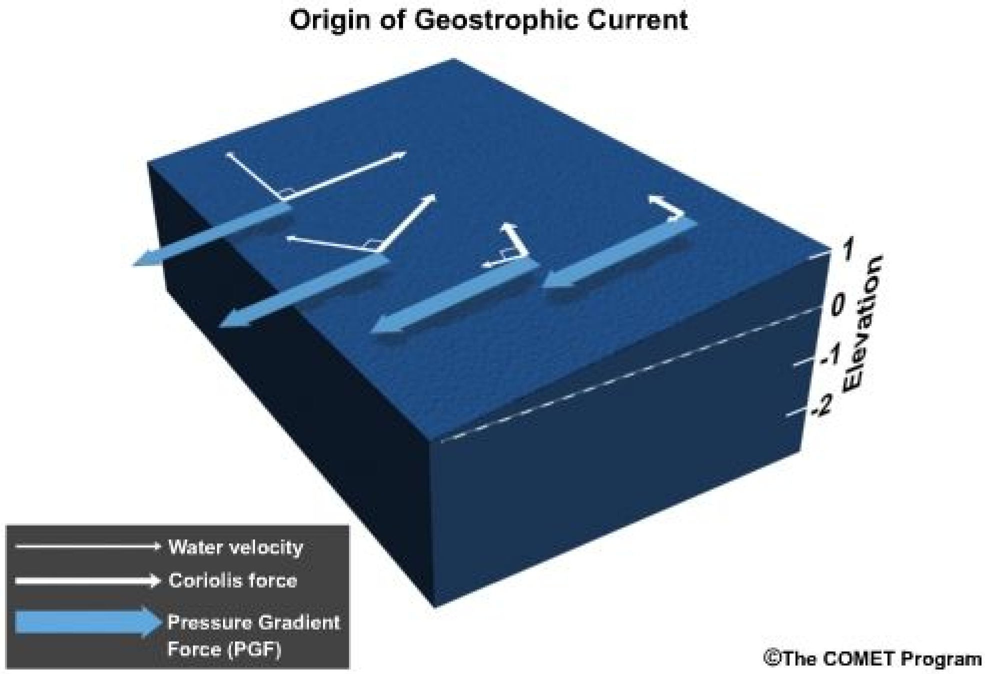
DRIFT CURRENT SUMMARY

– Drift currents are wind – generated.
– They tend to be affected by Coriolis Force, deflection is between 30° to 45° to their left or right, depending on the hemisphere.
– They tend to follow the patterns of the permanent High Pressure areas.
– They are surface currents, and their speed is a percentage of the wind speed that drives them.
– In high latitudes, current speed is about 2% of the wind speed.
– In low latitudes, current speed is about 4% of the wind speed.
– Typical drift current speeds are between 1 to 2 knots.
– Monsoon current circulation is mainly caused by the wind, so is an example of drift currents.
– North and South Equatorial currents are drift currents

GEOSTROPHIC OR GRADIENT OR STREAM CURRENTS

A persistent slope in sea surface leads to what we call **Geostrophic currents**. It is a current flowing down a slope on the ocean's surface. Geostrophic current are also known as Gradient currents, because of the slope are also known as "stream" currents, from the concept of water streaming down a slope.

Naturally, water tends to flow down slope from an area of higher elevation to one of lower elevation. However, this flow gets deflected due to the Coriolis force: to the right in the northern hemisphere and to the left in the southern hemisphere. As the current accelerates down slope, it is progressively deflected until it flows parallel to surface elevation contours. At this point the Coriolis force balances the pressure gradient force. When this occurs, we have achieved **geostrophic balance**.



Picture Courtesy :- Cooperative Program for Operational Meteorology, Education and Training (COMET®)- University Corporation for Atmospheric Research (UCAR) and the National Weather Service (NWS)

The slope may be caused by:

- A difference in water level caused by water pile-up as a result of it being carried there by drift currents. The current flows from the higher level to the lower level.

- A difference in water temperature. The warm water expands and is higher than the cold water. The current flows down the slope from warm water to cold water.

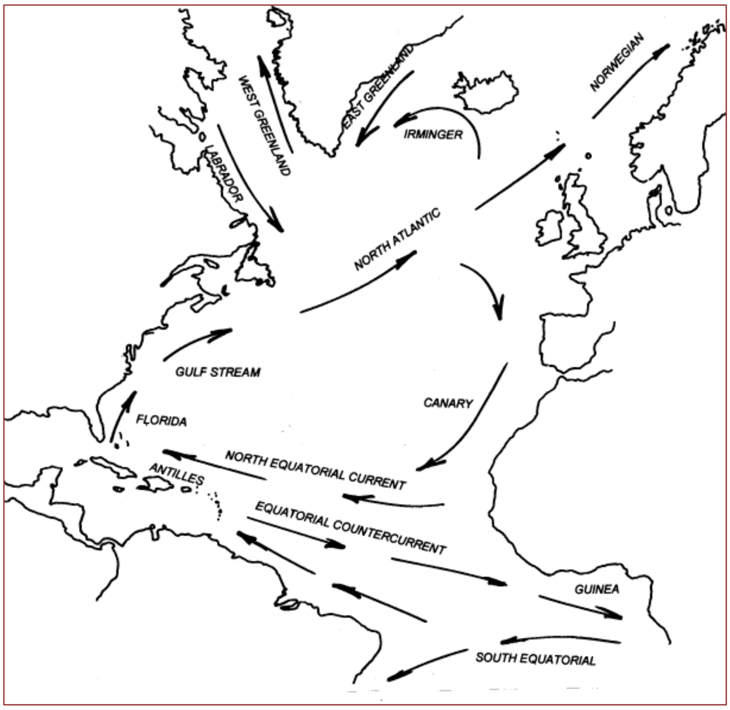
- A difference in water density. The lower density water rises higher than the higher density water and so the current flows down the slope from lower density to higher density water.

The flow of the current down the slope flow will be deflected by Coriolis force. The amount by which deflection will take place depends on the strength of the Coriolis force.

Gradient currents generally are faster than drift currents. Speeds are usually about 2 to 3 knots, but some currents are stronger. Gradient currents are generally deeper currents than drift currents, and the whole body of water tends to move, rather than just the upper layers.

EXAMPLES OF GRADIENT CURRENTS

The Gulf Stream

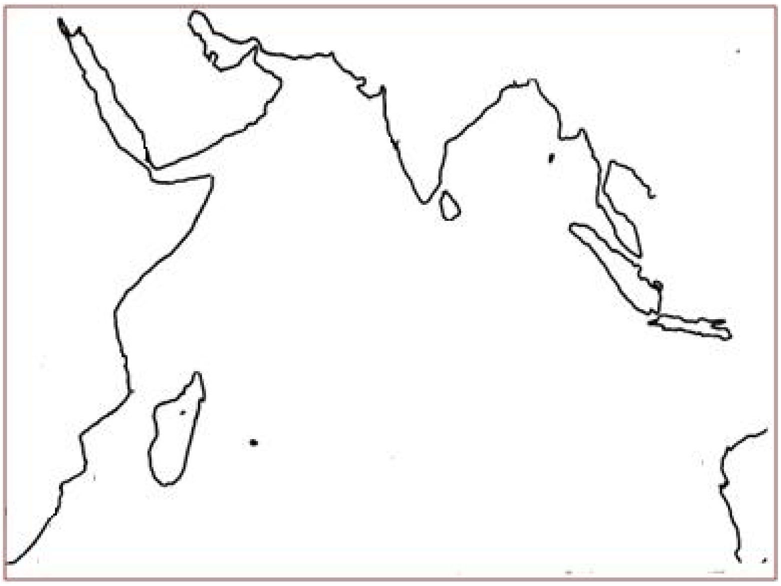


The North and South Equatorial currents in the Atlantic Ocean both push water into the Gulf of Mexico, heaping up the water in the Caribbean Sea before it streams out from the Gulf.

This water escapes north of Cuba into the North Atlantic Ocean past Florida Cape (where it is known as the Florida current) before becoming the Gulf Stream. This current transfer much heat from the equatorial regions to the northern hemisphere.

This body of water is affected by the Atlantic High and the Icelandic Low, so is really a combination of both Gradient and Drift currents, but is considered to be largely a gradient current. The slope of the water surface in the Gulf of Mexico rises towards the west.

THE EQUATORIAL COUNTER CURRENTS



Activity 6:- Draw and label the Equatorial Counter Currents on the chart provided below as shown by the Lecturer.

In the Atlantic, Pacific and Indian Oceans, the North and South Equatorial Currents push the surface water towards the west causing an increase in the water level on the western sides of these oceans.

This can be seen in the diagram below, where the water is pushed to the African coast by the north and south equatorial currents.

This water escapes from the higher level as a gradient current, flowing "downhill", away to the north and south. A large proportion flows back along the equator.

This easterly flow is known as the Equatorial Counter Current, and is common to all the oceans.

The counter currents are a result of both a difference in water level and also water temperature. At the equator, the water to the western sides of the oceans is warmer than the water to the eastern sides of the oceans.

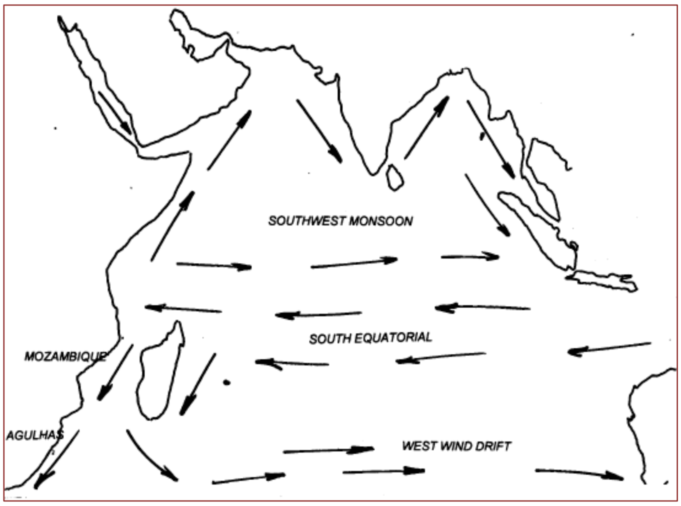
The counter currents are stronger than the equatorial currents that cause them.

The reason that the currents remain in the equatorial region is quite simple: as the water flows back towards the east, Coriolis force prevents it from flowing away from the equator: if the flow moves north of the equator, Coriolis force will deflect the water to its right, directing it back towards the equator. Conversely , if the water flow moves to the south of the equator, Coriolis force deflects the water to its left, back towards the equator again.

The earth's "thermal" equator lies slightly to the north of the geographical equator. The counter currents flow generally slightly north of the geographical equator, near the thermal equator. The axis of the counter currents generally coincides with the location of the ITCZ.

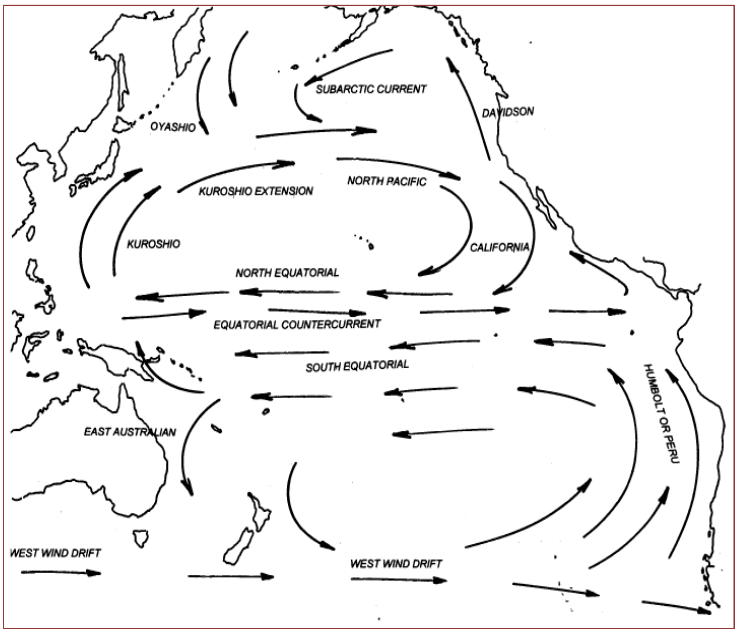
EAST AFRICAN CURRENT AND SOMALI CURRENTS, MOZAMBIQUE AND AGULHAS CURRENTS

As explained above, the Indian Ocean Equatorial Currents piles up the water on the east coast of Africa, resulting in a higher level than the surrounding ocean. This water then flows north as the East African Current which in the South West monsoon becomes the strong Somali Current, as shown opposite.
The water also flows south down the African coast to form the Mozambique Current, which in turn becomes the Agulhas Current which flows south westerly down the southern coast.



It is this current which makes the Southern African coastline notorious for abnormal or “freak” waves, caused, it is thought, by the prevailing south westerly winds in winter blowing against this moving body of water at the point of its strongest flow, i.e. the current axis which flows along the continental shelf itself. Mariners are always advised to sail either inside or outside the 200m depth contour for this reason.

THE PERU (HUMBOLDT) CURRENT



The Southern Ocean Drift Current flowing to the east is continually moving water up against the south western shores of Southern South America. There is an increase in water level against the coast of Peru and this water escapes downhill from this area northwards as the Peru Current, joining the general circulation anticlockwise around the South Pacific Ocean. This is a gradient current caused by a difference in water level.

THE KURO SHIO CURRENT

This current is the Pacific's equivalent of the Atlantic's Gulf Stream. The increase in water level to the west of the Pacific Ocean results in water escaping downhill to the north as the Kuro Shio Current. Some of the water from the Pacific Equatorial Currents "escapes" into the Indian Ocean through the islands near Borneo. The Kuro Shio is not as strong as the Gulf Stream.

THE EAST AND WEST GREENLAND CURRENTS

Water in the north of the Atlantic Ocean, in Arctic regions, has a comparatively low salinity due to the large content of melted glacier ice and snow. This lower density water flows southwards towards higher density water in the Atlantic, down the coast of East Greenland as the East Greenland Current.

Coriolis force, acting to the right, keeps this current close to the Greenland Coast, turning the current round Cape Farvel before it flows northwards up the West Greenland Coast as the West Greenland Current.

This current is an example of cold water flowing towards warmer water, seemingly against gravity, however the difference of density effect is larger than the temperature effect.

BAY OF BENGAL CURRENTS

During winter, when the Northeast monsoon is blowing over the Bay of Bengal, the currents flow generally towards the southwest. The colder northeast wind of the monsoon cools the water at the northern end of the Bay of Bengal, so these waters become colder than the water at the southern end.

There is now a temperature gradient between the northern and southern ends of the Bay, and as a result a temperature gradient counter current flows closer inshore from the warm water to the cold, against the normal drift current flow.

MEDITERRANEAN CURRENTS

In the Mediterranean Sea, the major current flow is quite interesting. The Mediterranean, the youngest sea, was only formed about twelve thousand years ago, and is the shallowest sea. It consists of about a million square miles of water, virtually entirely surrounded by land. There is only really one entry and one exit point, namely the Straits of Gibraltar. The Suez Canal is sometimes considered an exit point for water, but it is tiny compared to the strait at Gibraltar.

The landmasses around the Mediterranean have very hot, dry climates with low rainfall, and so evaporation in the Mediterranean is high. The water becomes more saline and denser the further eastward it travels.

The water flows into the Mediterranean at the surface through the Straits of Gibraltar from the Atlantic. It is deflected to its right by Coriolis force, along the African coast, and becomes denser and more saline with increasing The dense water at the eastern end sinks and flows back westward below the surface currents. As the water flows into the Mediterranean, Coriolis force deflects the water to the right. As a result, the water flows around the Mediterranean in an anticlockwise direction, staying close to the coast as it does so.

Vessels may save time by keeping close to the coast of Africa on passage from Gibraltar to Suez. Returning, vessels should keep further off shore.

DRIFT AND STREAM CURRENTS

In general, the North East and South East Trade Winds cause the North and South Equatorial Currents. The Westerly winds of the temperate latitudes cause the West Wind Drift Currents of the North Atlantic, North Pacific and the Southern Oceans.
The general distribution of ocean currents is as follows:

- At middle (below 40°N latitude) and low latitudes, warm currents flow towards pole along the eastern coasts of continents and cold currents flow towards the along the western coasts. This is true in both hemispheres.

  In the Northern Hemisphere at high latitudes, cold currents flow towards the equator along the east coasts of continents, and warm currents flow towards pole along the western coasts.

- In monsoonal regions, ocean currents vary with the seasons, and irregular coastlines can cause deviations in the general distribution of ocean currents.

These currents in turn pile up water where they flow against large landmasses. The piling up of water causes the stream currents.

Stream currents formed in this way include warm and cold currents:

WARM AND COLD CURRENTS

Warm currents

A warm current brings warm water into cold water and is usually found on the east coast of continents in the low and middle latitudes (true in both hemispheres). In the Northern Hemisphere they are located on the west coasts of continents in high latitudes.
Warm currents are so named because they are relatively warm for their latitude.

Cold currents

A cold current brings cold water into warm water. Cold currents are usually found on the west coast of continents in the low and middle latitudes (true in both hemispheres) and the east coast in the northern latitudes in the Northern Hemisphere.

Cold currents are so named because they are relatively cold for their latitude.

In general, currents which set westwards or eastwards acquire the temperatures appropriate to their latitude and are not known as warm or cold currents.

In general currents flowing towards the equator are cold (relatively cold for their latitude). Currents flowing away from the equator are warm currents.

Equatorial currents are usually classed as warm currents on the western sides of the oceans. The Gulf Stream becomes the North Atlantic Drift Current and is classified as a warm current.

The Southern Ocean Drift Current and the North and South Equatorial Currents are examples of eastward or westward flowing currents.

On the western sides of the oceans, the Equatorial Currents having been in the tropics for some time are much warmer than the same currents on the eastern side. It is this warm water which is important in the development of Tropical Revolving Storms.

Currents which set North or South over large distances transport warm or cold water from higher to lower latitudes, or vice versa. These currents have a significant effect upon the climates of those countries bordering these currents and it is these currents that are known as warm or cold currents.

Where cold currents meet warm currents, severe meteorological conditions may exist.

Where the warm Gulf Stream meets the colder Labrador Current, on the Grand Banks of Newfoundland, advection fog is common. Icebergs carried southwards by the Labrador Current are also found in this area, increasing the hazard to shipping. The warmer Gulf Stream eventually melts the icebergs.

There is a sharp demarcation between these two currents in this area, known as the "Cold Wall". Here sea temperatures can change 12°C within less than a ship's length. The boundary is often seen as a change in water colour; the Gulf Stream water being dark blue, and the Labrador Current water being green.

WARM CURRENTS

- Flow away from the equator
- Flow along the west side of an ocean
- Gulf Stream, Kuroshio Current, Mozambique and Agulhas, Brazil Current, East Australia Current

COLD CURRENTS

- Flow on the east shore towards the equator
  - Canary
  - California
  - Benguela
  - West Australian
  - Peru (Humboldt)

- Flow out of the far north
  - Labrador
  - Greenland
  - Kamchatka (Oyashio)

COUNTER CURRENTS

- Current flowing opposite to the wind
- North & South Equatorial Currents flow west
- Equatorial Countercurrents flow east in between along the surface
- Cromwell Current (210 m thick, 400 km wide, 5000 km long) flows east 30 m under the South Equatorial Current

GEOSTROPHIC OR GRADIENT CURRENT SUMMARY

– Also known as stream or slope currents.

– Gradient currents are caused by a difference in water:
  - o Level
  - o Temperature
  - o density

– They tend to be affected by Coriolis Force, deflection is between 30° to 45° to their left or right, depending on the hemisphere.

- They tend to flow from:
  - o Higher level to lower level water
  - o Warmer level to colder level water
  - o Lower density level to higher density level water
- They are much deeper than drift currents.
- They are faster currents, usually 2 to 3 knots.
- Equatorial Counter Currents are typical examples of gradient currents.
- Kuro Shio and the Gulf Stream are examples of predominantly

EFFECTS THAT OCEAN CURRENTS HAVE ON WEATHER

Generally, the following statements may be made concerning the effect's ocean currents have on weather:

- West coasts of continents in Tropical and subtropical latitudes (except close to the Equator) are bordered by cool waters. Their average temperatures are relatively low with small diurnal and annual ranges. There is fog, but generally the areas (southern California, Morocco, etc.) are dry.
- West coasts of continents in middle and higher latitudes are bordered by warm waters that cause a distinct marine climate. They are characterized by cool summers and relatively mild winters with a small annual range of temperatures (upper west coasts of the United States and Europe).
- Warm currents parallel east coasts in Tropical and subtropical latitudes. This results in warm and rainy climates. These areas lie in the western margins of the subtropical anticyclones and are relatively unstable (Florida, the Philippines, Southeast Asia).
- East coasts in the lower middle latitudes (leeward side) have adjacent warm waters that produce a modified continental-type climate. The winters are fairly cold, and the summers are warm or hot.
- East coasts in the higher middle latitudes have adjacent cool ocean currents, with subsequent cool summers.

Indirectly, ocean currents also influence the location of the primary frontal zones and the tracks of cyclonic storms.

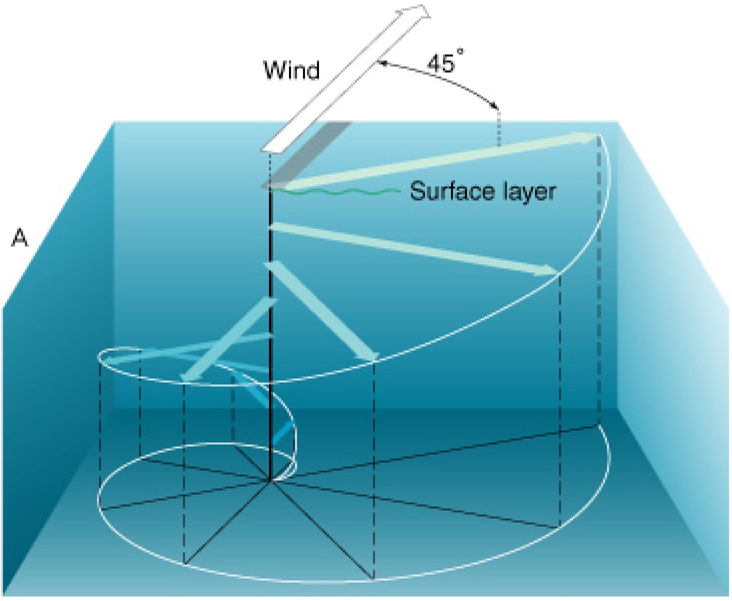
Two of the main hurricane tracks in the Atlantic appear to be associated with warm waters. One follows the warm waters through the Caribbean, and the other follows the waters off the northern and eastern coasts of Florida and the Greater Antilles. Extratropical cyclones of fall and winter also appear to be attracted to warm waters.

EKMAN SPIRAL

When wind blows across water, friction between the wind and water transfers a small amount of the wind's energy to the water, starting the water in motion. With time and persistent winds, a surface current develops.

However, the current that develops does not move parallel to the wind direction. Rather, it moves at a direction that is 20° to 60° from the wind direction, to the right in the northern hemisphere and to the left in the southern hemisphere.

The Arctic explorer and oceanographer Fridtjof Nansen first described this phenomenon. Nansen was interested in ocean currents in polar seas. In 1893, he allowed his 39-m (128-ft) wooden ship, the *Fram,* to freeze into Arctic pack ice about 1100 km (680 mi) south of the North Pole. His goal was to drift with the ice and cross the North Pole thereby determining how ocean currents affect the movement of pack ice. The *Fram* remained locked in pack ice for 35 months but only came within 394 km (244 mi) of the North Pole. As the *Fram* slowly drifted with the ice, Nansen noticed that the direction of ice and ship movement was consistently 20 to 40 degrees to the right of the prevailing wind direction.He observed that icebergs consistently moved at an angle to the right of the wind direction. He gave the problem to his student, Vang Walfrid Ekman to solve. The solution is now known as the **Ekman spiral**.



The Ekman spiral describes how the horizontal wind sets surface waters in motion. As represented by horizontal vectors, the speed and direction of water motion change with increasing depth.

Figure 4: EKMAN spiral

Picture courtesy:

NASA – Ocean Motion and surface currents

http://oceanmotion.org
According to the Ekman spiral under ideal circumstances, surface water moves at a 45° angle to the wind direction. The water immediately below the surface doesn't feel the wind. Instead, it feels the water immediately above. So it moves at slight angle to the right of the surface water, but not as fast due to frictional losses. This continues down the water column, each layer moving a little to the right and a little slower than the layer immediately above it. When all the incremental motions are added up, the bulk motion of the affected water column is about 90° from the wind direction.

In the Northern Hemisphere, the Ekman spiral predicts net water movement through a depth of about 100 to 150 m (330 to 500 ft) at 90 degrees to the wind direction (Figure B). That is, if one adds up all the vectors in (Figure A), the resulting flow is at 90 degrees to the *right* of the wind direction.

In the Southern Hemisphere, the net water movement is 90 degrees to the *left* of the wind direction. This net transport of water due to coupling between wind and surface waters is known as **Ekman transport**.

Because the real ocean does not match the idealized conditions of the Ekman spiral, wind-induced water movements often differ appreciably from theoretical predictions. In shallow water, for example, the water depth is insufficient for the full spiral to develop so that the angle between the horizontal wind direction and surface-water movements can be as little as 15 degrees. As the depth of the water increases, the angle also increases and approaches 45 degrees.

When wind drives water toward shore, local sea level rises (set up). Conversely, when wind drives water away from shore, sea level falls (set down). In areas with a relatively small tidal range, this wind-driven current can dominate the tidal current.

INERTIAL CURRENT

When a sustained wind suddenly dies, the wind-forced current has momentum, and continues as an inertial current. This inertial current looks like a series of diminishing loops.

UPWELLING

Upwelling refers to a process that is observed to be common along continental coastlines (Coastal Upwelling) and at the equator (Equatorial Upwelling).

Coastal Upwelling

In coastal environments, winds coming off the land push the surface layers of water away from shore, producing a void at the surface. Cold, nutrient-rich water from underneath the surface layers rushes to the surface along the coast, filling this void.

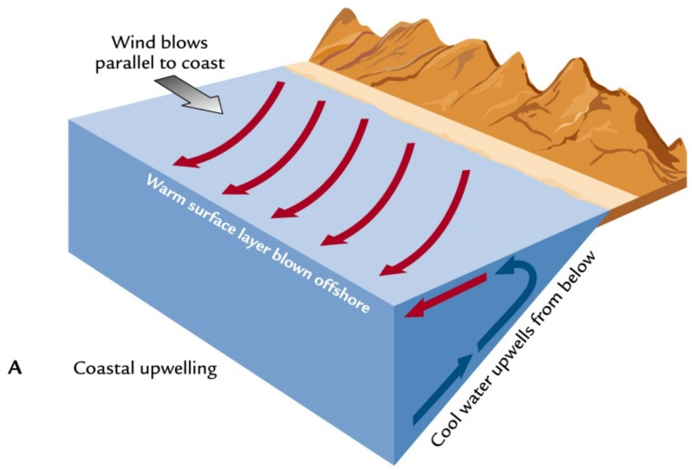


Figure 5 : Coastal upwelling
Picture Courtesy: William F. Ruddimann (2001). *Earth's Climate — Past and Future*. Palgrave Macmillan.

Equatorial upwelling

At the equator, a different process results in upwelling of cold water. In this instance, water currents on either side of the equator are moving in opposite directions because of planetary rotation and the Coriolis effect. This creates an area of low pressure alongside the continents, creating a void for deeper water to rush into and take its place. It brings with it large quantities of micro-organisms like planktons for fish to feed upon.

These regions are important because they are the world's most important fishing grounds, and as they are good fishing grounds areas of upwelling have large concentration of fishing vessel which the senior officer should be aware of, to exercise caution prior navigating in these areas.

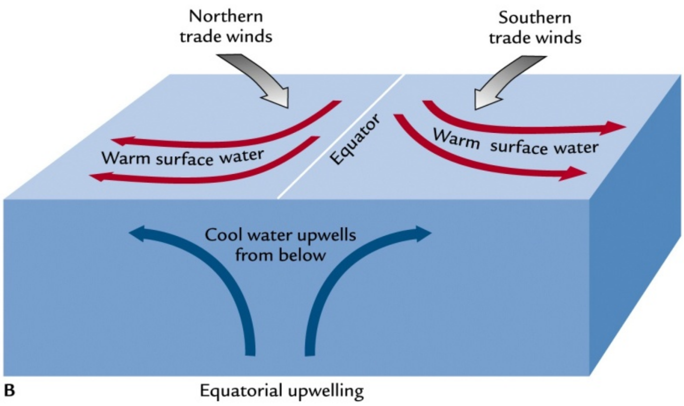


Figure 6 : Equatorial upwelling

Picture Courtesy: William F. Ruddimann (2001). *Earth's Climate — Past and Future*. Palgrave Macmillan.

The areas where the upwelling process can be found are in the waters off the coasts of:

- West Australia
- California
- Peru
- Portugal and
- Namibia

DENSITY-DRIVEN CURRENTS

When water masses with different densities are juxtaposed horizontally, there is a tendency for the low-density water to flow over the high-density water and/or high-density water to flow under low-density water.
Several near shore processes lead to horizontal density differences:

- Freshwater runoff from land
    - Seasonal runoff (weeks)
    - Local, heavy rainfall (hours - days)

- Evaporation in shallow bay
- Upwelling
- Seasonal heating and cooling
- Wind-driven vertical mixing
- Horizontal advection of temperature or salinity

Currents forced by seasonal runoff events or persistent winds will develop a significant geostrophic component.

Summarising:

In response to Ekman transport:

- Surface water moves 45° from the wind direction.
- The depth-averaged motion of the water column is 90° from the wind direction.
- Upwelling occurs along the equator and in coastal areas.

A persistent slope in the sea surface leads to Geostrophic currents. Sea surface slopes arise in 2 ways: density differences and Ekman transport.

1. A column of sea water with a lower average density will have a higher sea surface elevation than a column with a higher average density. Water tends to flow from low density to high density.
2. Ekman transport can result in a sea surface slope, resulting in geostrophic currents.

Surface ocean currents

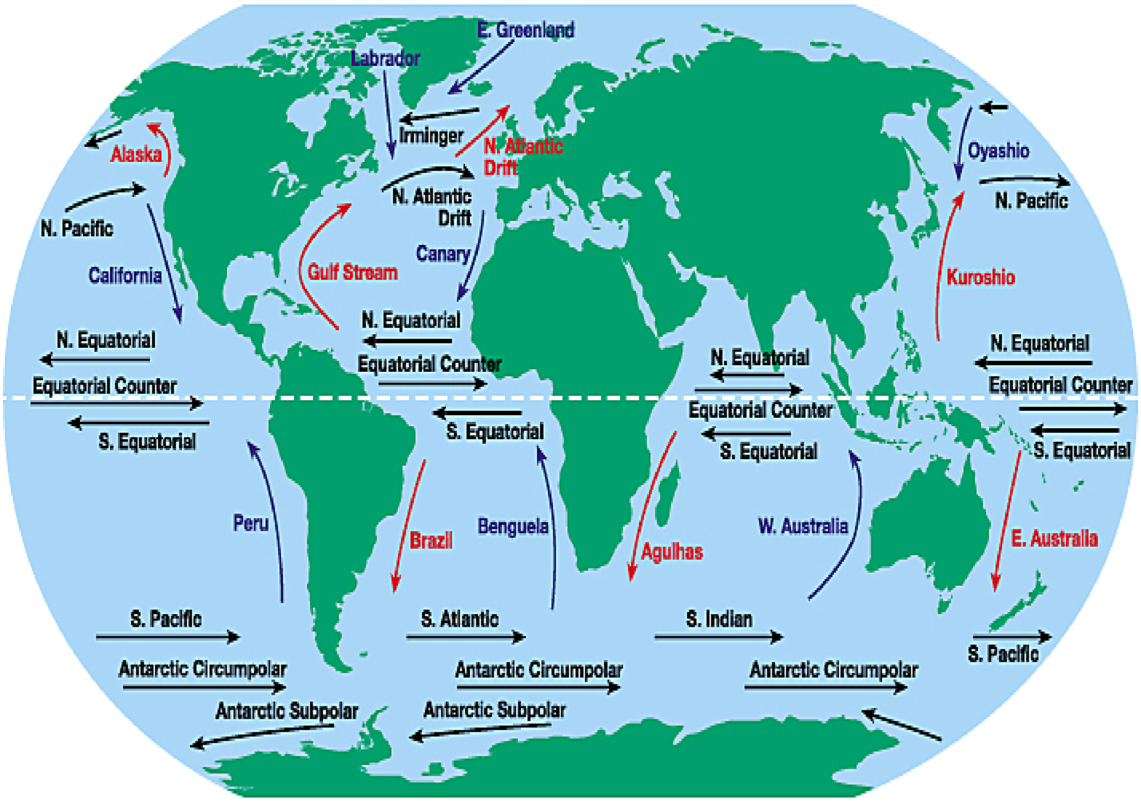


Figure 7 : This illustration shows the circulation of the ocean's surface water. Names of the major ocean currents are noted with warm currents are red and cold currents blue

Picture courtesy: The National Earth Science Teachers Association – NASA- http://www.windows2universe.org/earth/Water/images/Surface_currents_jpg_image.html

DEEP OCEAN CURRENTS

Deep ocean currents (also known as Thermohaline Circulation) are caused by:

- The density of sea water varies globally due to differences in temperature and salinity. Surface water is heated by the sun, and warm water is less dense than cold water. Similarly, fresh water is less dense than salty water. At northern latitudes, surface water is cooled by extremely cold air. This cool water can becomes denser than the underlying water causing it to sink. The sinking and transport of large masses of cool water gives rise to the **thermohaline** circulation, which is driven by density gradients due to variations in temperature and salinity.
- The earth's rotation also influences deep ocean currents

Summarizing:

In general, wind-driven currents dominate the upper ocean, and thermohaline circulation drives the movement of the deep ocean.
Currents below the level of the Ekman spiral are driven primarily by differences in density.

- Density differences arise from cooling at high latitudes and evaporation at low latitudes.
- Most of the deep water in the world's ocean basins originates in the North Atlantic.
- The densest water in ocean basins forms off the coast of Antarctica.
- Downwelling at high latitudes and upwelling in other regions leads to meridional overturning circulation.

SHALLOW WATER CURRENTS

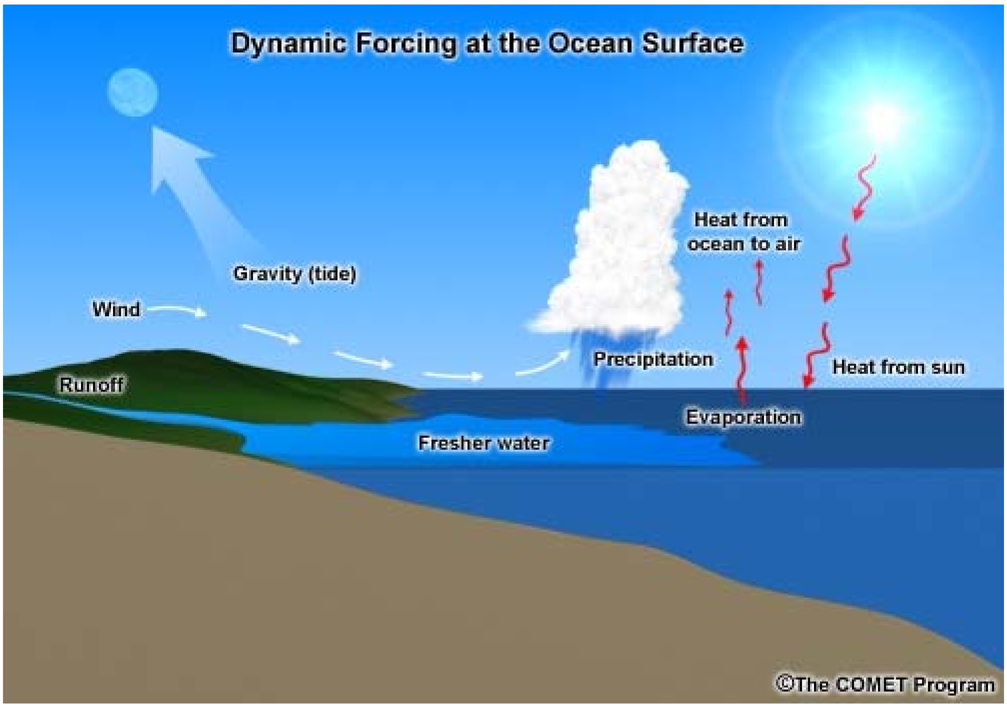


Figure 8: Dynamic forcing at the Ocean surface

Picture Courtesy: - Cooperative Program for Operational Meteorology, Education and Training (COMET®)- University Corporation for Atmospheric Research (UCAR) and the National Weather Service (NWS)

Currents in shallow water differ markedly from those in deep water for several reasons:

1. The water is shallow enough that friction and bathymetry modify surface currents.
2. Tidal influences are stronger and may be the dominant driving force.
3. The proximity to freshwater runoff can create strong horizontal and vertical density differences.
4. Currents are frequently constrained by the coastal boundary or shallow-water bathymetry.
5. Coastal weather patterns differ substantially from those over the open ocean.

Shallow water currents are highly variable across both time and space.

TIDAL CURRENTS

The gravitational attraction of the sun and moon result in horizontal tractive forces. These tractive forces slide water across the surface of the earth resulting in tidal currents.

Greater tidal ranges typically result in higher tidal current velocities.

Far from land, tidal currents tend to describe an ellipse with every tidal cycle. In confined bays and estuaries, tidal currents tend to reverse direction rapidly after a short period of "slack water".

In long open channels, the strongest currents coincide with high and low tide. We refer to this pattern as a progressive wave.

In small, enclosed basins, slack water coincides with high and low tide. We refer to this pattern as a standing wave.

In some rivers near the coast, the current in the channel never reverses, even though water elevations rise and fall.

CURRENT CHARTS

Ocean current information is published in the form of current charts. There are many methods of showing current information, and this section will examine three main methods of current representation available for use by ships' officers.
Chart BA5310: The World – General Surface Current Distribution.

This particular chart shows the general current direction only. It is none of the three main methods of representing current set and rate, but a short discussion is relevant here. The current arrows indicate the more constant direction currents, which may be stronger currents, and the shorter arrows indicate the less constant direction currents, which may be weaker. This chart does not give any indication of the actual direction or strength of any individual current.

The main chart shows the Indian Ocean currents during the South West Monsoon, but to allow for the North East Monsoon, there is an inset which shows the change of during this season.

All other currents which reverse direction seasonally are indicated by pecked lines representing the current flow in January. Normal arrows represent the current direction in July.

Small portion of Chart BA 5310

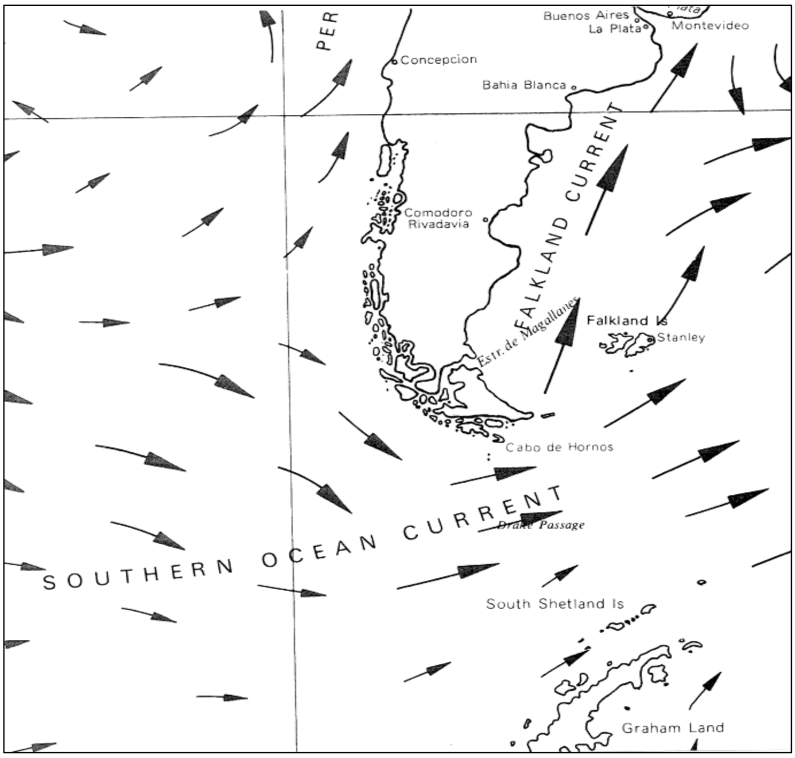


Figure 9: Portion of BA 5310
VECTOR MEAN CURRENTS
Vector Mean Current Chart

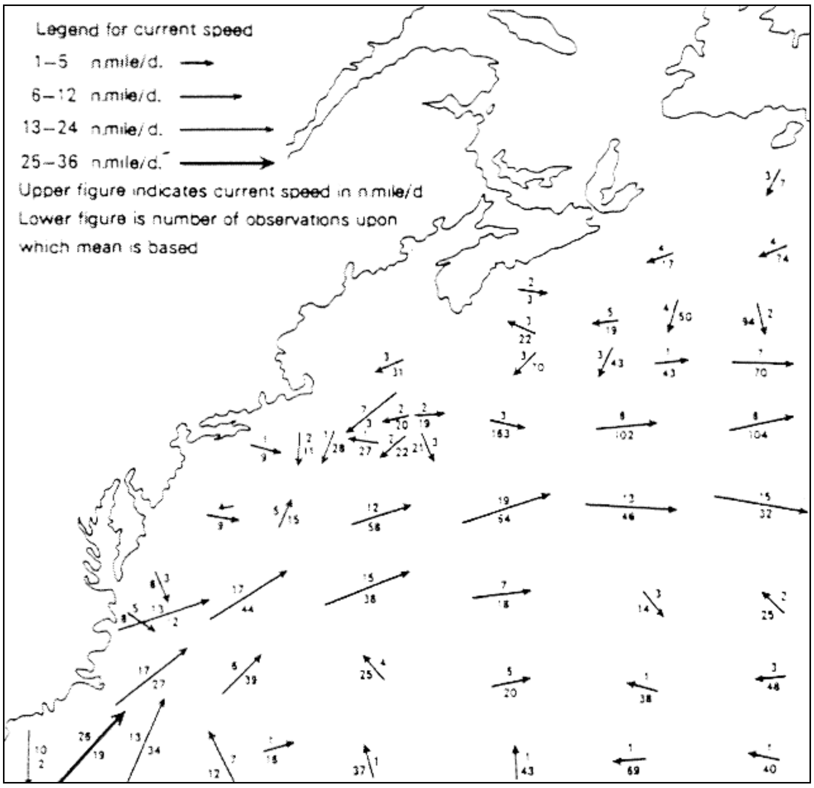


Figure 10: Portion of a Vector Mean Current Chart

A vector mean current is the resultant current of all observations made for any one location. It takes into account both the direction and the speed of the current on every day on which records were taken. It can be regarded as showing the overall movement of the water over a period of time. It is the direction that a floating bottle might drift over a long period of time, and the total distance travelled in that direction divided by the total period of time that observations were taken would be taken as the mean speed.

A vector mean current chart is best used for finding the average drift of drifting objects over a long period of time. It is of limited use in search and rescue operations if knowledge of the actual set and drift is not known.

The vector mean current does not represent the most likely current at any specific time.
A drifting object (e.g. and iceberg) may, for example, drift at 2 knots to the south for one month, and then drift at 2 knots to the north for the next month, essentially finishing up in the same position that it started from. If its drift were plotted according to this method, the resultant vector drift would be zero, and will show as a very small vector on a vector chart, even though the iceberg had actually travelled more than 2,500 miles!

The speed of the current is indicated by the length of the arrows, and this may be indicated above them.

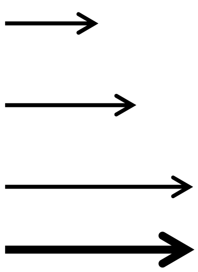
A legend will be on the chart and usually indicates speeds of

1 – 5 miles per day

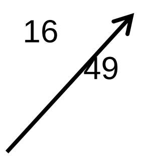
6 – 12 miles per day

13 – 24 miles per day

25 – 36 miles per day



Speeds are also indicated by figures on the arrows. The upper figure indicates current speed in miles per day, and the lower figure is the number of observations upon which the vectors are based.



VECTOR MEAN CURRENT REPRESENTATION SUMMARY

- Current flows in direction of arrow.
- Only the Resultant current of all observations for any one spot is displayed.
- Does not give the true current.
- Shows the overall movement of water over a period.
- Speed is shown by length of arrow, often above arrow.
- Current speed is in Miles per day.
- Number of observations is shown below arrow.

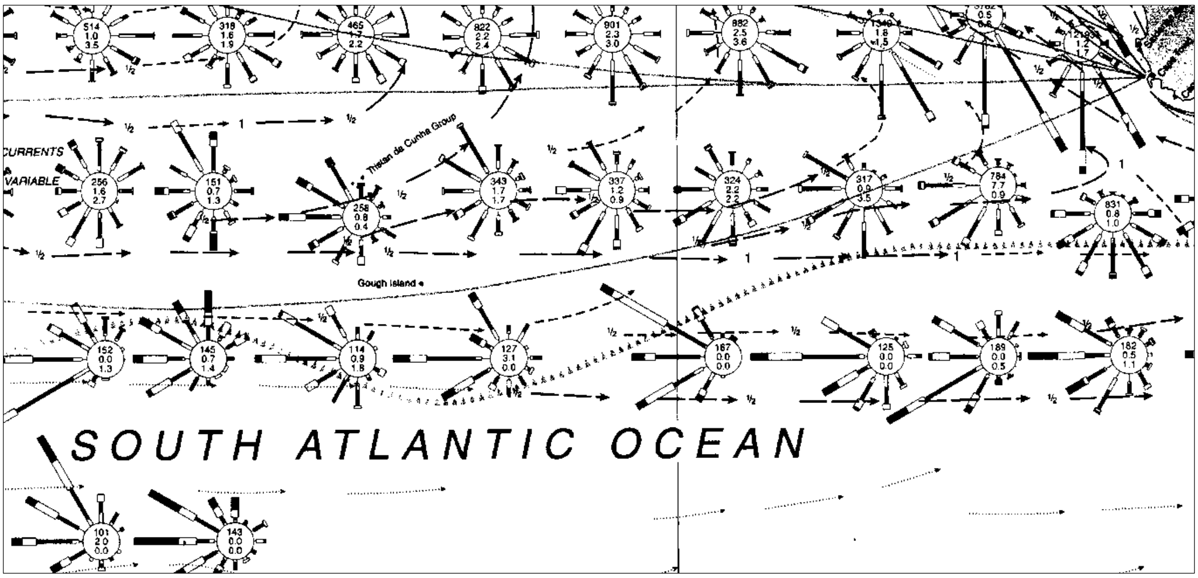
In this diagram, the resultant current is setting 045°T at an average of 16 miles per day in this NE'ly direction, based on 49 observations.

PREDOMINANT CURRENTS

Predominant Surface current charts can be found in Admiralty Sailing Directions and Admiralty Routeing Charts. They are mainly used for passage planning, and indicate an approximation of the most likely or most frequent currents in an area.

Admiralty Routeing Charts

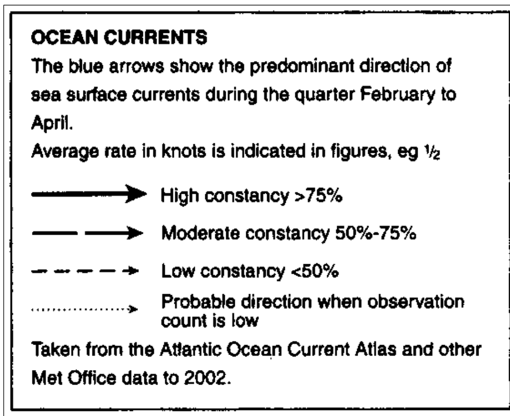
These charts show predominant currents for each month, combined with the preceding month and the following month using green arrows. For example the chart for April shows the predominant currents for the months of March, April and May combined.



A portion of the new format Admiralty Routeing Charts: Note the predominant current arrows

Recently the Admiralty has published the newer format Routeing Charts, which are in full colour and have slightly different symbols, as shown in the diagram opposite:

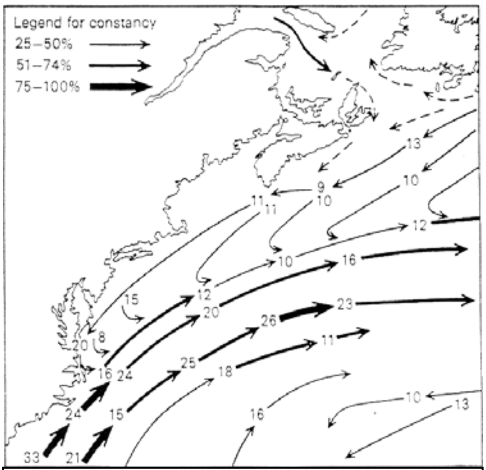
The currents are in blue ink, and are labelled high, moderate, and low constancy.



Key to the newer format Admiralty Routeing Chart symbols for predominant currents

Predominant Current Charts

The currents shown on these charts are the most frequent or most likely currents. The predominant current direction is found by first determining all currents for that location by observing currents within successive 90° sectors, each displaced 15° from the last; and then finding the mid-direction of the 90° sector having the greatest number of observations.



A portion of a Predominant Current Chart

Predominant Direction. The direction of the current arrow on the chart is the mid-direction of the 90° sector containing the greatest number of observations.

Predominant Speed. The speed shown for the current is the arithmetic mean of all the speeds within the 90° sector. This may be shown as knots, or as miles per day.

Constancy. This is the number of observations within the 90° sector divided by the total number of observations expressed as a percentage. It is represented by the thickness of the arrow.

Where constancy is high, there is little difference between a vector mean current and a predominant current.

As constancy decreases, the difference between a vector mean current and a predominant current increases.

A predominant current chart indicates the most likely current to expect on any one occasion.

CURRENT ROSES

Currents are observed for a specific location over a 360° sector. The currents are then plotted, and are arranged into eight or sixteen directions, corresponding to the cardinal points of the compass. As in the case of predominant currents, a scale is used to indicate strength reliability of the currents.

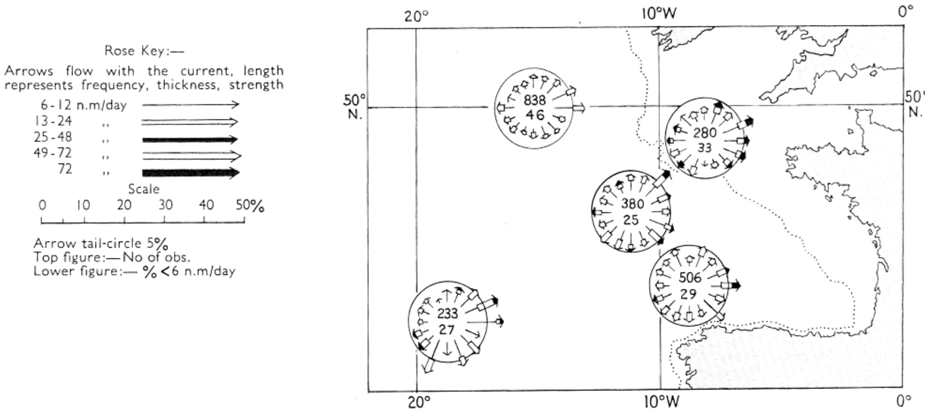
PREDOMINANT CURRENT REPRESENTATION SUMMARY

- Shows frequent or most likely currents
- Use of 90° sectors, each overlapping and displaced by 15°.
- Predominant current is taken as being in the sector containing the most number of observations.
- Predominant direction is the mid-direction of this sector.
- Predominant speed is the arithmetic mean of all the currents in this sector.
- Constancy (measure of highest probability) is found by taking the number of observations in this sector and comparing it to the total number of observations. It is expressed as a percentage.
- Thicker arrows = greater constancy
- High constancy, little difference between Predominant and Vector Mean formats.
- Uses: Routeing, passage planning – with current roses.

As they are arranged by direction, the Mariner can see a breakdown of the currents observed at the time that the chart was made, and so have a greater appreciation of the relative movement of the water observed throughout the period.

It is important to realise that these are not the actual currents experienced; it is a representation of the averages for the different currents realised in eight or sixteen directions. This does result in a more accurate and realistic method of displaying the currents observed, and this format is particularly useful for this reason.

Current roses are found in Admiralty Sailing Directions and on specific charts.



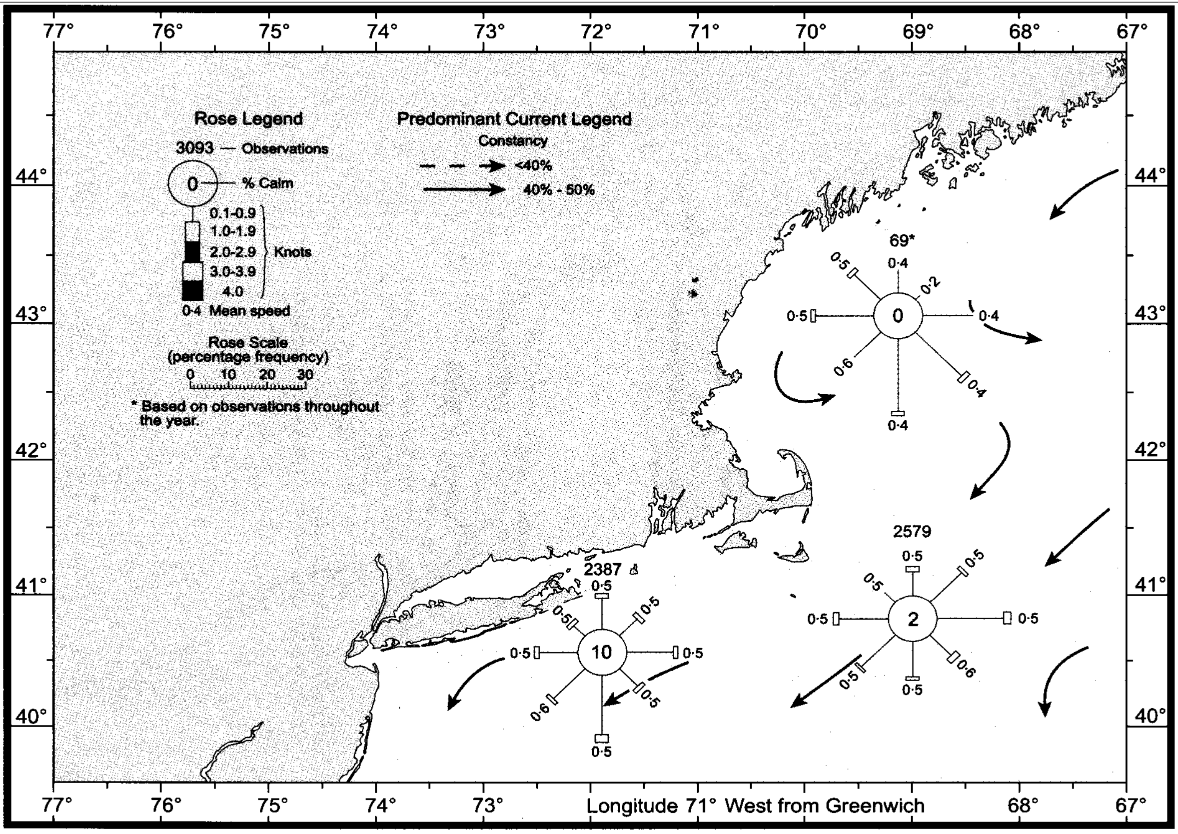
The thickness of the arrows indicate the current rate in nautical miles per day.

The length of the arrow indicates the frequency of the current in a direction according to the scale.

The upper figure in the centre of the rose indicates the number or observations and the lower figure indicates the percentage of currents less than 6 nautical miles per day.

NEW FORMAT CURRENT ROSES

As in the case of the Predominant Current charts, these are also being modernised by the Admiralty in their publications. Today, one finds the current information in both formats, and the diagram below is an example of this:



WINTER

Predominant currents - direction, constancy and variability (1.103)

Example of newer format current representation in the latest Admiralty Sailing Directions

Note the similarities with the older format rose. The chief difference is that the current speeds are quoted in knots, otherwise the rose is largely the same. It must be noted that all the information that the Mariner requires will be included in the diagram, so a close inspection of it is necessary to ensure proper understanding.

There is considerable variation in the information displayed in different volumes of the Admiralty Sailing Directions. Different volumes show slightly different roses, especially with respect to the specific details of interpreting them.

Some roses will have the total number of observations displayed as the upper number within the circle, others as shown in the example above. Some roses will have the percentage of currents less than 0.5 knots expressed as the lower number in the circle, others will have only this number within the circle.

There appears to be no standard at this point, so it is up to the user to ensure that the correct interpretation is obtained.

ANNEX 3

**SAMPLE POWERPOINT PRESENTATION
OCEAN CURRENT SYSTEMS**

Ocean Currents

Sample Power point presentation for **1.8.3.1 Ocean Current Systems** – Function 1 - IMO Model Course 7.01 Master and Chief Mate – Revision 1

(20012011)

Surface Currents

- The interaction between the ocean's surface and the circulation of the lower atmosphere (that is, surface winds) is the primary cause of the surface currents in the oceans.
- A current generally refers to the horizontal movement of water.

Ocean currents

Ocean currents can be classified based on water depth.

- Open-ocean currents occur in water deeper than 200 m.
- Coastal currents occur in water shallower than 200 m.

Open-ocean currents

In deep water (open-ocean currents):

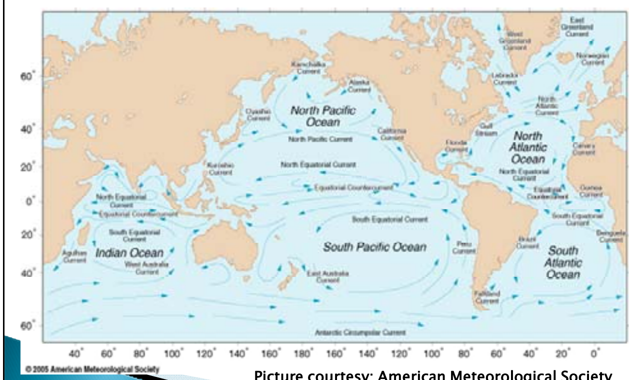
- Wind drives surface currents.
- Density differences drive deep currents.

Coastal currents

In shallow water (coastal currents):

- Tides become important.
- Friction and bathymetry more strongly affect currents.
- Fresh water runoff changes water density.

World Ocean surface currents



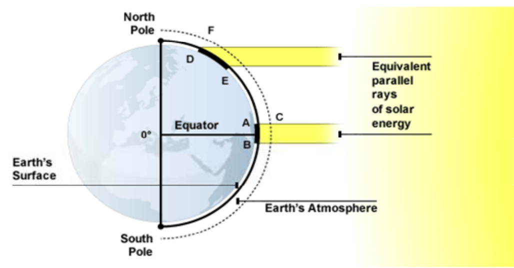
Picture courtesy: American Meteorological Society

Causes for Ocean surface currents

The causes for Ocean surface currents are:
Sun's energy

- Closer to the equator at low latitudes the oceans and atmosphere receive more energy from the Sun and receive less energy near the poles.
- The oceans and atmosphere gets heated by the sun producing winds. When the winds blow over the oceans, they experience friction due to the ocean surface roughness. This frictional interaction results in transfer of energy to the sea surface and produces waves and currents.
- This Energy from the sun strikes Earth most directly near the equator. The same amount of energy is spread out over a larger area near the poles,

Sun's Energy



Picture courtesy
http://www.bbc.co.uk/scotland/learning/bitesize/higher/geography/physical/quiz/atmosphere/

Global wind circulation animation

http://www.meted.ucar.edu/oceans/currents/wind_circ1-5.htm

Courtesy :- Cooperative Program for Operational Meteorology, Education and Training (COMET®)- University Corporation for Atmospheric Research (UCAR) and the National Weather Service (NWS)

Causes for Ocean surface currents

Earth's rotation

- Due to the rotation of the earth, a virtual force is created which is known as the Coriolis force.
- An object moving on a straight path on the surface of the earth is apparently deflected due to the rotation of the earth because of the Coriolis Effect.
- In the northern hemisphere this forces moving air and water to move towards the right in a clockwise spiral.
- In the southern hemisphere, this forces moving air and water to move towards the left in a counter clockwise spiral.

Coriolis effect on the wind

French scientist Gaspard-Gustave Coriolis gave the mathematical expression for the Coriolis force in an 1835 paper in connection with the theory of water wheels.

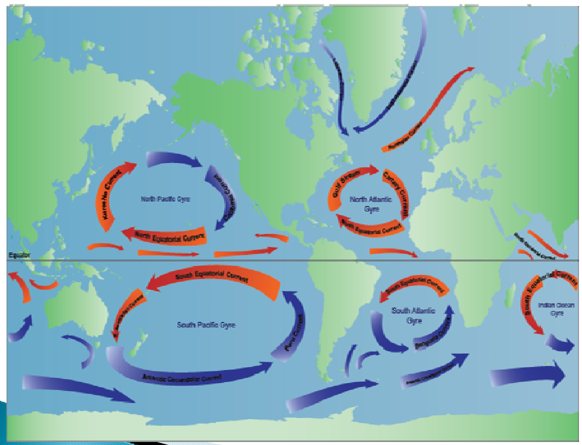
Coriolis effect

short video on explanation of coriolis effect:

http://www.shorstmeyer.com/msj/geo165/2009/movies/coriolis.mov

courtesy: Steve Horstmeyer, Chief Meteorologist, WXIX TV, FOX19, Cincinnati, OH, USA

Coriolis effect on the Ocean surface currents



Picture courtesy: The Centers for Ocean Sciences Education Excellence.
COSEE Coastal Trends, University of Maryland Center for Environmental Science Cambridge, Maryland

CURRENTS DUE TO EARTH'S ROTATION

- Northern Hemisphere – Circle clockwise
- Southern Hemisphere – Circle counter clockwise
- Warm water – Flow away from the equator
- Cold water – Flow towards the equator
- Western Part – Have warm water (Gulf Stream)
- Eastern Part – Have cold water (California)

Characteristics of Current

- Currents are referred to by their "drift" and "set". Usually the currents are strongest near the surface and may attain speeds over five knots. At depths, currents are generally slow with speeds less than 0.5 knots.
- We refer to the speed of a current as its "drift." Drift is measured in terms of knots. The current's "set" refers to the direction in which the current is moving (toward).
- The strength of a current refers to the speed of the current also. A fast current is considered strong. A current is usually strongest at the surface and decreases in strength (speed) with depth. Most currents are less than or equal to 5 knots.

Drift Currents or wind driven currents

- Drift currents are caused by winds blowing continuously across the surface of the sea. Friction between the surface level of the wind and the sea surface drags the water in the same direction as the wind.
- The movement of the surface layer of water is initially in the same direction as the wind, but as water moves, the Coriolis force deflects the flow between 30° to 45°to its right in the Northern Hemisphere, and between 30° to 45°to its left in the Southern Hemisphere.
- The speed of the drift current is greatest at the surface and diminishes rapidly with depth.
- Two important drift currents are the North and South Equatorial Drift Currents travelling to the west near to and parallel to the equator.

Application of the Knowledge for Ship officers

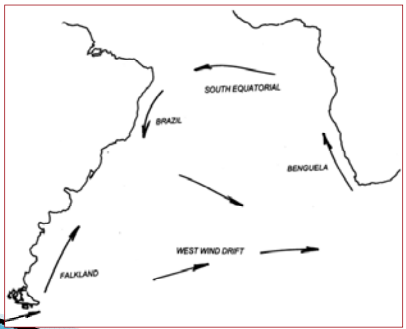
- As a senior officer, the names of all major currents should be known, whether they are drift or stream currents, and whether they are warm or cold. It should also be known in which direction the currents are setting.
- Knowledge of these currents is important for determining fog areas, ice movements, and in weather-routeing the vessel.

Currents of the North Atlantic Ocean

Activity 1:- Draw and label the currents of the North Atlantic Ocean on the chart provided in the handout

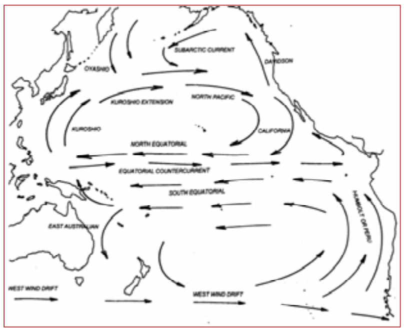
Currents of the South Atlantic Ocean

Activity 2:- Draw and label the currents of the South Atlantic Ocean on the chart provided in the handout



Currents of the Pacific Ocean

Activity 3:- Draw and label the currents of the Pacific Ocean on the chart provided in the handout

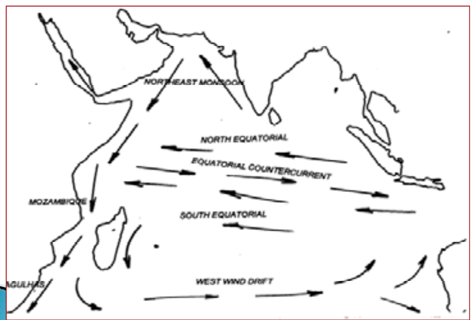


Currents in the Indian Ocean

- In the North Indian Ocean, including the Bay of Bengal and the Arabian Sea, surface currents are determined by the prevailing monsoon winds, and they reverse direction at the change of the monsoon seasons. The China Sea currents are also affected by this seasonal change in wind direction.

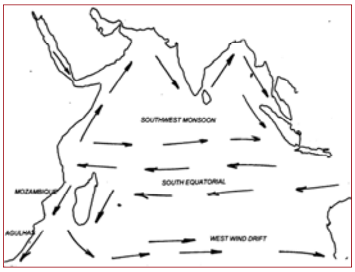
Currents in the Indian Ocean during the NE Monsoon

Activity 4:- Draw and label the currents in the Indian Ocean during the NE Monsoon on the chart provided in the handout.



Currents in the Indian Ocean during the SW Monsoon

Activity 5:- Draw and label the currents in the Indian Ocean during the SW Monsoon on the chart provided in the handout.



Wind Drift Current (contd)

North Atlantic and North Pacific West Wind Drift Currents.

- These drift currents set eastward across their respective oceans, blown by the prevailing Southwest winds. They are warm currents taking the warm waters of the Gulf Stream and the Kuro Shio Currents and transporting them to the eastern side of the Atlantic and Pacific Oceans.

Southern Ocean West Wind Drift Current

- The Roaring Forties create the West Wind Drift Current of the Southern Oceans. This current sets to the east.

DRIFT CURRENT SUMMARY

- Drift currents are wind – generated.
- They tend to be affected by Coriolis Force, deflection is between 30° to 45° to their left or right, depending on the hemisphere.
- They tend to follow the patterns of the permanent High Pressure areas.
- They are surface currents, and their speed is a percentage of the wind speed that drives them.

DRIFT CURRENT SUMMARY (contd)

- In high latitudes, current speed is about 2% of the wind speed.
- In low latitudes, current speed is about 4% of the wind speed.
- Typical drift current speeds are between 1 to 2 knots.
- Monsoon current circulation is mainly caused by the wind, so is an example of drift currents.
- North and South Equatorial currents are drift currents.

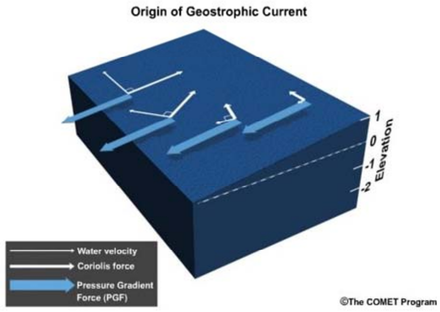
GEOSTROPHIC OR GRADIENT OR STREAM CURRENTS

- A persistent slope in sea surface leads to what we call Geostrophic currents.
- It is a current flowing down a slope on the ocean's surface.
- Geostrophic current are also known as Gradient currents, because of the slope are also known as "stream" currents, from the concept of water streaming down a slope.

GEOSTROPHIC OR GRADIENT OR STREAM CURRENTS (contd)

- Naturally, water tends to flow down slope from an area of higher elevation to one of lower elevation. However, this flow gets deflected due to the Coriolis force: to the right in the northern hemisphere and to the left in the southern hemisphere.
- As the current accelerates down slope, it is progressively deflected until it flows parallel to surface elevation contours

Origin of Geostrophic current



Picture Courtesy :- Cooperative Program for Operational Meteorology, Education and Training (COMET®)- University Corporation for Atmospheric Research (UCAR) and the National Weather Service (NWS)

Animation: Origin of Geostrophic current

http://www.meted.ucar.edu/oceans/currents/geo_current.htm

Courtesy :- Cooperative Program for Operational Meteorology, Education and Training (COMET®)- University Corporation for Atmospheric Research (UCAR) and the National Weather Service (NWS)

EXAMPLES OF GRADIENT CURRENTS

The Gulf Stream

The Equatorial Counter Currents

Activity 6:- Draw and label the Equatorial Counter Currents on the chart provided in the handout.

EXAMPLES OF GRADIENT CURRENTS

- The Gulf Stream
- The Equatorial Counter Currents
- East African Current and Somali Currents, Mozambique and Agulhas Currents

EXAMPLES OF GRADIENT CURRENTS (contd)

- The Peru (Humboldt) Current
- The Kuro Shio Current
- The East and West Greenland Currents
- Bay of Bengal Currents
- Mediterranean Currents

Warm Currents

- A warm current brings warm water into cold water and is usually found on the east coast of continents in the low and middle latitudes (true in both hemispheres). In the Northern Hemisphere they are located on the west coasts of continents in high latitudes.
- Warm currents are so named because they are relatively warm for their latitude.

Warm Current (contd)

- Flow away from the equator
- Flow along the west side of an ocean
- Gulf Stream, Kuroshio Current, Mozambique and Agulhas, Brazil Current, East Australia Current

Cold Currents

- A cold current brings cold water into warm water. Cold currents are usually found on the west coast of continents in the low and middle latitudes (true in both hemispheres) and the east coast in the northern latitudes in the Northern Hemisphere.
- Cold currents are so named because they are relatively cold for their latitude.

Cold Currents (cont)

Flow on the east shore towards the equator

- Canary
- California
- Benguela
- West Australian
- Peru (Humboldt)

Flow out of the far north

- Labrador
- Greenland
- Kamchatka (Oyashio)

COUNTERCURRENTS

- Current flowing opposite to the wind
- North & South Equatorial Currents flow west
- Equatorial Countercurrents flow east in between along the surface
- Cromwell Current (210 m thick, 400 km wide, 5000 km long) flows east 30 m under the South Equatorial Current

GEOSTROPHIC OR GRADIENT CURRENT SUMMARY

- Also known as stream or slope currents.
- Gradient currents are caused by a difference in water:
  - Level
  - Temperature
  - density
- They tend to be affected by Coriolis Force, deflection is between 30° to 45° to their left or right, depending on the hemisphere.
- They tend to flow from:
  - Higher level to lower level water
  - Warmer level to colder level water
  - Lower density level to higher density level water

GEOSTROPHIC OR GRADIENT CURRENT SUMMARY (contd)

- They are much deeper than drift currents.
- They are faster currents, usually 2 to 3 knots.
- Equatorial Counter Currents are typical examples of gradient currents.
- Kuro Shio and the Gulf Stream are examples of predominantly gradient currents.

EKMAN spiral

- When wind blows across water, friction between the wind and water transfers a small amount of the wind's energy to the water, starting the water in motion. With time and persistent winds, a surface current develops.

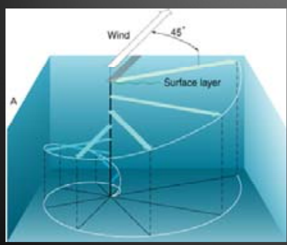
- However, the current that develops does not move parallel to the wind direction. Rather, it moves at a direction that is 20° to 60° from the wind direction, to the right in the northern hemisphere and to the left in the southern hemisphere.

EKMAN Spiral

- The Arctic explorer and oceanographer Fridtjof Nansen

- Vang Walfrid Ekman

Ekman spiral



- *The Ekman spiral describes how the horizontal wind sets surface waters in motion. As represented by horizontal vectors, the speed and direction of water motion change with increasing depth.*

Picture courtesy: Oceanmotion

EKMAN spiral conceptual animation

http://www.meted.ucar.edu/oceans/currents/ekman_deepwater.htm

Surface and depth averaged transport currents due to Ekman spiral for deep water in the Northern Hemisphere.

Ekman spiral in shallow waters

- In shallow water, the water depth is insufficient for the full spiral to develop so that the angle between the horizontal wind direction and surface-water movements can be as little as 15 degrees. As waters deepen, the angle increases and approaches 45 degrees.

Ekman spiral for shallow water Interactive animation

http://www.meted.ucar.edu/oceans/currents/ekman_shallow.htm

Courtesy :- Cooperative Program for Operational Meteorology, Education and Training (COMET®)- University Corporation for Atmospheric Research (UCAR) and the National Weather Service (NWS)

Tidal current

- When wind drives water toward shore, local sea level rises (set up). Conversely, when wind drives water away from shore, sea level falls (set down). In areas with a relatively small tidal range, this wind-driven current can dominate the tidal current.

Currents caused by off shore winds- Animation

http://www.meted.ucar.edu/oceans/currents/met_tide1.htm

Courtesy :- Cooperative Program for Operational Meteorology, Education and Training (COMET®)- University Corporation for Atmospheric Research (UCAR) and the National Weather Service (NWS)

Currents caused by coast-parallel winds - Animation

http://www.meted.ucar.edu/oceans/currents/met_tide2.htm

Courtesy :- Cooperative Program for Operational Meteorology, Education and Training (COMET®)- University Corporation for Atmospheric Research (UCAR) and the National Weather Service (NWS)

Inertial Current

- When a sustained wind suddenly dies, the wind-forced current has momentum, and continues as an inertial current. This inertial current looks like a series of diminishing loops
- Animation.

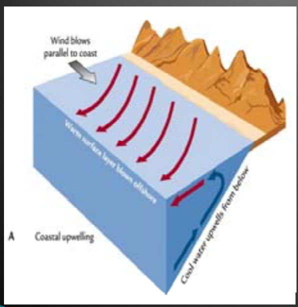
http://www.meted.ucar.edu/oceans/currents/inertial_currents.htm

Courtesy :- Cooperative Program for Operational Meteorology, Education and Training (COMET®)- University Corporation for Atmospheric Research (UCAR) and the National Weather Service (NWS)

Upwelling:

- Upwelling refers to a process that is observed to be common along continental coastlines (Coastal Upwelling) and at the equator (Equatorial Upwelling).

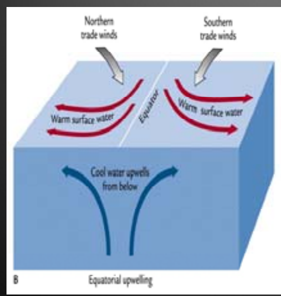
Coastal Upwelling



- In coastal environments, winds coming off the land push the surface layers of water away from shore, producing a void at the surface. Cold, nutrient-rich water from underneath the surface layers rushes to the surface along the coast, filling this void.

Picture Coutesy: William F. Ruddimann (2001). *Earth's Climate — Past and Future.* Palgrave Macmillan.

Equatorial upwelling



- At the equator, a different process results in upwelling of cold water. In this instance, water currents on either side of the equator are moving in opposite directions because of planetary rotation and the Coriolis effect. This creates an area of low pressure alongside the continents, creating a void for deeper water to rush into and take its place. It brings with it large quantities of micro-organisms like planktons for fish to feed upon.

Picture Coutesy: William F. Ruddimann (2001). *Earth's Climate — Past and Future.* Palgrave Macmillan.

Upwelling (contd)

The areas where the upwelling process can be found are in the waters off the coasts of:

- West Australia
- California
- Peru
- Portugal and
- Namibia

These regions are important because they are the world's most important fishing grounds, and as they are good fishing grounds areas of upwelling have large concentration of fishing vessel which the senior officer should be aware of, to exercise caution prior navigating in these areas.

Upwelling animation

http://www.classzone.com/books/earth_science/terc/content/visualizations/es2405/es2405page01.cfm?chapter_no=visualization

Courtesy:- Exploring Earth website, created by the Center for Earth and Space Science Education at Technical Education Research Centers (TERC), Inc., Cambridge, Massachusetts. Funded in part by a grant from the National Science Foundation.

Or

http://www.whoi.edu/oceanus/viewVideo.do?fileid=3803&id=3692

Coastal Upwelling (Illustration and animation by Jack Cook.)Courtesy- Woods Hole Oceanographic Institution (WHOI)

Density-Driven Currents

Density current concept - Animation

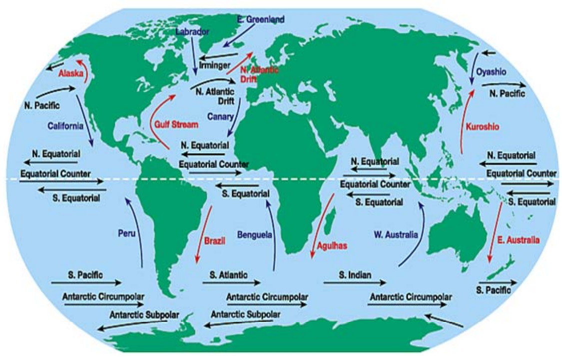
http://www.meted.ucar.edu/oceans/currents/density_current_concept.htm

Geostrophic flow with density driven currents- Animation

http://www.meted.ucar.edu/oceans/currents/geostrophic_flow.htm

Courtesy :- Cooperative Program for Operational Meteorology, Education and Training (COMET®)- University Corporation for Atmospheric Research (UCAR) and the National Weather Service (NWS)

Summarising Surface ocean currents



This illustration shows the circulation of the ocean's surface water. Names of the major ocean currents are noted with warm currents are red and cold currents blue

Picture courtesy: http://www.windows2universe.org/earth/Water/images/Surface_currents_jpg_image.html

Deep ocean currents (Thermohaline Circulation)

Deep ocean currents (also known as Thermohaline Circulation) are caused by:

- The density of sea water varies globally due to differences in temperature and salinity. Surface water is heated by the sun, and warm water is less dense than cold water. Similarly, fresh water is less dense than salty water. At northern latitudes, surface water is cooled by extremely cold air. This cool water can becomes denser than the underlying water causing it to sink. The sinking and transport of large masses of cool water gives rise to the **thermohaline** circulation, which is driven by density gradients due to variations in temperature and salinity.
- The earth's rotation also influences deep ocean currents

Animation of the Thermohaline circulation

http://www.meted.ucar.edu/oceans/currents/global_thermo.htm

Courtesy :- Cooperative Program for Operational Meteorology, Education and Training (COMET®)- University Corporation for Atmospheric Research (UCAR) and the National Weather Service (NWS)

CURRENT CHARTS

Chart BA5310: The World – General Surface Current Distribution.

- VECTOR MEAN CURRENTS CHART
- PREDOMINANT CURRENTS
- CURRENT ROSES

VECTOR MEAN CURRENT REPRESENTATION SUMMARY

- Current flows in direction of arrow.
- Only the Resultant current of all observations for any one spot is displayed.
- Does not give the true current.
- Shows the overall movement of water over a period.
- Speed is shown by length of arrow, often above arrow.
- Current speed is in Miles per day.
- Number of observations is shown below arrow.
- Use: finding average drift of objects, e.g. for search and rescue purposes.

PREDOMINANT CURRENT REPRESENTATION SUMMARY

- Shows frequent or most likely currents
- Use of 90° sectors, each overlapping and displaced by 15°.
- Predominant current is taken as being in the sector containing the most number of observations.
- Predominant direction is the mid-direction of this sector.
- Predominant speed is the arithmetic mean of all the currents in this sector.
- Constancy (measure of highest probability) is found by taking the number of observations in this sector and comparing it to the total number of observations. It is expressed as a percentage.
- Thicker arrows = greater constancy
- High constancy, little difference between Predominant and Vector Mean formats.
- Uses: Routeing, passage planning – with current roses.

The END

Questions ?

ANNEX 4

AIDS FOR CLASSROOM ACTIVITIES
CURRENTS OF THE OCEANS

Annex 4- Aids for classroom activities – as per Sample lesson plan, page 3-4 with reference to Annex 2 Participant's handout, page 9 and Annex 3 power point presentation, slide 20.

ACTIVITY 1

Currents of the North Atlantic Ocean

To elucidate the topic for better understanding, the instructor should illustrate the diagram of the Activity 4 (the labelled diagram is in the power point presentation slide 20) using this activity sheet provided, on either transparencies, placing on the OHP and marking the currents by erasable coloured pens, or if Interactive boards are in use then blank activity sheets(black and white or colour) same provided here, can be inserted in the power point presentation, and currents can be drawn on them, in front of the class, for the students to understand and copy on to their blank sheets provided in the participants handout page 9.

Also see next page for the coloured maps.

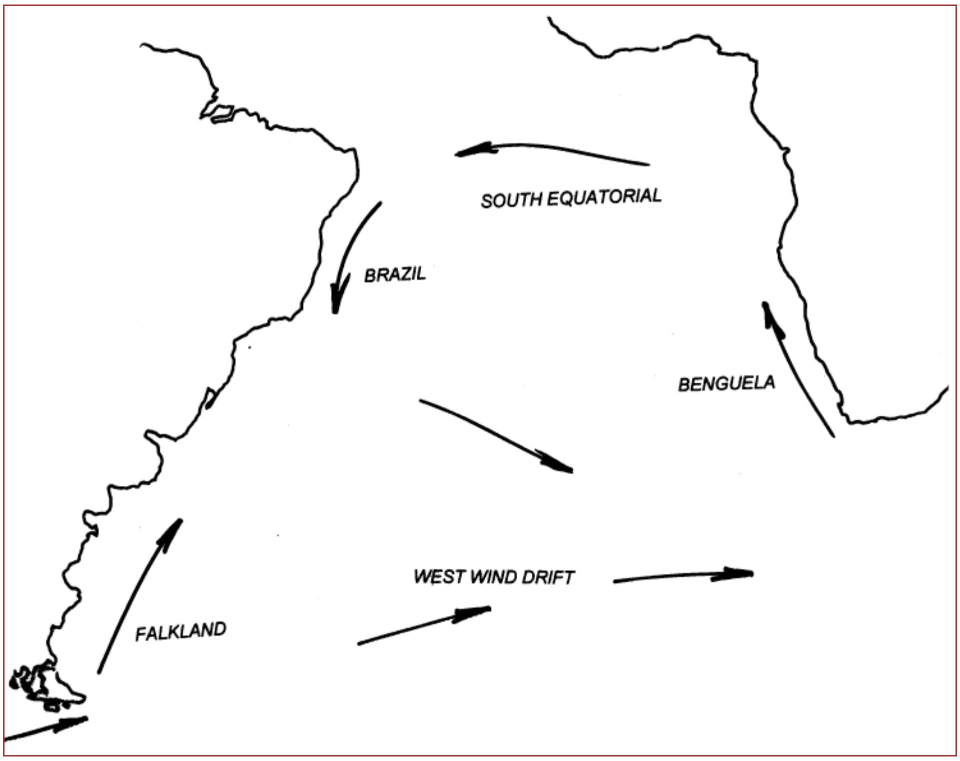

CANADA
UNITED STATES
NORTH ATLANTIC
OCEAN
BRAZIL

Annex 4- Aids for classroom activities – as per Sample lesson plan, page 3-4 with reference to Annex 2 Participant's handout, page 10 and Annex 3 power point presentation, slide 21.

ACTIVITY 2

Currents of the South Atlantic Ocean

To elucidate the topic for better understanding, the instructor should illustrate the diagram of the Activity 4 (the labelled diagram is in the power point presentation slide 21) using this activity sheet provided, on either transparencies, placing on the OHP and marking the currents by erasable coloured pens, or if Interactive boards are in use then blank activity sheets(black and white or colour) same provided here, can be inserted in the power point presentation, and currents can be drawn on them, in front of the class, for the students to understand and copy on to their blank sheets provided in the participants handout page 10.



Also see the next page for coloured maps.

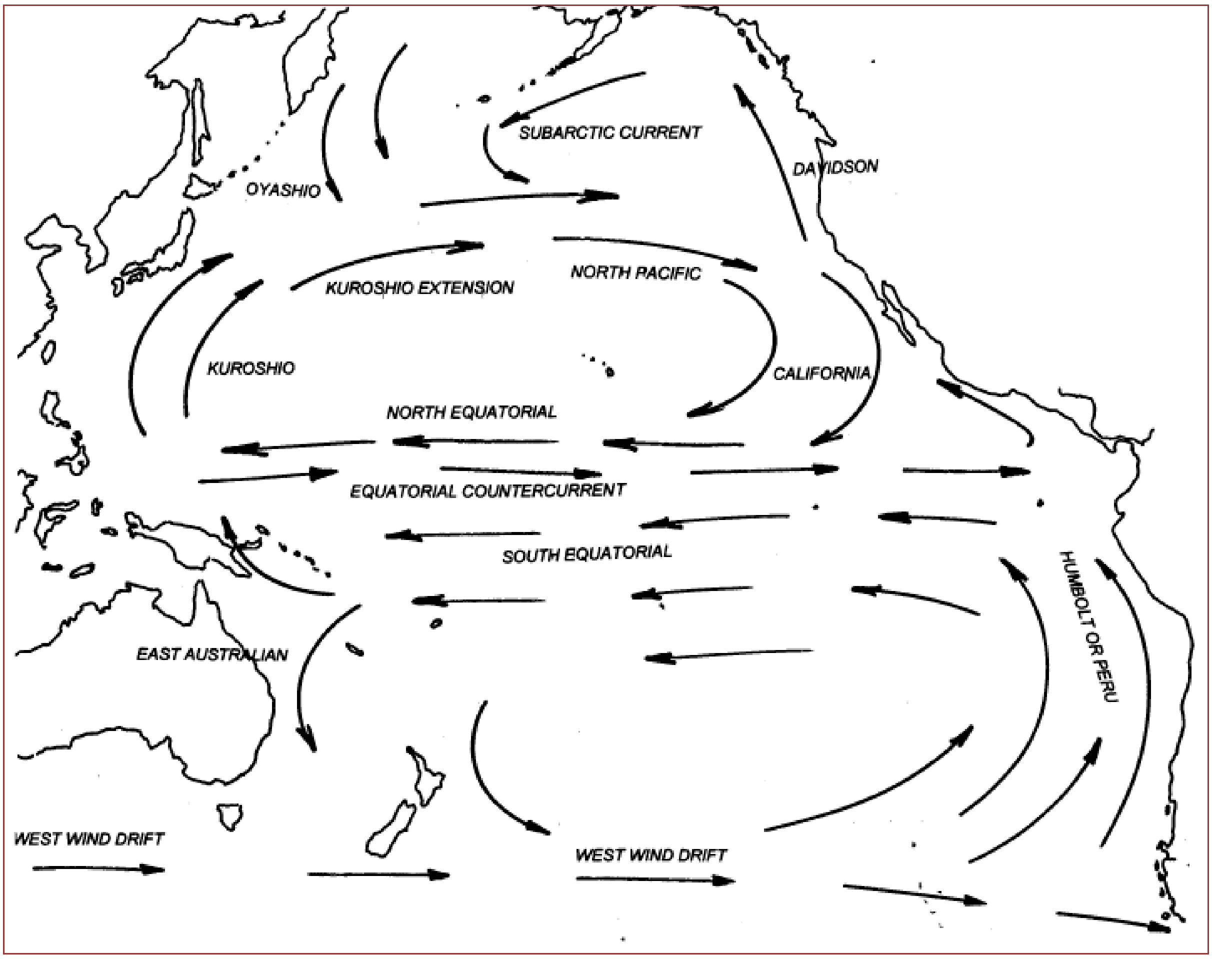

BRAZIL
BOLIVIA
PARAGUAY
URUGUAY
ARGENTINA
SOUTH ATLANTIC
OCEAN
ANGOLA
ZAMBIA
TANZANIA
NAMIBIA
BOTSWANA
SOUTH AFRICA

Annex 4- Aids for classroom activities – as per Sample lesson plan, page 3-4 with reference to Annex 2 Participant's handout, page 11 and Annex 3 power point presentation, slide 22.

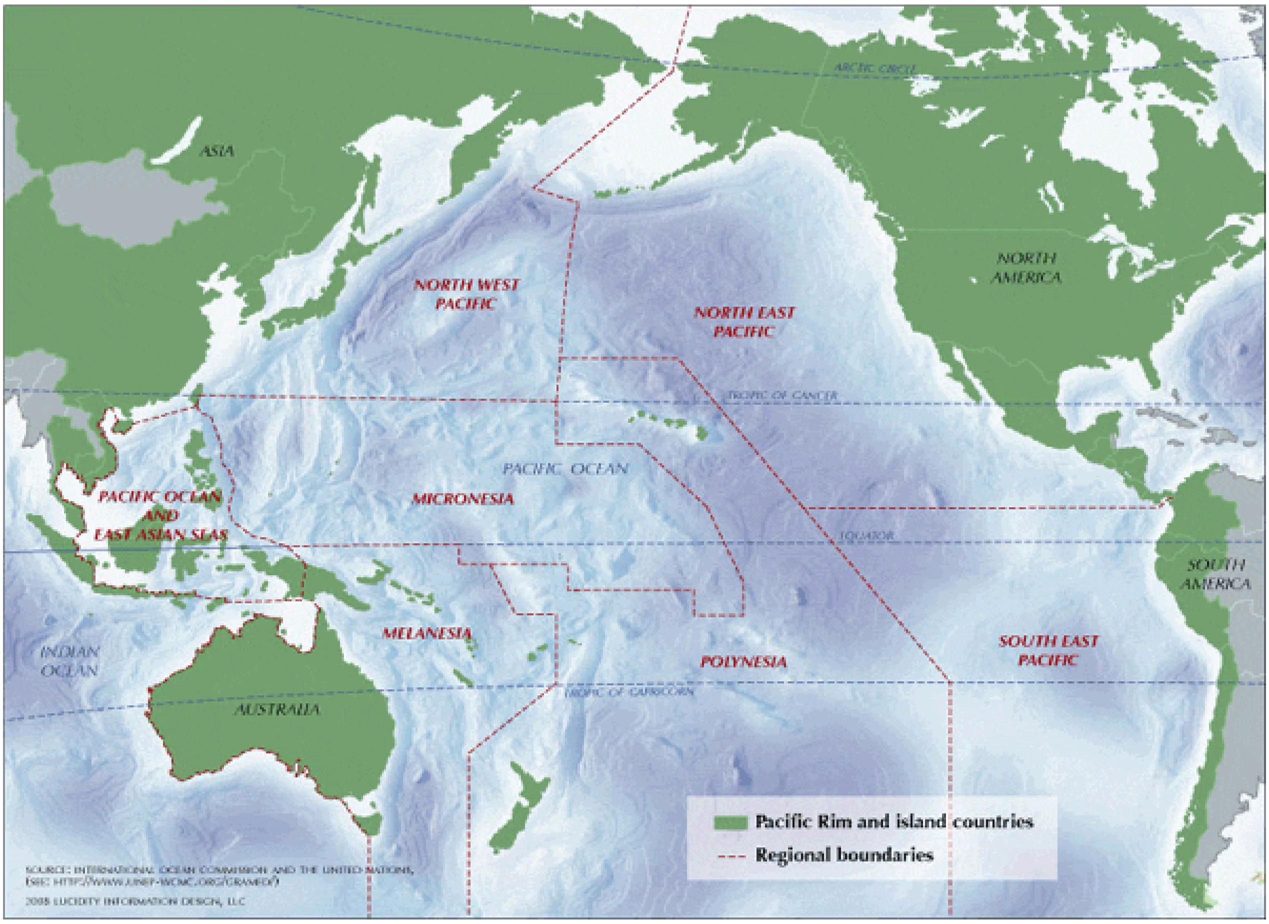
ACTIVITY 3

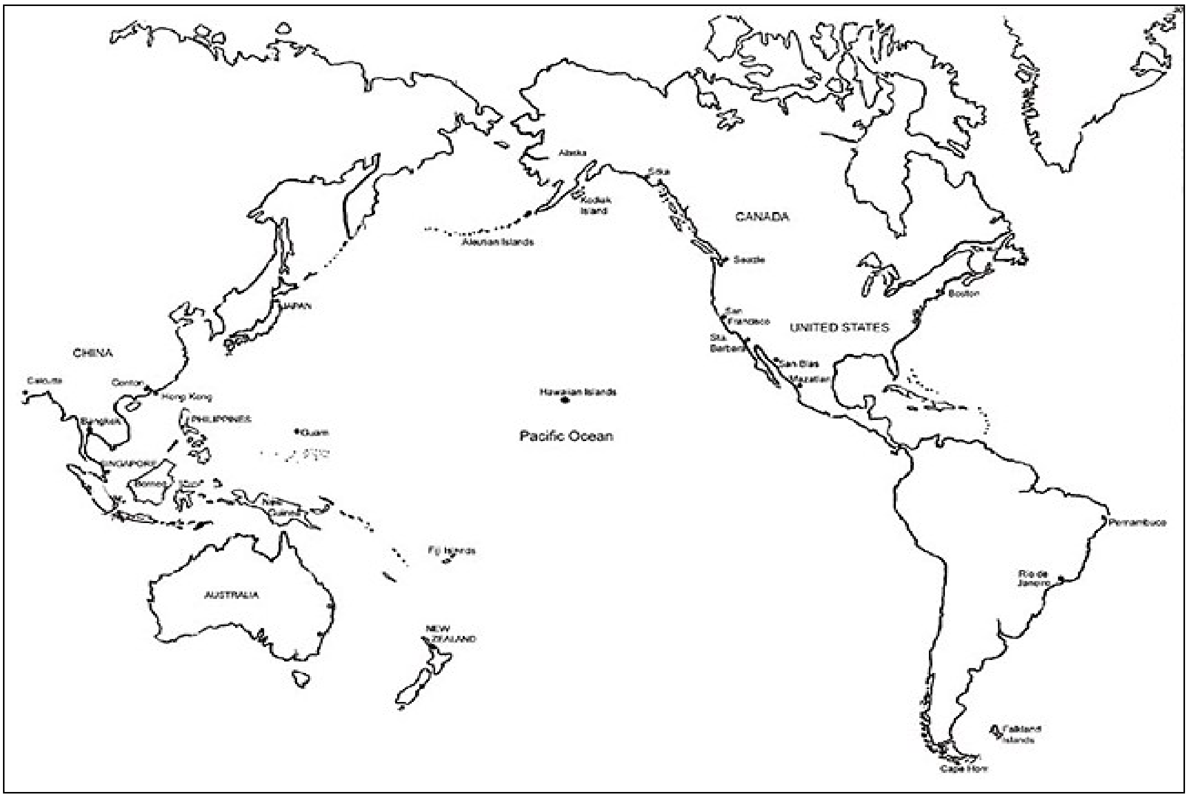
Currents of the Pacific Ocean

To elucidate the topic for better understanding, the instructor should illustrate the diagram of the Activity 4 (the labelled diagram is in the power point presentation slide 22) using this activity sheet provided, on either transparencies, placing on the OHP and marking the currents by erasable coloured pens, or if Interactive boards are in use then blank activity sheets(black and white or colour) same provided here, can be inserted in the power point presentation, and currents can be drawn on them, in front of the class, for the students to understand and copy on to their blank sheets provided in the participants handout page 11.



Also see the next page for colour map.


ARCTIC CIRCLE
ASIA
NORTH WEST PACIFIC
NORTH EAST PACIFIC
NORTH AMERICA
TROPIC OF CANCER
PACIFIC OCEAN
MICRONESIA
PACIFIC OCEAN AND EAST ASIAN SEAS
EQUATOR
SOUTH AMERICA
MELANESIA
POLYNESIA
SOUTH EAST PACIFIC
INDIAN OCEAN
AUSTRALIA
TROPIC OF CAPRICORN
Pacific Rim and island countries
Regional boundaries
2005 LUCIDITY INFORMATION DESIGN, LLC

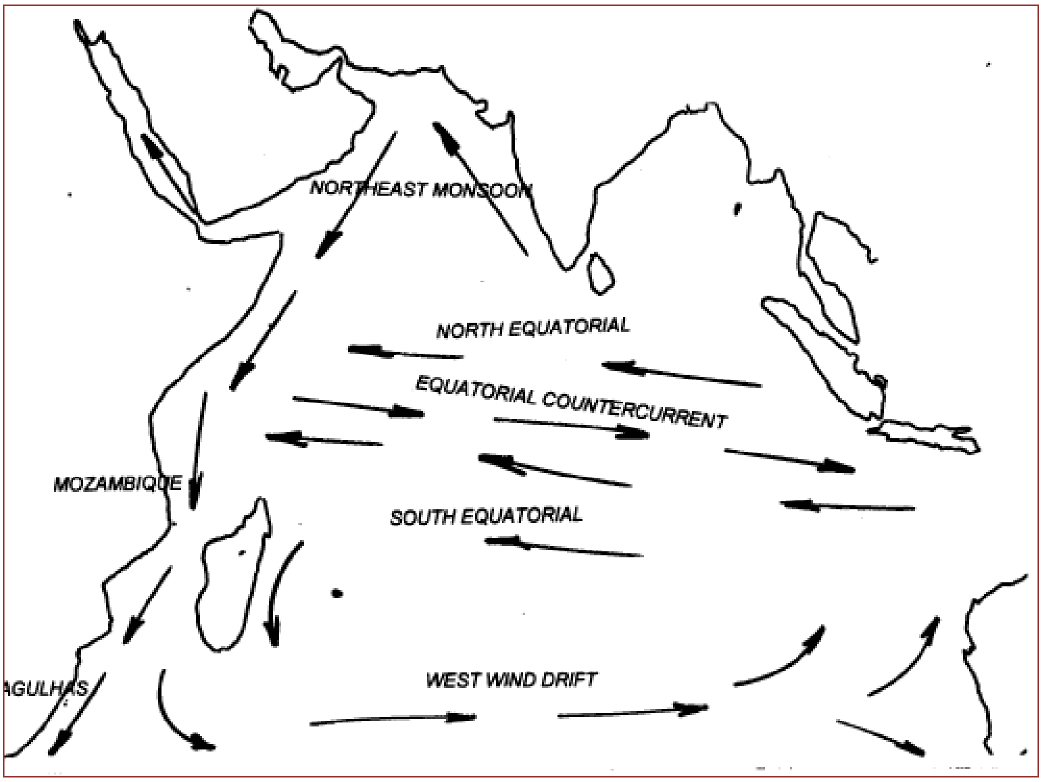

Alaska
Sitka
Kodiak Island
Aleutian Islands
CANADA
Seattle
Boston
San Francisco
UNITED STATES
Sta. Barbara
San Blas
Mazatlan
JAPAN
CHINA
Calcutta
Canton
Hong Kong
Bangkok
PHILIPPINES
Guam
Hawaiian Islands
Pacific Ocean
SINGAPORE
Borneo
New Guinea
Fiji Islands
AUSTRALIA
NEW ZEALAND
Pernambuco
Rio de Janeiro
Falkland Islands
Cape Horn

Annex 4- Aids for classroom activities – as per Sample lesson plan, page 3-4 with reference to Annex 2 Participant's handout, page 12 and Annex 3 power point presentation, slide 24.

ACTIVITY 4

Currents of the Indian Ocean during the NE Monsoon

To elucidate the topic for better understanding, the instructor should illustrate the diagram of the Activity 4 (the labelled diagram is in the power point presentation slide 24) using this activity sheet provided, on either transparencies, placing on the OHP and marking the currents by erasable coloured pens, or if Interactive boards are in use then blank activity sheets(black and white or colour) same provided here, can be inserted in the power point presentation, and currents can be drawn on them, in front of the class, for the students to understand and copy on to their blank sheets provided in the participants handout page 12.



Also see next page for the coloured maps.


SAUDI ARABIA
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TANZANIA
SEYCHELLES
COMOROS
MALAWI
ANGOLA
ZAMBIA
MOZAMBIQUE
MADAGASCAR
ZIMBABWE
MAURITIUS
NAMIBIA
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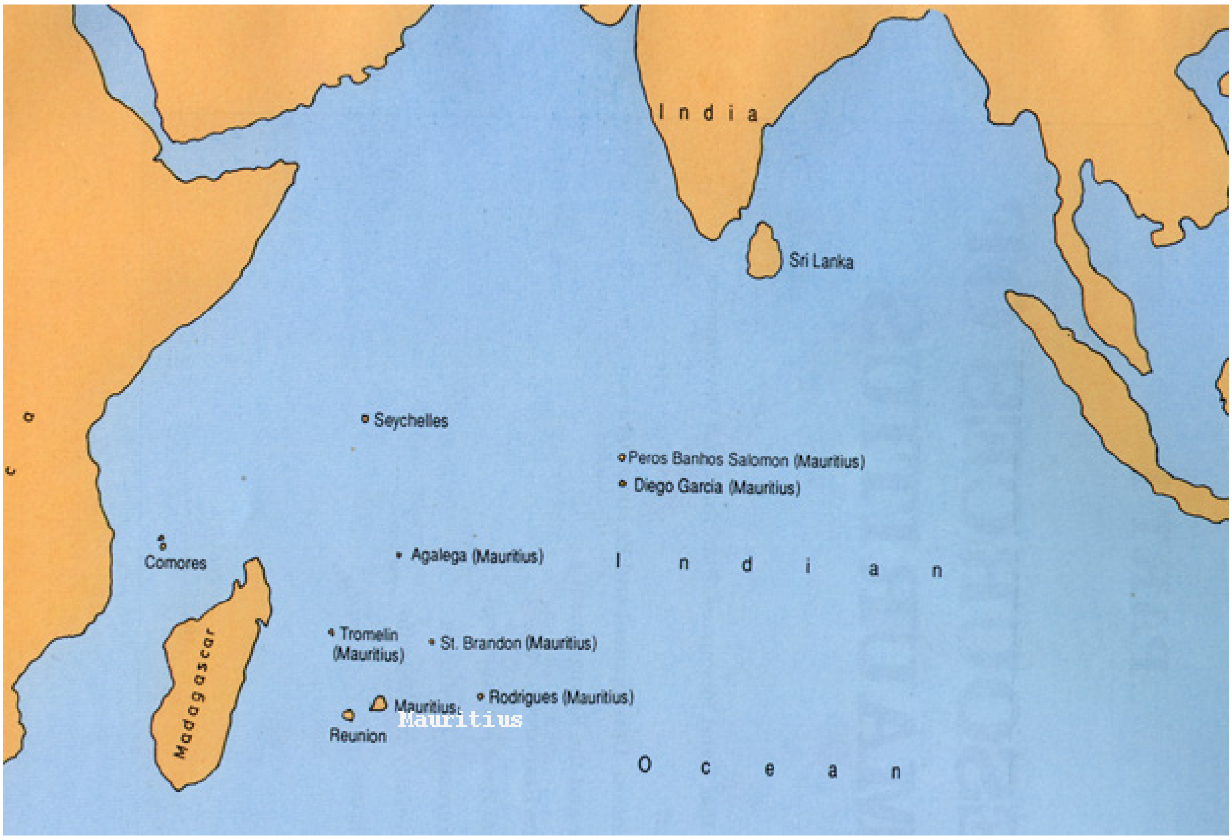
INDIA
SRI LANKA
MALDIVES
VIETNAM
THAILAND
MALAYSIA
TAIWAN

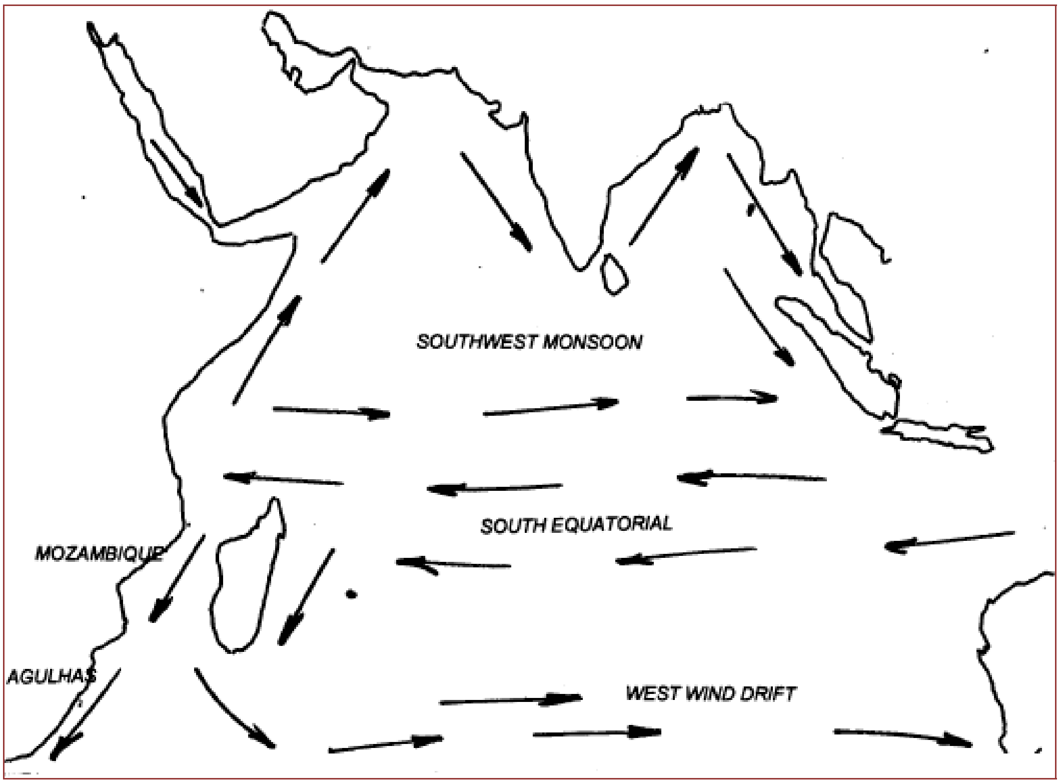

India
Sri Lanka
Seychelles
Peros Banhos Salomon (Mauritius)
Diego Garcia (Mauritius)
Comores
Agalega (Mauritius)
Indian
Madagascar
Tromelin
(Mauritius)
St. Brandon (Mauritius)
Mauritius
Rodrigues (Mauritius)
Mauritius
Reunion
Ocean

Annex 4- Aids for classroom activities – as per Sample lesson plan, page 3-4 with reference to Annex 2 Participant's handout, page 12 and Annex 3 power point presentation, slide 25.

ACTIVITY 5

Currents of the Indian Ocean during the SW Monsoon

To elucidate the topic for better understanding, the instructor should illustrate the diagram of the Activity 4 (the labelled diagram is in the power point presentation slide 25) using this activity sheet provided, on either transparencies, placing on the OHP and marking the currents by erasable coloured pens, or if Interactive boards are in use then blank activity sheets(black and white or colour) same provided here, can be inserted in the power point presentation, and currents can be drawn on them, in front of the class, for the students to understand and copy on to their blank sheets provided in the participants handout page 12.



Also see the next page for coloured maps.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TANZANIA
SEYCHELLES
COMOROS
MALAWI
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NAMIBIA
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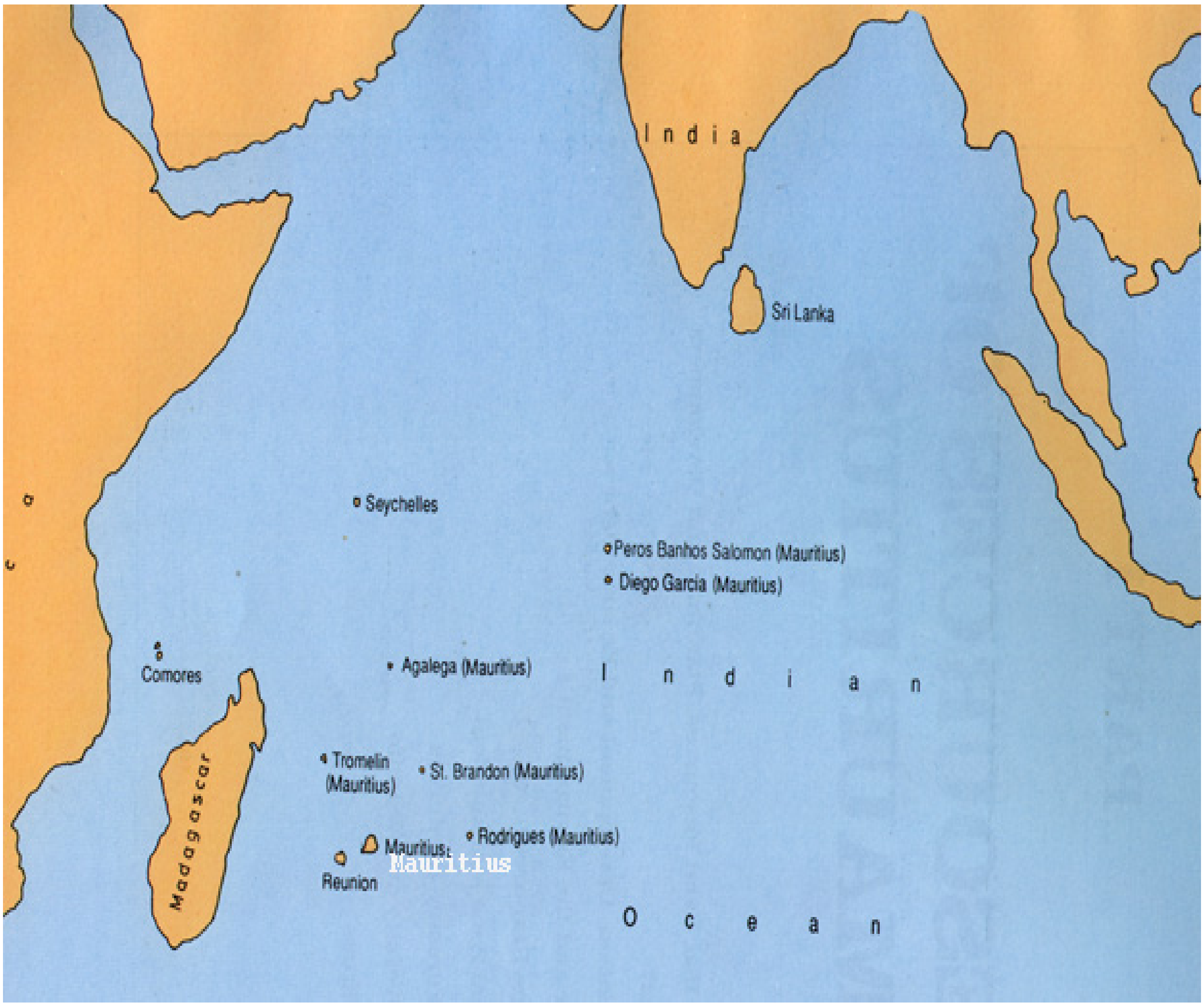
INDONE


India
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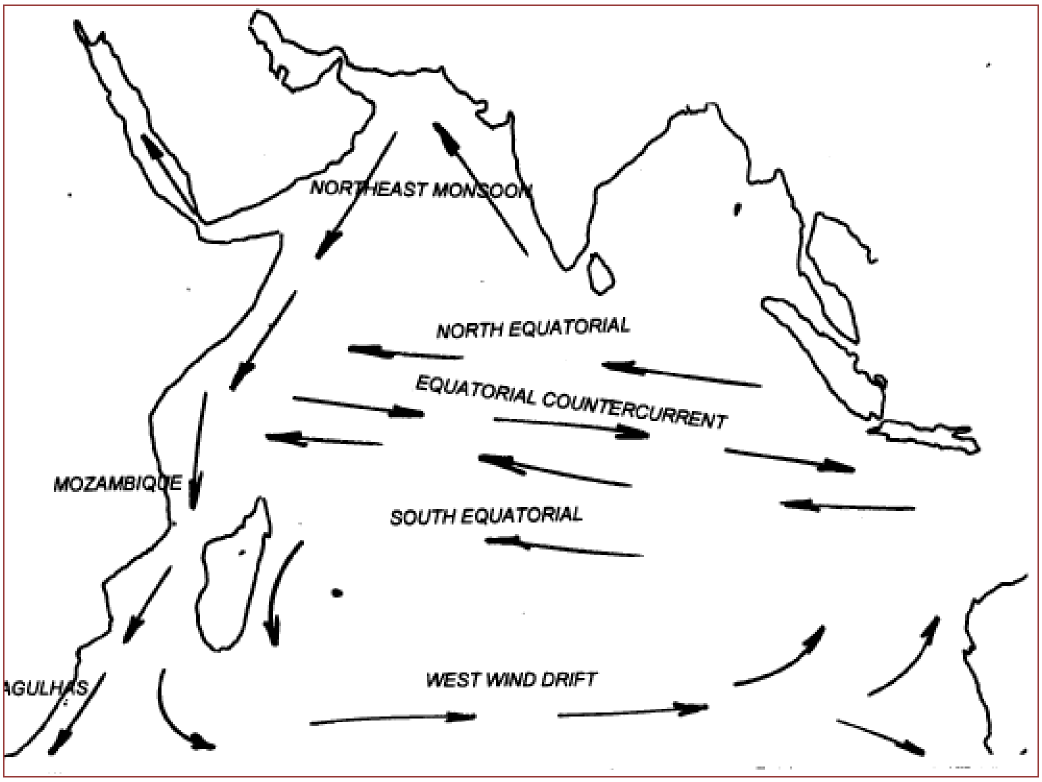
Peros Banhos Salomon (Mauritius)
Diego Garcia (Mauritius)
Comores
Agalega (Mauritius)
Indian
Madagascar
Tromelin (Mauritius)
St. Brandon (Mauritius)
Mauritius
Rodrigues (Mauritius)
Mauritius
Reunion
Ocean

Annex 4- Aids for classroom activities – as per Sample lesson plan, page 3-4 with reference to Annex 2 Participant's handout, page 16 and Annex 3 power point presentation, slide 34.

ACTIVITY 6

The Equatorial Counter Currents

To elucidate the topic for better understanding, the instructor should illustrate the diagram of the Activity 4 (the labelled diagram is in the power point presentation slide 34) using this activity sheet provided, on either transparencies, placing on the OHP and marking the currents by erasable coloured pens, or if Interactive boards are in use then blank activity sheets(black and white or colour) same provided here, can be inserted in the power point presentation, and currents can be drawn on them, in front of the class, for the students to understand and copy on to their blank sheets provided in the participants handout page 16.



Also see the next page for coloured maps.


SAUDI ARABIA
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SOMALIA
CENTRAL AFRICAN REPUBLIC
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KENYA
DEMOCRATIC REPUBLIC OF THE CONGO
TANZANIA
SEYCHELLES
COMOROS
MALAWI
ANGOLA
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MOZAMBIQUE
MADAGASCAR
MAURITIUS
ZIMBABWE
NAMIBIA
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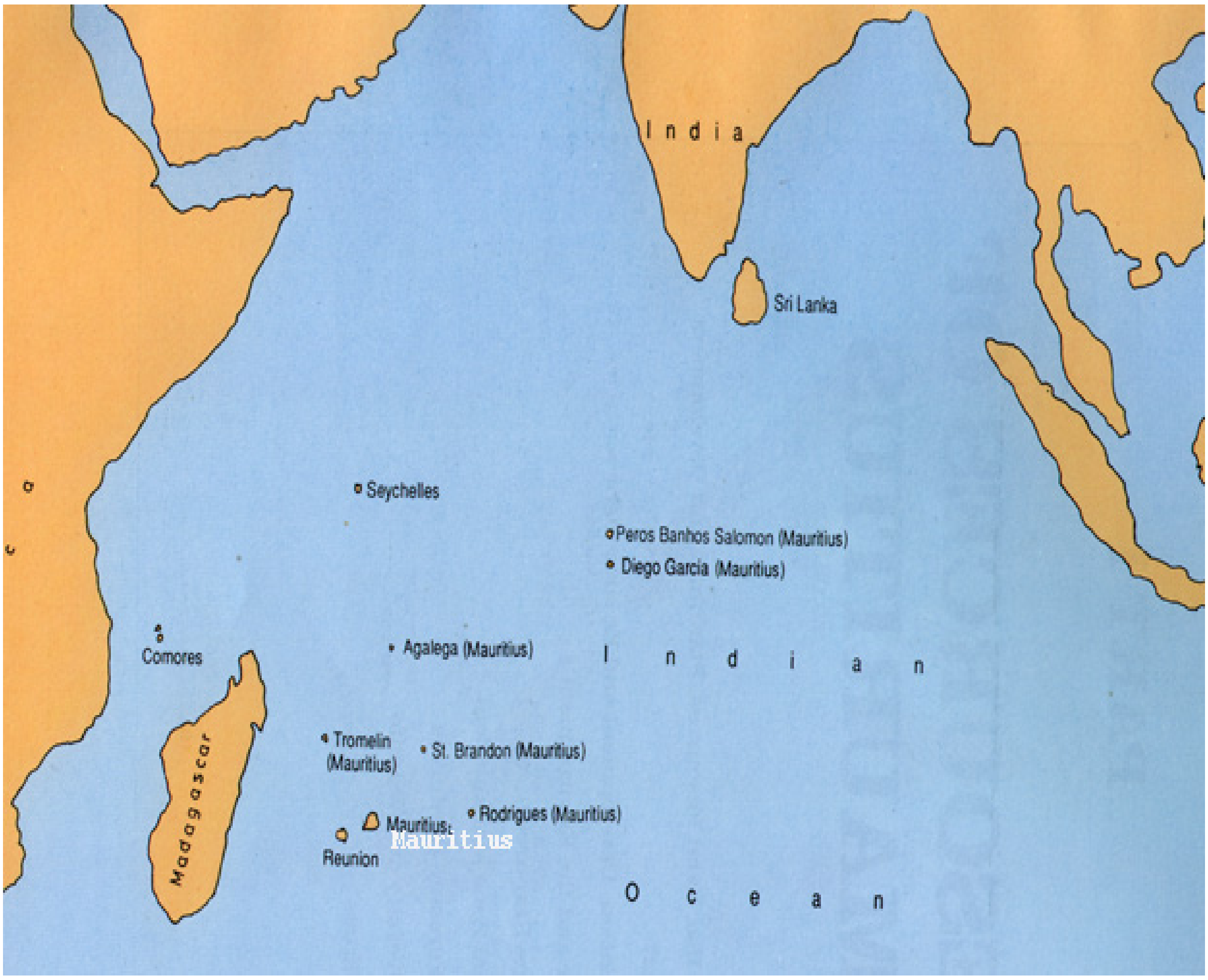
MALAYSIA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Sri Lanka
Seychelles
Peros Banhos Salomon (Mauritius)
Diego Garcia (Mauritius)
Comores
Agalega (Mauritius)
Indian
Madagascar
Tromelin (Mauritius)
St. Brandon (Mauritius)
Mauritius
Rodrigues (Mauritius)
Mauritius
Reunion
Ocean

Ocean Surface Currents Properties

Name	Transport (Sv)	Ocean	Type	Comment
Agulhas	20-90	South Atlantic	Warm	
Alaska		North Pacific	Warm	
Angola	5	South Atlantic		
Antarctic CP	130	Southern		
Antarctic Coastal	10	Southern		
Antilles	2-7	North Atlantic		
Azores	8	North Atlantic		
Benguela	7-15	South Atlantic	Warm/Cool	
Brazil	20-70	South Atlantic	Warm	
California		North Pacific	Cool	
Canary	8	North Atlantic	Cool	
Caribbean	26-33	Caribbean Sea		
East Australian		South Pacific	Warm	
East Greenland	7-35	North Atlantic		
East Iceland		North Atlantic		
Florida	30	North Atlantic		
Guiana	10	North Atlantic		
Guinea	3	North Atlantic		
Gulf Stream	30-150	North Atlantic	Warm	Western Boundary Current
Irminger	2-4	North Atlantic		
Kuroshio		North Pacific	Warm	
Labrador	4-8	North Atlantic	Cool	
Loop Current	30	North Atlantic		
Malvinas	10	South Atlantic		aka Falkland
Mexican	8-10	Caribbean Sea		
North Atlantic	35-40	North Atlantic		
North Atlantic Drift	30	North Atlantic	Warm	
North Pacific Drift		North Pacific	Warm	
North Brazil	10-30	North Atlantic		
North Equatorial	15	North Atlantic		
North Equatorial CC	18	North Atlantic		
Norwegian	2-4	North Atlantic		
Oyashio		North Pacific	Cool	aka Kamchatka

Name	Transport (Sv)	Ocean	Type	Comment
Peru		South Pacific	Cool	aka Humboldt
Portugal		North Atlantic		
Slope		North Atlantic		
Slope Jet		North Atlantic		
South Atlantic		South Atlantic		
South Equatorial	15	South Atlantic		
Spitsbergen		North Atlantic		
Subtropical CC	4-10	North Atlantic		
Weddell Scotia CF	40-90	North Atlantic		
West Australian		Indian	Cool	
West Greenland		North Atlantic		
West-Spitsbergen		Atlantic		
West Wind Drift		South Pacific	Cool	
Yucatan	23-33	Caribbean Sea		

CC == Counter Current, CF == Confluence, CP == Circumpolar

Transport is the estimated annual range in 10^6 m^3/s.

Reference: - http://oceancurrents.rsmas.miami.edu/properties.html

Explanation of Transport:-

The Sverdrup (Sv), named in honour of the pioneering oceanographer Harald Sverdrup is a unit of measure of volume transport. It is used almost exclusively in oceanography, to measure the transport of ocean currents. Its symbol is **Sv**. Note that the sverdrup is *not* an SI unit, and that its symbol conflicts with the sievert's symboll. It is equivalent to 10^6 cubic metres per second (0.001 km^3/s, or about 264 million U.S. gallons per second). The entire global input of fresh water from rivers to the ocean is equal to about 1 sverdrup.

Recent studies suggest that the water transport in the Gulf Stream steadily increases from 30 Sv in the Florida Current to a maximum of 150 Sv at 55°W longitude.

Reference: - http://en.wikipedia.org/wiki/Sverdrup

ASSIGNMENT SAMPLE:

Some Suggested Resources:
- Routeing Chart – relevant to the assignment
- Ocean Passages of the World
- Sailing Directions appropriate to the assignment
- Admiralty List of Radio Signals Volume 3
- Admiralty List of Radio Signals Volume 5
- The Mariners' Handbook

Sample Questions:
A vessel will cross the North Atlantic Ocean in February, from Liverpool to Halifax following a recommended route

Or

A vessel will cross the Indian Ocean in February, from Colombo to Durban following a recommended route.

Or

A vessel will cross the South Pacific Ocean in April, from Brisbane to Panama following a recommended route.

Or

A vessel will cross the North Pacific Ocean in August, from Yokohama to Panama, following a recommended route

Making use of all available resources:-

1. State the route that you choose to follow and justify your choice, essentially from the meteorological perspective.

2. List the main geographic climatic areas which the vessel will transit and summarise its identifying features from the data available to you from your research.

3. Clearly state, giving your reasons, in which of the geographic climatic areas the vessel would most probably encounter adverse weather conditions and sea states.

4. List the major stations broadcasting facsimile charts, weather bulletins and other pertinent meteorological information available to the navigator which would assist in the safe passage of the vessel on this route.

5. Discuss the relative merits of the use of shipboard versus shore-based weather-routeing for this route, and state your preference in this particular instance.

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