STCW Circular No. 2015 - 03

ANNEX I

UPDATING COURSE FOR
OFFICER IN CHARGE OF A NAVIGATIONAL WATCH
(On Seagoing Ships of 500 Gross Tonnage or More)

In Compliance with
Regulation I/11, par. [4] and [5]
of the
2010 Manila Amendments to the
1978 STCW Convention

PART A
COURSE FRAMEWORK

1. OBJECTIVES

This training program entitled **"Updating Course for Officer in Charge of a Navigational Watch"** serving on seagoing ships of 500 gross tonnage or more was developed to comply with the requirements under paragraphs [4] and [5] of Regulation I/11 (Revalidation of Certificates) and in consonance with Regulation I/15 (Transitional Provisions) of the 2010 Manila Amendments to the 1978 International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (1978 STCW Convention, as amended).

It also intends to update the knowledge, understanding and proficiency of Officers in Charge of a Navigational Watch serving on board seagoing ships of 500 gross tonnage or more, who were certificated under the 1978 STCW Convention, as amended in 1995, with the new competence requirements and revalidate their Certificate of Competency (COC) ~~under the 2010 Manila Amendments~~.

Additionally, this training program covers certain KUPs leading to Management Level Deck competencies that are now incorporated in the new Bachelor of Science in Marine Transportation (BSMT) curriculum to align and prepare the aforementioned Officers in taking the new management level course for marine deck officers.

2. ENTRY STANDARDS

Entrants to this training program must be Officers in Charge of a Navigational Watch on seagoing ships of 500 gross tonnage or more who are holders of COC issued under Regulation II/1 of the 1978 STCW Convention, as amended in 1995.

3. EXEMPTION

Trainees who have already completed training on the "Operational Use of Electronic Chart Display and Information System (ECDIS) can be exempted from the training requirements under Function 1, Module 2 of this training program but shall still be subject to assessment covering the said module. However, if such trainee so intends to retake the aforesaid module, he may do so.

4. COURSE INTAKE LIMITATIONS

Maritime Training Institutions (MTIs) offering this training program shall ensure that trainees shall not exceed a maximum of **24 in each class**. For practical sessions, the following **man-machine ratio** shall apply:

- **3:1** for each bridge simulator exercise;
- **2:1** for each ECDIS practical exercise; and
- **2:1** for each cargo handling practical exercise using full mission cargo handling simulator or **1:1** when using desktop cargo handling simulator.

5. CERTIFICATE OF COURSE COMPLETION

Trainees who have successfully completed this training program and passed the assessment hereof shall be issued a Certificate of Training Completion. The format of such certificate shall be in accordance with the format prescribed by the Administration.

6. STAFF REQUIREMENTS

Every MTI offering this training program shall have a Training Supervisor, a minimum of two (2) Instructors and at least one (1) Assessor, who shall be subject to accreditation by the Administration and meet the general and specific qualification standards per function for an Instructor and an Assessor of the Management Level Course for Marine Deck Officers as provided for under MARINA STCW Circular No. 2014-04.

7. TRAINING FACILITIES

For the theoretical part of this training program, the MTI offering this training program shall provide *at least one (1) dedicated classroom* with *multimedia overhead projector*, *a computer set*, *white board and paraphernalia* needed, and other facilities needed. This does not however prevent METIs from utilizing additional teaching facilities to support learning.

8. TRAINING EQUIPMENT

For Function 1:

1. At least one (1) Bridge Simulator with:
    1.1. a valid "Type-approved Certificate" issued by an internationally recognized Classification Body stating the simulator's compliance with Regulation I/12 of the 1978 STCW Convention, as amended and showing the STCW Competence Standards that can be covered/addressed using such simulator;
    ~~1.2. mini station/s;~~
    ~~1.3. an Instructor Station;~~
    1.4. briefing room; and
    1.5. debriefing room.

2. An ECDIS Simulator with a valid "Type-approved Certificate" issued by an internationally recognized Classification Body stating the simulator's compliance with Regulation I/12 of the 1978 STCW Convention.

For Function 2:

1. Cargo handling simulator with a valid "Type-approved Certificate" issued by an internationally recognized Classification Body stating the simulator's compliance with Regulation I/12 of the 1978 STCW Convention, as amended and the competence standards that can be covered/addressed using such simulator; and

For Function 3:

1. Bridge Simulator as prescribed for Function 1; and
2. Cargo handling simulator as prescribed for Function 2.

9. TEXTBOOKS AND OTHER REFERENCES, VIDEOS AND OTHER TEACHING AIDS

MTIs offering this training program shall be responsible in determining and selecting the textbooks and other references that they will use, provided that the same shall be relevant and updated. The guidance and suggestions in the revised IMO Model Course 7.03 and 7.01 validated during the 44th Session of the IMO's Sub-Committee on STW may be considered in determining the textbooks, videos and other teaching aids that would be necessary to facilitate learning in this training program.

PART B
COURSE OUTLINE

MODULE	COMPETENCE AND TOPICS	HOURS ALLOCATED
FUNCTION 1. NAVIGATION AT THE OPERATIONAL LEVEL *(including selected KUPs leading to certain Competences in Navigation at the Management Level (ML)*		
F1 - Module 1	**Maintain a safe navigational watch**	
	1. Blind pilotage techniques	2
	2. The use of reporting in accordance with the General Principles for Ship Reporting Systems and with VTS procedures	2
	3. Bridge resource management	8
F1 - Module 2	**Use of ECDIS to maintain the safety of navigation**	
	1. Navigation using ECDIS:	
	1.1. Elements of ECDIS	10
	1.2. Watchkeeping with ECDIS	9
	1.3. ECDIS Route Planning and Monitoring	9
	1.4. ECDIS Targets, Charts & System	7
	1.5. ECDIS Responsibility & Assessment	6
F1 - Module 3	**Plan a voyage and conduct navigation (ML)**	
	1. Voyage planning and navigation for all conditions by acceptable methods of plotting ocean tracks	16
	2. Navigation and monitoring of the voyage	6
F1 - Module 4	**Determine position and the accuracy of resultant position fix by any means (ML)**	
	1. Position determination in all conditions	
	1.1. Using modern electronic navigational aids	10
F1 - Module 5	**Determine and allow for compass errors (ML)**	
	1. The principles and errors of the magnetic compass	
	1.1. The errors of the magnetic compass and their correction	4
	2. The principles and errors of gyro compasses	
	2.1. Gyro compass errors and correction	4
	3. Systems under the control of the master gyro and the operation and care of the main types of gyro-compasses	1

MODULE	COMPETENCE AND TOPICS	HOURS ALLOCATED
F1 - Module 6	**Forecast weather and oceanographic conditions (ML)**	
	1. Synoptic charts and weather forecasting	
	1.1. Synoptic and prognostic charts and forecasts from any source	3
	1.2. The range of information available through fax transmission, internet and email	1
	1.3. Weather Forecasting	8
	2. Characteristics of Various Weather Systems	
	2.1. Tropical revolving storms (TRS)	4
	2.2. The main types of floating ice, their origins and movements	2
	2.3. The guiding principles relating to the safety of navigation in the vicinity of ice	2
	2.4. Conditions leading to ice accretion on ship‘s superstructures, dangers and remedies available	2
	3. Ocean Current System	
	3.1. Surface water circulation of the ocean and principal adjoining seas	2
	3.2. The principle of voyage planning with respect to weather conditions and wave height	2
	3.3. The formation of sea waves and swell waves	1
	4. Calculation of tidal conditions	
	4.1. Ability to calculate tidal conditions	4
	5. Appropriate Nautical Publications on Tides and Currents	
	5.1. Nautical publications on tides and currents and information which can be obtained via internet and email	1
F1 - Module 7	**Operate remote controls of propulsion plant and engineering systems and services (ML)**	
	1. Operating principles of marine power plants	8
	2. Ships’ auxiliary machinery	4
	3. General knowledge of marine engineering system	4

MODULE	COMPETENCE AND TOPICS	HOURS ALLOCATED
FUNCTION 2. CARGO HANDLING AND STOWAGE AT THE OPERATIONAL LEVEL *(covering selected KUPs leading to certain Competence in Cargo Handling and Stowage at the Management Level (ML)*		
F2 - Module 1	**Plan and ensure safe loading, stowage, securing, care during the voyage and unloading of cargoes (ML)**	
	1. Effect on trim and stability of cargoes and cargo operations	8
F2 - Module 2	**Carriage of dangerous goods (ML)**	
	1. 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	2
	2. Carriage of dangerous, hazardous and harmful cargoes; precautions during loading and unloading and care during the voyage	14

FUNCTION 3. CONTROLLING THE OPERATION OF THE SHIP AND CARE FOR PERSONS ON BOARD AT THE OPERATIONAL LEVEL *(including selected KUPs leading to certain Competence in Controlling the Operation of the Ship and Care of Persons on board at the Management Level (ML)*		
F3 - Module 1	**Ensure compliance with pollution prevention requirements**	
	1. Importance of proactive measures to protect the marine environment	4
F3 - Module 2	**Application of leadership and team working skills**	
	1. Shipboard personnel management and training	20
	2. Related international maritime conventions and recommendations, and national legislation	
	3. Task and workload management	
	4. Effective resource management	
	5. Decision making techniques	

MODULE	COMPETENCE AND TOPICS	HOURS ALLOCATED
F3 - Module 3	**Control trim, stability and stress (ML)**	
	1. Fundamental principles of ship construction and the theories and factors affecting trim and stability and measures necessary to preserve trim and stability	
	1.1. Stability	24
	1.2. Effect on stability in the event of damage to and consequent flooding of a compartment and countermeasures to be taken	7
	1.3. IMO recommendations concerning ship stability	1
F3 - Module 4	**Monitor and control compliance with legislative requirements and measures to ensure safety of life at sea, security and the protection of the marine environment (ML)**	
	1. International maritime law embodied in international agreements and conventions, with regard to:	
	1.1. Certificates and other documents required to be carried on-board ships by international conventions	1
	1.2. Responsibilities under the relevant requirements of the International Convention on Load Lines	1
	1.3. Responsibilities under the relevant requirements of the International Convention for the Safety of Life at Sea	2
	1.4. Maritime declarations of health and the requirements of the International Health Regulations	1
	1.5. Responsibilities under other international maritime law embodied in international agreements and conventions that impact on the role of management level deck officers	
	1.5.1. Convention on Facilitation of International Maritime Traffic, 1965, as amended (FAL 1965)	1
	1.5.2. United Nations Convention on the Law of the Sea (UNCLOS)	1
	1.5.3. Maritime Labor Convention (MLC 2006)	2
	1.6. Responsibilities under international instruments affecting the safety of the ship, passengers, crew and cargo	2
	1.7. National legislation for implementing international agreements and conventions	1

TOTAL HOURS (Excluding Time for Assessment): 234

General Rule on Time Allocation:

METIs must note that the number of hours allocated for the topics in this Function are the minimum and can be increased as may be necessary to cover other topics that may be deemed necessary to further update the operational level officers subject herein.

PART C
COURSE SYLLABUS

COURSE SYLLABUS

FUNCTION 1

NAVIGATION AT THE OPERATIONAL LEVEL

(Including Selected KUPs Leading to Certain Competencies in the Management Level)

FUNCTION 1

MODULE 1: Maintain a Safe Navigational Watch

1.1.1. Blind pilotage techniques

1.1.1.1. Knowledge of navigational techniques used for safe navigation in restricted visibility

- explains the importance of using parallel index techniques using Radar
- describes the provisions for using video mapping on radar / ARPA

1.1.2. The use of reporting in accordance with the General Principles for Ship Reporting Systems and with VTS procedures

1.1.2.1. describes the use of reporting in accordance with the general principles for ship reporting systems and with VTS procedures

1.1.3. Bridge resource management

Note: *This part is intended to ensure that trainees can apply the generic leadership, teamwork and resource management competence developed in Function 3 to the bridge environment.*

1.1.3.1. describes the basic principles of bridge resource management

1.1.3.2. explains how responsibility for the safety is clearly defined at all times, including periods when the master is on the bridge and while under pilotage

1.1.3.3. demonstrates clear, concise communications and acknowledgements (at all times) in a seaman-like manner

1.1.3.4. demonstrates the allocation, assignment and prioritization of resources

1.1.3.5. demonstrates the importance of ensuring the effectiveness of communication between bridge team members

1.1.3.6. explains the importance of ensuring the effectiveness of information exchange with pilot

1.1.3.7. demonstrates effective information exchange

1.1.3.8. defines "situational leadership"

1.1.3.9. explains the relationship between assertiveness and leadership

1.1.3.10. explains the importance of challenge and response

1.1.3.11. explains the importance of obtaining and maintaining situational awareness

1.1.3.12. demonstrates appropriate challenges and responses

1.1.3.13. demonstrates the ability to maintain situational awareness in complex situations

FUNCTION 1

MODULE 2: Use of ECDIS to maintain the safety of navigation

Note: *METIs should also refer and ensure that the details of IMO Model Course 1.27 are adequately covered in setting their own Course Syllabu and Instructor's Guide / Lesson Plan.*

1.2.1. Knowledge and understanding of ECDIS

1.2.1.1. describes principal types of Electronic Chart System

1.2.1.2. describes the differences between Vector and Raster Charts

1.2.1.3. describes the terms and definitions used in the context of ECDIS

1.2.1.4. explains the major characteristics of ECDIS data such as data term and definition; data contents; data structure; attribute; data quality and it accuracy

1.2.1.5. describes the position reference system

1.2.1.6. describes ECDIS display characteristics

1.2.1.7. explains the scope and selection of chart data display categories

1.2.1.8. explains the safety value available in ECDIS

1.2.1.9. describes the automatic and manual functions of ECDIS

1.2.1.10. explains various sensors, its accuracy requirement and state proper action to take in case malfunction

1.2.1.11. describes the production and distribution of updates-manual, semi-automatic and automatic updating

1.2.1.12. describes the route planning and route monitoring in ECDIS

1.2.1.13. describes the route planning information; route planning calculation; calculation the voyage schedule; construction of a route; planned route checking for navigator safety; alternative route; optimization of route planning and ultimate route selection

1.2.1.14. explains route and voyage monitoring; check route measurement and calculations; navigation in open sea, coastal and confined waters using ECDIS; current and wind effects

1.2.1.15. demonstrates the uses of all specific functions and obtain all relevant information for route planning and monitoring for navigating and for the ship's safety:

- sea area selection,
- route planning information,
- construction of a route,

- adjustment of a planned route,
- curve track planning,
- planning notes,
- safety values,
- check for navigational safety,
- Ultimate route, monitored area,
- vector time,
- check measurements,
- alarms, and
- current and wind.

1.2.1.16. explains the meaning of Status Indications, Indicators and Alarm relating to ECDIS

1.2.1.17. explains the typical errors of interpretation and take proper action to avoid these errors

1.2.1.18. explains the meaning of voyage recording, operate the corresponding functions and the reconstruction of past track

1.2.1.19. describes the possible risk of over-reliance and complacency on ECDIS

FUNCTION 1

MODULE 3: Plan a voyage and conduct navigation (ML)

1.3.1. Voyage planning and navigation for all conditions by acceptable methods of plotting ocean tracks

Note: *METIs and instructors should include refresher topics about passage planning, position monitoring, chartwork, sailings using plane, mercator and great circle methods, tidal, meteorology and oceanography for Officers in charge of a Navigational Watch before proceeding to main content of this module.*

1.3.1.1. determines key parameters for the voyage to be planned and briefs officers appropriately

1.3.1.2. fully appraises all information that may be relevant to the voyage, including information from:

- Routeing and pilot charts,
- Ocean Passages of the World,
- Sailing Directions,
- Charts,
- IMO Routeing Guide,
- Lists of Lights,

- Lists of Radio Signals,
- Tidal and Tidal Stream Information,
- Loadline, insurance and charter party parameters,
- Port Information,
- Notices to mariners,
- Navigation Warnings,
- Meteorological information, and
- Vessel condition, draught, trim and handling characteristics.

1.3.1.3. plans voyages from berth to berth 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,
- areas of restricted/confined/pilotage waters,
- traffic separation schemes en-route,
- expected traffic density,
- operational requirements in terms of passage time and fuel consumption,
- areas of extensive tidal effects,
- ensuring adequate fuel, water and provisions,
- ensuring the safety of the personnel, property and the environment,
- ship reporting requirements in vessel traffic service (VTS) and other reporting areas, and
- vessel condition, draught, trim and handling characteristics.

1.3.1.4. ensures that charts, course cards and other voyage planning documentation, i.e. navigation notebooks etc accurately detail the plan and are prepared in accordance with industry practice including ECDIS where appropriate

1.3.1.5. ensures that positions, distances and ETAs or average speed required calculations completed using Mercator sailing, great circle sailing, composite great circle sailing and limited latitude sailing are accurate

1.3.1.6. ensures that there is adequate fuel, water and provisions on board for the voyage

1.3.1.7. ensures that all watchkeeping officers are fully briefed and familiar with the voyage plan

1.3.1.8. ensures that watchkeeping offers understand the circumstances in which they may deviate from the initial plan and the requirement to update the plan where this occurs

1.3.2. Navigation and monitoring of the voyage

1.3.2.1. plans and establishes parameters and guidance to watchkeeping officers to ensure that the navigation and monitoring of the voyage is appropriate for the area being navigated, with particular regard to navigation in areas of:

- restricted waters,
- meteorological conditions,
- ice,
- restricted visibility,
- traffic separation schemes,
- vessel traffic service (VTS) areas, and
- areas of extensive tidal effects.

1.3.2.2. ensures that the vessel's position is monitored using two or more independent position determination systems appropriate to the area

1.3.2.3. ensures that the vessel's position is determined at appropriate intervals and monitored continuously

1.3.2.4. ensures that the execution of the voyage plan is monitored and that any required alterations are appraised, evaluated and approved where these are outside the authority of the watchkeeping officer

FUNCTION 1

MODULE 4: Determine position and the accuracy of resultant position fix by any means (ML)

1.4.1. Position determination in all conditions using Modern Electronic Navigational Aids

1.4.1.1. 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

Note: *MTIs and instructors should include refresher topics about the principles, operation, limitations and errors of electronic navigational aids for Officers in charge of a Navigational Watch, such as Loran C, e-Loran, GNSS including GPS and augmented satellite systems, Echo Sounders and Speed Measurement systems, before proceeding to main content of this module.*

- ensures that the most appropriate electronic systems and electronic navigation aids are used for position monitoring in any area given the information the system may provide and the limitations, errors and accuracy of the available system
- verifies that each electronic navigation aid used is set up and operated effectively
- provides guidance and support to cadets and watchkeeping officers in the correct set up and use of electronic navigation aids
- assesses the accuracy of position monitoring using electronic navigation aids
- ensures that the vessel position is determined at appropriate frequencies and monitored continuously using the most appropriate electronic navigation aids available and this is cross checked with terrestrial or celestial observations where these are possible.

1.4.1.2. Integrated Navigation system (INS) and Integrated Bridge system (IBS)

- 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 potential dangers and degradation of integrity of this information
- evaluate 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 centralized 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

FUNCTION 1

MODULE 5: Determine and allow for compass errors (ML)

1.5.1. The principles and errors of the magnetic compass

1.5.1.1. The errors of the magnetic compass and their correction

- explains the importance of keeping a record of observed deviations
- determines deviations and prepares a table or graph of deviations
- defines the approximate coefficients A, B, C, D and E
- states the equation for the deviation on a given heading in terms of the coefficients
- describes the conditions which give rise to each of the coefficients
- explains the use of the approximate coefficients A, B,C, D and E
- describes why coefficients A and E may exist at a badly sited compass
- explains the non-magnetic causes of an apparent coefficient A
- explains that coefficient B results partly from the ship's permanent magnetism and partly from induced
- explains that induced magnetism may also contribute to coefficient C in a badly sited compass
- describes how the deviation associated with the coefficient permanent B varies with magnetic latitude

- describes how the deviation associated with the coefficient induced B varies with magnetic latitude
- explains why the deviation due to permanent magnetism should be compensated by permanent magnets and that due to induced magnetism by spherical soft iron correctors, where possible
- describes the causes of heeling error and how it varies with heel, course and magnetic latitude
- describes the correction of heeling error and why the correction does not remain effective with change of magnetic latitude
- defines the constants lambda 1 and lambda 2
- defines the constant mu
- explains how the soft iron spheres increase the mean directive force towards magnetic north and that the value of lambda with the spheres in place is called the ship's multiplier
- describes the vertical force instrument and its use in correcting heeling error
- describes methods of obtaining a table of deviations
- analyses a table of deviations to obtain approximate coefficients
- states that anything which could affect the deviation of the compass should be stowed in its sea-going position before correcting it
- explains the adjustment of the compass by the analysis and/or tentative methods and obtains a table of residual deviations
- states the order in which corrections should be made and explains why they are made in that order
- describes how heeling error may produce an unsteady compass on certain headings after a large change of magnetic latitude and how to deal with it
- explains why a large coefficient B may appear after a large change of magnetic latitude and how to correct it
- describes how sub-permanent magnetism gives rise to retentive error
- states that deviations may be affected by cargo of a magnetic nature, the use of electro-magnets for cargo handling, or repairs involving hammering or welding of steelwork in the vicinity of the compass
- defines the magnetic moment of a bar magnet as the product of the pole strength and the length of the magnet
- states that, for a suspended magnet vibrating in a magnetic field, T2 is proportional to 1/H, where T is the period of vibration and H is the field strength
- explains how the relative strengths of two fields may be found

1.5.2. The principles and errors of gyro compasses

1.5.2.1. Gyro compass errors and correction

- 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
- 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 behavior of a liquid ballast 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 inter-cardinal rolling error is reduced to negligible proportions
- states that inter-cardinal 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

1.5.3. Systems under the control of the master gyro and the operation and care of the main types of gyro-compasses in use at sea

1.5.3.1. defines the main systems under the control of the master gyro

1.5.3.2. defines the main types of gyro-compass in use at sea

1.5.3.3. refers to manufacturers' manuals to determine necessary maintenance tasks

FUNCTION 1

MODULE 6: Forecast weather and oceanographic conditions (ML)

1.6.1. Synoptic charts and weather forecasting

1.6.1.1. Synoptic and prognostic charts and forecasts from any source

- 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
- determines the likely movement of pressure systems
- evaluates the use of prognostic charts
- evaluates the information given in shipping forecasts
- evaluates the information received from internet and email

1.6.1.2. The range of information available through fax transmission, internet and email

- 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

1.6.1.3. Weather Forecasting

- forecasts anticipated local weather from synopsis and prognosis information received, the movement of meteorological systems, knowledge of local influences, observation of local conditions and movement of own ship

1.6.2. Characteristics of Various Weather Systems

1.6.2.1. Tropical revolving storms (TRS)

- 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 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

1.6.2.2. The main types of floating ice, their origins and movements

- 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

1.6.2.3. The guiding principles relating to the safety of navigation in the vicinity of ice

- 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

1.6.2.4. Conditions leading to ice accretion on ship‘s superstructures, dangers and remedies available

- 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 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

1.6.3. Ocean Current System

1.6.3.1. Surface water circulation of the ocean and principal adjoining seas

- 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
- 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

1.6.3.2. The principle of voyage planning with respect to weather conditions and wave height

- 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

1.6.3.3. The formation of sea waves and swell waves

- 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

1.6.4. Calculation of tidal conditions

1.6.4.1. Ability to calculate tidal conditions

- 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 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)

1.6.5. Appropriate Nautical Publications on Tides and Currents

1.6.5.1. Nautical publications on tides and currents and information which can be obtained via internet and email

- 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

FUNCTION 1

MODULE 7: Operate remote controls of propulsion plant and engineering systems and services (ML)

1.7.1. Operating principles of marine power plants

1.7.1.1. 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

1.7.1.2. 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
- 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

1.7.1.3. 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

1.7.1.4. 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

1.7.1.5. Bridge Control

- 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)

1.7.2. Ships’ auxiliary machinery

1.7.2.1. Auxiliary Steam Systems

- 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 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

1.7.2.2. 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

1.7.2.3. 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

1.7.2.4. 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
- 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

1.7.2.5. 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

1.7.2.6. 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

1.7.2.7. Stabilisers

- Describes the construction and operation of fin stabilizers
- Describes the arrangement and operation of a flume stabiliser

1.7.2.8. Sewage Treatment Plants

- Describes the operation of a chemical sewage treatment plant
- Describes the operation of a biological sewage treatment plant

1.7.2.9. 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

1.7.2.10. Incinerators

- Describes the functioning of a waste incinerator

1.7.2.11. 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

1.7.2.12. 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

1.7.3. General knowledge of marine engineering system

1.7.3.1. Marine Engineering Terms and Fuel Consumption

- 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 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:

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

– 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

1.7.3.2. Arrangements necessary for appropriate and effective engineering watches to be maintained for the purpose of safety under normal circumstances and ums operations

– 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

1.7.3.3. Arrangements necessary to ensure a safe engineering watch is maintained when carrying dangerous cargo

– Describes the arrangements necessary to ensure a safe engineering watch is maintained when carrying dangerous cargo

COURSE SYLLABUS

FUNCTION 2

CARGO HANDLING AND STOWAGE AT THE OPERATIONAL LEVEL

(Including Selected KUPs Leading to Certain Competencies in the Management Level)

FUNCTION 2

MODULE 1: Plan and ensure safe loading, stowage, securing, care during the voyage and unloading of cargoes (ML)

2.1.1. Effect on trim and stability of cargoes and cargo operations

2.1.1.1. Draught, Trim and Stability

- Given the draughts forward, aft and amidships, calculates 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
- Plans the loading and movement of cargo and other deadweight items to achieve specified draughts and/or stability conditions in terms of required statical and dynamic stability

FUNCTION 2

MODULE 2: Carriage of dangerous goods (ML)

2.2.1. 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

2.2.1.1. International Regulations and Codes

- Understands and applies the content the of International Regulations Standards, Codes and Recommendations on the carriage of dangerous cargoes, including the International Maritime Dangerous Goods (IMDG) Code, the International Maritime Solid Bulk Cargoes (IMSBC) Code

2.2.2. Carriage of dangerous, hazardous and harmful cargoes; precautions during loading and unloading and care during the voyage

2.2.2.1. Dangerous Goods in Packages

- 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
- Lists the explosives which may be carried on a passenger ship
- Describes the contents of the shipper‘s declaration of 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
- Verifies that the documentation provided to the ship and the packaging and labelling of packaged dangerous cargo complies with the requirements of the IMDG Code
- Explains the actions to take when documentation, packaging, labelling or the condition of packages does not meet the requirements of the IMDG Code
- Plans the stowage and segregation of a cargo containing dangerous goods when provided with the loading list, the copies of the shipper‘s declarations and the IMDG code to plan a stow and segregation and prepares the dangerous goods manifest and stowage plan for a cargo containing multiple dangerous goods

- Extracts the relevant references to EmS and MFAG
- Identifies the appropriate action to take in emergency and medical first aid situations involving dangerous goods
- 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 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 1, general provisions, definitions and training
  - part 2, classifications
  - part 4, packing and tank provisions
  - part 5, consignment procedures
  - part 6, construction and testing of packagings, intermediate bulk containers (IBCs), large packagings, portable tanks, multi-element gas containers (MEGCS) and road tank vehicles
  - part 7, requirements 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
  - 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 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
  - ensure the correct handling, stowage, segregation etc,
  - 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
- 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
- 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, by headings, the information given in an emergency schedule
- 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 substance
- 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
- 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
- Explains 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

2.2.2.2. Solid Bulk Cargoes

- Outlines the contents of the 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
- 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
- Explains how to distribute a high-density cargo between holds when detailed information is not available
- States that the loading instrument, loading information and the ship's stability information book and calculator should be used to check the suitability of a proposed stow for stresses and stability
- Describes how to prevent shifting of bulk cargo by reducing an excessively high GM
- Describes precautions to take before, during and after loading of bulk cargo
- Describes the precautions to take to minimise 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 national regulations should be complied with during the handling and carriage of bulk materials
- Sates that a copy of the Medical First Aid Guide for Use in Accidents Involving Dangerous Goods should be on board
- 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
- Explains the IMSBC code method for determining the approximate 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 categorizes cargoes into three groups - A, B and C:
    - 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 the content and use of the following: that in the added supplement of the IMSBC code, the IMO documents contained are:
    - The BLU code
    - The BLU manual
    - 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.1050(27) - 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

2.2.2.3. International Code for the Safe Carriage of Grain in Bulk (International Grain Code)

- 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
- Explains that the International Code for the Safe Carriage of Grain in Bulk (International Grain Code) are based on the recognition that grain like cargoes have a propensity to shift and that even fully loaded cargo spaces may contain voids that allow dangerous cargo shifts
- Defines the following terms as used in chapter VI of SOLAS:
  - grain
  - filled compartment
  - partly filled compartment
  - angle of flooding
- Explains that the Code requires 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 an assumed shift of cargo
- States the Code requirements for minimum stability in terms of initial meta centric height, angle of heel due to assumed grain shift and residual dynamic stability
- Explains that vessels with appropriate design features may be able to meet the required minimum stability criteria after the assumed movement of cargo without taking further physical precautions to reduce the shift of cargo
- Explains the stability and grain loading information that is required to be provided for such vessels if they are to receive a Document of Authorisation

- Explains the method of verifying that the loading of a vessel supplied with a Document of Authorisation meets stability requirements using volumetric heeling moments, cargo details and maximum deadweight heeling moments
- 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 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 importance of trimming to fill all of the spaces under decks and hatch covers to the maximum extent possible
- States that the ability to comply with the stability criteria should be demonstrated before loading
- States that the master should ensure that the ship is upright before proceeding to sea
- Explains the use of physical precautions to reduce cargo movement
- Describes the use and fitting of longitudinal divisions in both filled and partly filled compartments
- Demonstrates the use of Part C of the Code to determine the scantlings for uprights and shifting boards
- 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 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 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

COURSE SYLLABUS

FUNCTION 3

CONTROLLING THE OPERATION OF THE SHIP AND CARE FOR PERSONS ON BOARD AT THE OPERATIONAL LEVEL

(Including Selected KUPs Leading to Certain Competencies in the Management Level)

FUNCTION 3

MODULE 1: Ensure compliance with pollution prevention requirements

3.1.1. Importance of proactive measures to protect the marine environment

3.1.1.1. explains the need for taking proactive measures to protect the marine environment

3.1.1.2. describes the proactive measures that can be taken on board the ships to protect the marine environment for shipboard operations, including:

- bunkering;
- loading / discharging Oil, Chemicals and hazardous cargoes;
- tank cleaning;
- cargo hold washing;
- pumping out bilges (hold and engine room);
- ballast water exchange;
- purging and Gas freeing;
- disposal of other garbage; and
- discharge of sewage.

FUNCTION 3

MODULE 2: Application of leadership and team working skills

3.2.1. Shipboard personnel management and training

3.2.1.1. Organization of crew, authority structure, responsibilities

- Describes typical shipboard organization
- Explains management level, states positions and describes roles
- Explains operational level, states positions and describes roles
- Explains support level, states positions and describes roles
- Outlines chain of command

3.2.1.2. Cultural awareness, inherent traits, attitudes and behaviors, cross-cultural communication

- Explains cultural awareness
- Gives examples of inherent cultural traits
- Explains association between inherent traits, attitudes and behaviors
- Describes special care needed in cross-cultural communication, especially on board ship

3.2.1.3. Shipboard situation, informal social structures on board

- Describes common informal structures with multi-cultural crews
- Explains why informal social structures need to be recognized and allowed for
- Describes actions to improve cross-cultural relationships

3.2.1.4. Human error, situation awareness, automation awareness, complacency, boredom

- Explains terms "active failures" and "latent conditions"
- Explains errors of omission and errors of commission
- Describes and explains a typical error chain
- Explains situation awareness and gives a shipboard example
- Describes actions subsequent to a near miss
- Describes linkage between automation, complacency and boredom
- Describes actions to address complacency and boredom

3.2.1.5. Leadership and teamworking

- Explains functional and designated leadership
- Describes leadership qualities including self-awareness, situation awareness, interpersonal skills, motivation, respect
- Describes leadership characteristics, including persona, assertiveness, decisiveness, applying emotional intelligence
- Describes leadership techniques, including, leading by example, setting expectations, providing oversight, delegating
- Outlines the differences between team and group behavior
- Describes the advantages of a team approach in shipboard operations
- States the difference between a "standing team" and a "mission" or "task" team
- Explains "team-of-one" and why it is common on board
- States the features of good team communications

3.2.1.6. Training, structured shipboard training program

- Outlines importance of structured shipboard training
- Describes effective implementation of structured shipboard training

- Explains responsibility of officers to provide structured shipboard training
- Describes mentoring and coaching
- Describes how trainee progress through shipboard training programs is assessed
- Describes recording and reporting of trainee progress
- Describes company involvement in structured shipboard training programs
- Explains that training programs have to be adjusted to suit ship's operational needs

3.2.2. Related international maritime conventions and recommendations, and national legislation *(Note: Emphasis of this topic must be on human factors, not on technical factors)*

3.2.2.1. International maritime conventions

- Outlines intent, history and application of SOLAS convention, including the ISM and ISPS Codes
- Outlines intent, history and application of MARPOL Convention
- Outlines intent, history and application of STCW Convention and role of STW Sub-Committee
- Outlines intent, history and application of Maritime Labour Convention
- Describes the role of IMO with respect to maritime conventions
- Describes the role of ILO with respect to maritime conventions
- Describes how IMO and ILO collaborate with respect to maritime conventions
- Explains how convention provisions are implemented
- Explains role of flag state in implementing provisions of maritime conventions
- Explains role of port state in implementing provisions of maritime conventions

3.2.2.2. Recommendations and state legislation

- Explains how recommendations differ from regulations
- Describes the IMO guidelines on the mitigation of fatigue
- Describes the IMO principles of safe manning and the guidelines for their implementation
- Gives examples of recommendations and state legislation dealing with human factors

3.2.3. Task and workload management

3.2.3.1. Planning and coordination

- States what planning means with respect to individuals and groups
- Describes how planning outcomes are measured
- Describes the role of feedback with respect to planning outcomes
- Defines coordination
- Gives examples of shipboard coordination

3.2.3.2. Personnel assignment

- States what personnel assignment means
- Gives examples of personnel assignment on board

3.2.3.3. Human limitations

- Describes common human limitations such as fatigue, misunderstanding, and complacency
- Describes onboard activities that test human limitations, including use of technology
- Describes indicators that human limitations are being exceeded
- Explains steps taken to avoid pushing crew members beyond personal limitations
- Explains how hidden pressures can cause personal limitations to be exceeded
- Describes the consequences of pushing a person beyond their personal limitations
- Outlines STCW 2011 "Fitness for Duty" requirements

3.2.3.4. Time and resource constraints

- Gives examples of time constraints
- Describes factors that cause time constraints
- States how time constraints are usually addressed on board
- Gives examples of resource constraints
- Describes factors that cause resource constraints
- States how resource constraints are usually addressed on board

3.2.3.5. Personal abilities

- States personal characteristics essential to effective leadership and teamwork on board
- Describes own abilities contributing to leadership and teamwork on board
- Describes how personal characteristics are managed and strengthened
- Explains how to personally contribute to leadership and teamwork on board

3.2.3.6. Prioritization

- Gives examples of prioritization
- Explains why prioritization is necessary

3.2.3.7. Workloads, rest and fatigue

- Describes own shipboard workload
- Explains the dangers of high workload
- Explains the disadvantages of low workload
- Describes how workload can be assessed
- Describes how to ensure an appropriate workload
- States the provisions for seafarers to get adequate rest
- Describes recording of hours of rest
- Describes signs of fatigue
- Explains how fatigue can result in very serious consequences
- Gives examples of fatigue management guidelines and regulations

3.2.3.8. Management (leadership) styles

- Explains how leadership and management differ
- Explains and gives examples of designated and functional leadership
- States leadership qualities
- Describes leadership techniques
- Describes development of an effective leadership persona
- Explains the need for a leader to "have an honest look at himself or herself"

3.2.3.9. Challenges and responses

- Explains what is meant by a "challenge and response" environment
- Explains why a challenge and response environment is not always appropriate
- States when an authoritarian approach is justified
- Describes "chain of command"

3.2.4. Effective resource management

3.2.4.1. Effective communication aboard and ashore

- Describes the essence of effective communication
- States the main components of a communication system
- States the barriers to effective communication
- Describes four lines of communication
- Describes effective communication techniques
- Explains why closed loop communication is used when maneuvering the ship
- Describes communication protocols commonly used at sea
- Gives examples of internal and external communication
- Explains how communication with people ashore may differ from communication on board
- Explains what needs to be done to create a good communication climate

3.2.4.2. Allocation, assignment and prioritization of resources

- Outlines the resources to be managed aboard a ship at sea
- Describes how use of resources is managed
- Gives examples of shipboard resource allocation, assignment and prioritization

3.2.4.3. Decision making reflecting team experience

- Describes how to get the best out of a team
- Describes allocation of work based on competence
- Explains that good teamwork and leadership are indivisible
- Explains how a good leader can exploit a team dynamic

3.2.4.4. Assertiveness and leadership, including motivation

- Describes the leadership required of a junior watchkeeper
- Explains why assertive leadership may not be effective
- Describes how an individual or a team may be motivated and de-motivated

3.2.4.5. Obtaining and maintaining situation awareness

- Gives examples of situation awareness while watchkeeping
- Gives examples of lack of situation awareness while watchkeeping
- Describes how modern electronic aids can lead to lack of situation awareness
- Explains the dangerous link between fatigue and situation awareness

3.2.4.6. Appraisal of work performance

- Describes how work performance can be appraised
- States the benefits of effective work performance appraisal

3.2.4.7. Short and long term strategies

- Defines strategy
- Explains the role of short term strategies in effective onboard resource management
- Describes when the use of short term strategy is necessary
- Explains the role of long term strategies in effective onboard resource management

3.2.5. Decision making techniques

3.2.5.1. Situation and risk assessment

- Explains how a situation is assessed and gives an example
- States key characteristics of situation assessment
- Describes how situation awareness may be weakened
- Defines risk
- Describes the relationship between situation assessment and risk
- Describes how risk may be assessed
- Describes how risk may be managed
- Explains the role of risk assessment in risk management
- Describes the role of situation and risk assessment in decision making

3.2.5.2. Identify and consider generated options

- Gives examples of consideration of options available
- Describes how an option may be created
- Describes the role of leadership in creating options

3.2.5.3. Selecting course of action

- States obligation to identify most appropriate course of action
- Describes considerations in identifying most appropriate course of action

3.2.5.4. Evaluation of outcome effectiveness

- Gives examples of outcomes of shipboard courses of action
- Describes how the outcome of a course of action can be assessed
- Describes possible follow-up actions once outcome is assessed

3.2.5.5. Decision making and problem solving techniques

- Gives examples and explains problem solving techniques

3.2.5.6. Authority and assertiveness

- Explains the various forms of authority
- Describes the form of authority found on board a ship
- Gives meaning of assertiveness
- Describes shipboard situations justifying greater assertiveness

3.2.5.7. Judgment

- Gives meaning of judgment
- Explains difference between "reality judgment" and "value judgment"
- Gives example of use of judgment on board

3.2.5.8. Emergency management

- Describes the most common shipboard emergencies
- States leadership requirements when dealing with a shipboard emergency
- Describes the preparations for dealing with a shipboard emergency

FUNCTION 3

MODULE 3: Control trim, stability and stress (ML)

3.3.1. Fundamental principles of ship construction and the theories and factors affecting trim and stability and measures necessary to preserve trim and stability

3.3.1.1. **Stability**

3.3.1.1.1. 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

  $A = h (y1 + 4y2 + y3) / 3$

  where: A = area under curve
  h = interval length
  y1, y2, y3 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

  $A = 3h (y1 + 3y2 + 3y3 + y4) / 8$
  where: A = area
  h = interval length
  y1, y2, y3, y4 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(5y1 + 8y2 - y3) / 12

  where: A = area between first and second ordinates
  h = interval length
  y1, y2, y3, 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
- Uses Simpson‘s first, second and 5/8-1 Rules to approximate areas and volumes of ship structure and GZ curves with any number of ordinates and intermediate ordinates

3.3.1.1.2. 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
- Discusses the use of the Fresh Water Allowance and how to determine this for a ship
- 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
- States that the virtual rise of G or apparent reduction in effective GM due to free surface affect (in metres) at small can be calculated
- Describes the statical and dynamic effects on stability of the movement of liquids with a free surface
- Calculates the virtual reduction in GM for liquids with a free surface in spaces with rectangular and triangular waterplanes
- 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 the 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 ship's stability information 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 allowing for free surfaces on arrival at destination

3.3.1.1.3. Stability at Moderate and Large Angles of Heel

- States that the formula GZ = GM sin θ 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:
$GZ = (GM + BM / 2 \tan^2\phi) \sin\phi$
and other relevant data, calculates the value of GZ for a stated angle of heel

– 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

3.3.1.1.4. 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 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

3.3.1.1.5. Trim and List

- Defines longitudinal centre of gravity (LCG) and longitudinal centre of buoyancy (LCB)
- 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) = $\Delta \times GG_1$

  Where: GG1 is the horizontal distance between the position of LCG for the even- keel condition and the actual LCG
- States that trim = $(\Delta \times GG_1) / MCT\ 1cm$
- 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
- 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

3.3.1.1.6. 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 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

3.3.1.1.7. Approximate GM by Means of Rolling Period Test

- 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 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, GMo 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 $GMo = F / T^2$, 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

3.3.1.1.8. The Intact Stability Code

- Describes the general precautions to be taken against capsizing
- States the recommended criteria for passenger and cargo ships of all types
- 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
- Discusses the use of the weather criterion and how to assess whether a vessel complies with this
- 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

3.3.1.1.9. Intact Stability Requirements for the Carriage of Grain

- 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 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

3.3.1.1.10. Rolling of Ships

– 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

– 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

$$\tan\theta = \frac{v^2 \times \left(KG - \frac{d}{2}\right)}{g \times GM \times r}$$

3.3.1.1.11. Dry-docking and Grounding

– 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 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
- 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

3.3.1.1.12. Shear Force, Bending Moments and Torsional Stress

- 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 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

3.3.1.2. **Effect on stability in the event of damage to and consequent flooding of a compartment and countermeasures to be taken**

3.3.1.2.1. Effect of flooding on Transverse Stability and Trim

Passenger Vessels

- Explains what is meant by 'floodable length'
- Defines:
  - margin line
  - bulkhead deck
  - permeability of a space
- Explains what is meant by permissible length of compartments' in passenger ships
- Describes briefly the significance of the Criterion of Service Numeral

- Explains the significance of the factor of subdivision
- States the assumed extent of damage used in assessing the stability of passenger ships in damaged condition
- Summarises, 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 requirements for the final condition 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 minimum residual stability requirements in the damaged condition with the required number of compartments flooded
- Discusses the use of the damaged stability information required to be provided to the Master of a passenger vessel

Cargo Ships

- Distinguishes between ships of Type A and Type B for the purpose of computation of freeboard
- Describes the extent of damage that a Type A ship of over 150 m in length should be able to withstand
- Explains that a Type A ship of over 150m in length is described as a one compartment ship
- Describes the requirements for the survivability of Type B ships with reduced assigned freeboard
- 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 a loss of stability
  - structural failure

Calculation of Vessel Condition After Flooding

- States that, in the absence of hull damage, the stability is calculated in the usual way using the added mass and making allowance for free surface liquid
- States that free surface moments for any rectangular compartment that is flooded by salt water can be approximated by

$$\text{moment} = \text{length} \times (\text{breadth})^3 \times 1.025 / 12$$

- States that virtual loss of GM = $\frac{\text{moment}}{\text{flooded displacement}}$.
- 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 holed 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:

$$\text{increase in draught} = \frac{\text{volume of lost buoyancy}}{\text{area of intact waterplane}}$$

- 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 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 $\frac{lb^3}{12V}$ 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 $\frac{\text{waterplane area}}{\text{intact waterplane area x } l.b.d^2 / V}$

    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 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

Effects 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} / displaced 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

- 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

3.3.1.2.2. Theories Affecting Trim and Stability

- Describes the static and dynamic effects on stability of liquids with a free surface 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 terms synchronous and parametric rolling and pitching and describes the dangers associated with it
- Describes the actions that can be taken to stop synchronous and parametric effects

3.3.1.3. **Knowledge of IMO recommendations concerning ship stability**

3.3.1.3.1. Responsibilities under the International Conventions and Codes

- States minimum stability requirements required by Load Line Rules 1966
- States the minimum stability requirements and recommendations of the Intact Stability Code
- Explains the use of the weather criterion
- Demonstrates correct use of IMO Grain Regulations
- Explains how grain heeling moment information is used
- Describes the requirements for passenger ship stability after damage

FUNCTION 3

MODULE 4: Monitor and control compliance with legislative requirements and measures to ensure safety of life at sea, security and the protection of the marine environment (ML)

3.4.1. International Maritime Law Embodied in International Agreements and Conventions, with regard to:

3.4.1.1. **Certificates and other documents required to be carried on-board ships by international conventions**

- states that IMO publishes a list of certificates and documents required to be carried on board ship
- states how a current version of the IMO list of certificates and documents required to be carried on board ship may be obtained
- identifies the certificates required by MLC (2006) to be carried on board ship
- identifies the certificates and documents that are required to be carried on board a ship of any type using the IMO information
- states the period of validity for each of the above certificates and explains the requirements for renewing or maintaining the validity of each
- explains how each of the certificates and documents required to be carried on board ships are obtained
- explains the proof of validity that may be required by authorities for the certificates and documents above

3.4.1.2. **Responsibilities under the relevant requirements of the International Convention on Load Lines**

- states that a ship to which the Convention applies must comply with the requirements for that ship
- explains the general requirements of the Conditions of Assignment to be met before any vessel can be assigned a loadline
- describes the factors that determine the freeboards assigned to a vessel
- describes the requirements and coverage of initial, renewal and annual surveys
- describes the contents of the record of particulars which should be supplied to the ship
- explains the documentation and records that must be maintained on the ship in terms of:
  - certificates
  - record of particulars
  - record of freeboards
  - information relating to the stability and loading of the ship
- 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, 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
- describes the preparation required for renewal and annual loadline surveys
- 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
- 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
- explains the treatment of a port lying on the boundary between two zones or areas
- explains the circumstances in which an International Load Line Certificate (1966) would be cancelled by the Administration

3.4.1.3. **Responsibilities under the relevant requirements of the International Convention for the Safety of Life at Sea**

- 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 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
- 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
- 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 necessary for the voyage
- states which ships should carry the International Code of Signals

1.1.1. **Maritime declarations of health and the requirements of the International Health Regulations**

.1 **Arrival Documents and Procedures**

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
- 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 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 concerning cargo and goods
- describes the measures concerning baggage

Plague

- 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
- 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 required 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

1.1.2. **Responsibilities under other international maritime law embodied in international agreements and conventions that impact on the role of management level deck officers**

.1 Convention on Facilitation of International Maritime Traffic, 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
  - dangerous goods manifest
- 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 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

.2 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 defines the legal status of the high seas and establishes regulations for the control of marine pollution

- 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 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
- 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 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)
- 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 harbors conditional on meeting additional pollution regulations

.3 Maritime Labor Convention (MLC 2006)

- explains that the Maritime Labor Convention, 2006 is an important new international labor Convention that was adopted by the International Labor Conference of the International Labor 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 Labor Convention, 2006 has two primary purposes:
    - to bring the system of protection contained in existing labor 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 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 Labor 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 Labor Convention, 2006 as it contains a comprehensive set of global standards, based on those that are already found in 68 maritime labor instruments (Conventions and Recommendations), adopted by the ILO since 1920
- states that the new Convention brings almost all of the existing maritime labor 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 Labor Certificate as well as a Declaration of Maritime Labor Compliance
- states that ships below 500 GT are subject to inspection at intervals not exceeding three years
- explains that the existing ILO maritime labor 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 Labor Convention, 2006 will no longer be bound by the existing Conventions when the new Convention 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 Labor Certificate and Declaration of Maritime Labor 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
  - **Labor-supplying Responsibilities:** Recruitment and Placement services, Social security provisions

– explains that it occasionally contains new subjects in comparison to the existing ILO Maritime labor 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 labor standards as the aim is to maintain the standards in the current maritime labor 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 Labor 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 labor inspections for ships above 500 gross tonnage 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 labor certificate and a declaration of maritime labor 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 labor certificate and a declaration of maritime labor compliance

– explains that the Maritime Labor 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 labor 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 labor 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 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

1.1.3. Responsibilities under international instruments affecting the safety of the ship, passengers, crew and cargo

.1 Ballast Water Convention 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 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, Regulation 28 – 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

.2 Port state control

– 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 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 substandard 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

– identifies how to ascertain which port state agreement a particular port state might be party to and any areas of particular focus that may currently be in place

– outlines that the list of certificates and documents which are checked during the inspection are:

1. International Tonnage Certificate (1969);
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 (MLC and STCW);
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 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)
- 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 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 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;
  - 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 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 organizations provide information to Equasis and is used heavily by charterers and insurers as well as marine Administrations with port State control functions

1.1.4. National legislation for implementing international agreements and conventions

- explains the process by which international agreements and conventions are ratified and implemented into national legislation

(End of the Training Program)