भारत सरकार / GOVERNMENT OF INDIA
पत्तन, पोत परिवहन और जलमार्ग मंत्रालय
MINISTRY OF PORTS, SHIPPING AND WATERWAYS
नौवहन महानिदेशालय, मुंबई
DIRECTORATE GENERAL OF SHIPPING, MUMBAI

File No.13-40011/1/2023-O/o ENGG - DGS **May 24, 2024**

DGS Order No. 9 of 2024

Subject: MEO NCV Grade Certificates of Competency- Review of the Course curriculum, Eligibility, Examination, Assessment and Certification.	
References:	a) MS Notice No.16 of 2008 b) MS Notice No.02 of 2010 c) STCW Circular No.18 of 2012 d) STCW Circular No.21 of 2012 e) STCW Circular No.22 of 2012 f) STCW Circular No.23 of 2012

1. WHEREAS the International Maritime Organization (IMO) amended the Standards of Training, Certification and Watchkeeping for Seafarers (STCW Convention) and the STCW Code in 2010 through the Manila amendments, which had introduced newer regulations, bringing-in more clarity into the requirements governing 'Near Coastal Voyage'(NCV) Certificates of Competency.

2. Whereas, the GoI through the Merchant Shipping (Standards of Training, Certification and Watch-keeping for Seafarers) Rules, 2014, introduced newer grades of NCV Certificates of Competency (CoC) and prescribed minimum requirements, the details of which are as under:
   - Rule 44: Marine Engineer Officer Class II (NCV) (Second Engineer Officer on ships, other than Tankers, powered by main propulsion machinery of between 3000 KW to 8000 kW, operating in Near-Coastal Voyages).

ships, other than Tankers, powered by main propulsion machinery of between 3000 KW to 8000 kW, operating in Near-Coastal Voyages).

- Rule 45: Marine Engineer Officer Class I (NCV) (Chief Engineer Officer on ships other than Tankers powered by main propulsion machinery of between 3,000 kW and 8,000 kW on Near-Coastal Voyages).

3. Whereas the Directorate General of Shipping (DGS) had outlined the detailed course curriculum for the preparatory courses of the above NCV grades, vide DGS (STCW) Circulars No. 22 & 23 of 2012.

4. Recognizing, that the Course curriculum for the above referred read along with the career progression flow diagrams for a NCV marine engineer to proceed to the higher grade of CoC with enhanced propulsion power, introduced in the TEAP Manual Part 'A' have not evoked the desired interests amongst the NCV engineers, the Directorate General of Shipping, constituted a committee to identify and suggest feasible modifications to the above Course to facilitate smooth career progression of NCV Engineers.

5. Whereas the Committee constituted with representation of domain experts from various industry organizations and professional bodies, after several deliberations on the level of knowledge, understanding and proficiency required under the different sections listed in the Column 2 of the table A-III/2 of the STCW Code, submitted its recommendations.

6. Now therefore, the Director General of Shipping, after due examination of the report and its recommendations against the requirements of the STCW'78 Convention as amended, issues the appended EAC Circular for the information and compliance of all stakeholders.

24/05/24

(Shyam Jagannathan)

Director General of Shipping

To

1. The Principal Officers, Mercantile Marine Department, Mumbai/Kolkata/Chennai/Kandla/Kochi.
2. The Surveyor-in-Charge, Mercantile Marine Department, Goa/Jamnagar/Port Blair/Visakhapatnam/Tuticorin/Noida/Haldia/Paradip/Mangalore
3. Indian National Shipowner's Association (INSA), Mumbai.
4. Indian Coastal Conference Shipping Association (ICCSA), Mumbai
5. Institute of Marine Engineers (India)
6. The Chief Surveyor with the Govt.of India
7. Engineering Wing
8. Training Branch
9. Hindi cell
10. Computer cell

DGS Circular No. 13 of 2024
(EAC Branch (Engineering))

File No.13-40011/1/2023-O/o ENGG - DGS	Date: 24/05/2024

Sub: MEO NCV Grade Certificates of Competency- Review of the Course curriculum, Eligibility, Examination, Assessment and Certification.

I. STRUCTURE OF THE COURSE

(A) MEO (SEO-NCV):

1. The Course for NCV Second Engineer Officer (SEO) grade Certificate of Competency examinations will have two components:
   - Part 'A' course of two months duration, and
   - Part 'B' course of four months duration.
2. There will not be any change in the syllabus for the Part 'A' as has been detailed in the STCW Circular No.22 of 2012. The Part 'A' of the course NCV Management grade, which is currently known as MEO Class III (SEO Part A) with course ID No: 161, however, will be renamed as MEO NCV SEO Part 'A'.
3. The course curriculum for Part B, prescribed by the STCW Circular No.22 of 2012 for the MEO Class II Second Engineer Officer (NCV) - upto 8000 KW (other than Tankers) course has been reviewed and revised; and shall be a consolidated and integrated version of the two courses for the Second Engineer Officer (NCV) grade i.e. MEO Class III SEO (upto 3000 KW) Part 'B' and the MEO Class II SEO Part 'B' [3000 ~8000 KW, other than Tankers]. The new course will be known as MEO (SEO-NCV) Part 'B' Course, Duration: 4 months. The four months course curriculum for the new course is attached as **Annexure 'A'**.
4. The course syllabus prescribed above is designed with an objective to aid faster and smooth career progression of the Management level officers of the NCV grade, requiring the MEO SEO aspirants to undertake the new Part 'A' and Part 'B' only once, i.e. a common course for the MEO Class III – NCV SEO and the MEO Class II -NCV SEO examinations.
5. On satisfactory completion of the above course, the candidate will have the option to appear for (i) MEO- CLASS III Second Engineer Officer (NCV) - upto 3000 KW or (ii) MEO-

CLASS II Second Engineer Officer (NCV) - upto 8000 KW (other than Tankers), based on his/her qualification / sea service.

(B) MEO (CEO-NCV):

6. The course curriculum prescribed by the STCW Circular No.23 of 2012 for the MEO Class I Chief Engineer Officer (NCV) - upto 8000 KW (other than Tankers) course has been reviewed and revised; and shall be a consolidated and integrated version of the two courses for the Chief Engineer Officer (NCV) grade i.e. MEO Class III CEO (upto 3000 KW) and the MEO Class I CEO [3000 ~8000 KW, other than Tankers]. The new course will be known as MEO (CEO - NCV) Course, Duration:2 months. The two months course curriculum is attached as **Annexure 'B'**.

7. The course syllabus is designed in a manner to aid the career progression of the Management level officers of the NCV grade and requires the MEO CEO aspirant to undertake the preparatory only once, i.e. a common course for the MEO Class III– NCV CEO and the MEO Class I -NCV CEO examinations.

8. On satisfactory completion of the above courses, the candidate will have the option to appear for (i) MEO- CLASS III Chief Engineer Officer (NCV) - upto 3000 KW or (ii) MEO- CLASS I Chief Engineer Officer (NCV) - upto 8000 KW (other than Tankers), based on his/her qualification / sea service.

(C) TRANSITION SCHEME FOR EXISTING COC HOLDERS:

9. Recognizing the need to provide a pathway for the existing NCV Class III engineers to upgrade their CoC to the higher propulsion power upto 8000 KW (other than Tankers), the Maritime Training Institutes approved to conduct the MEO Class I-NCV & MEO Class II-NCV grade courses, are permitted to conduct the Bridging course. The detailed syllabus for bridging course and allotted time for the topics to be covered, are tabulated in the attached **Annexure 'C'** for MEO Class II NCV and **Annexure 'D'** for MEO Class I NCV.

10. The Bridging course of one month duration for existing MEO-III (SEO-upto 3000KW) to upgrade to MEO-II (SEO- Upto 8000KW) can be undertaken by the Maritime Training Institutes who are already approved for the 4 months SEO Part 'B' course. The Bridging course syllabus has been designed in a manner that it can be carved out of the 4 months (480

hrs) course to include the Bridging course of one month (120 hrs) duration, so that prospective candidates can seamlessly attend the course.

11. The Bridging course of two weeks duration for existing MEO-III (CEO-upto 3000KW) to upgrade to MEO-II (CEO- Upto 8000KW) can be undertaken by the Maritime Training Institutes who are already approved for the 2 months CEO course. The Bridging course syllabus has been designed in a manner that it can be carved out of the 2 months (280 hrs) course to include the Bridging course of two weeks (60 hrs) duration, so that the prospective candidates can seamlessly attend the course.

(D) REVISED ENTRY CRITERIA:

7. Recognizing the shortage of qualified NCV grade engineers, the Directorate General of Shipping, in consultation with the industry, has reviewed the intake standards for the entry into the NCV stream on the engineering side. The attempt to broaden the intake standard is an endeavor to provide an opportunity for the seafarers with potential to progress into the next level, and thereby addressing the growing demands and evolving competency requirements of the industry. To facilitate the above, the Flow diagram No.III/11-1 of the TEAP Manual Part 'A' is hereby amended and the revised Flow diagram with a broadened intake category leading to certification as NCV Class IV Engineer is provided in **Flow Diagram (FD)-1.**

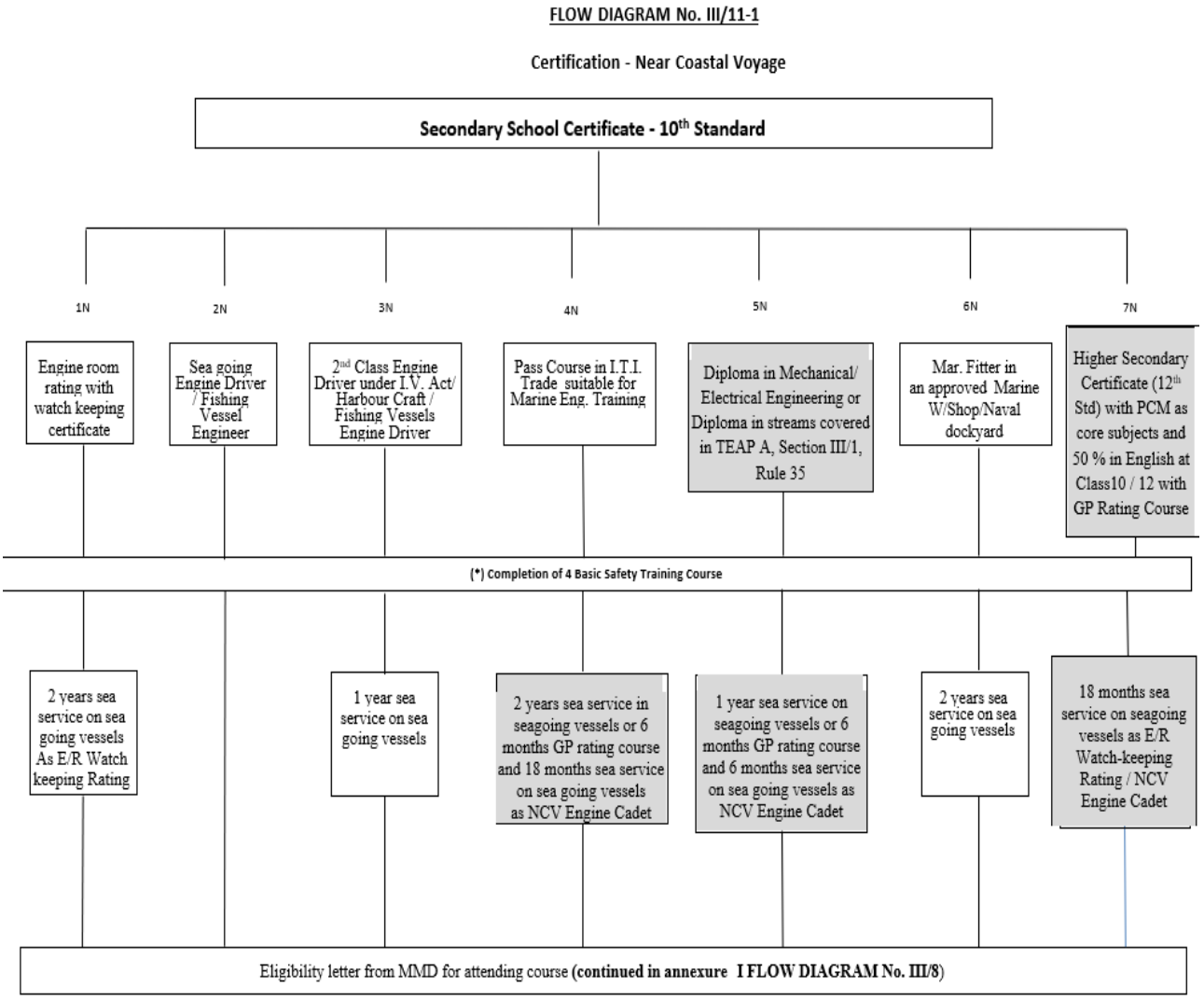
(E) CERTIFICATION PROCESS:

8. The Flow Diagram No III/11-5 of the TEAP Manual Part 'A' depicting the flow of certification process NCV Grades (Upto 3000KW) is hereby amended, and the revised flow diagram is shown as **Flow Diagram (FD)-2.**

9. The Flow Diagram No III/11-6 of the TEAP Manual Part 'A' depicting the the flow of certification process NCV Grades (Upto 8000KW) and the upgradation process for the existing NCV Class III Certificate of Competency holders is hereby amended and the revised flow diagram is as shown as **Flow Diagram (FD)-3.**

Flow Diagram (FD)-1

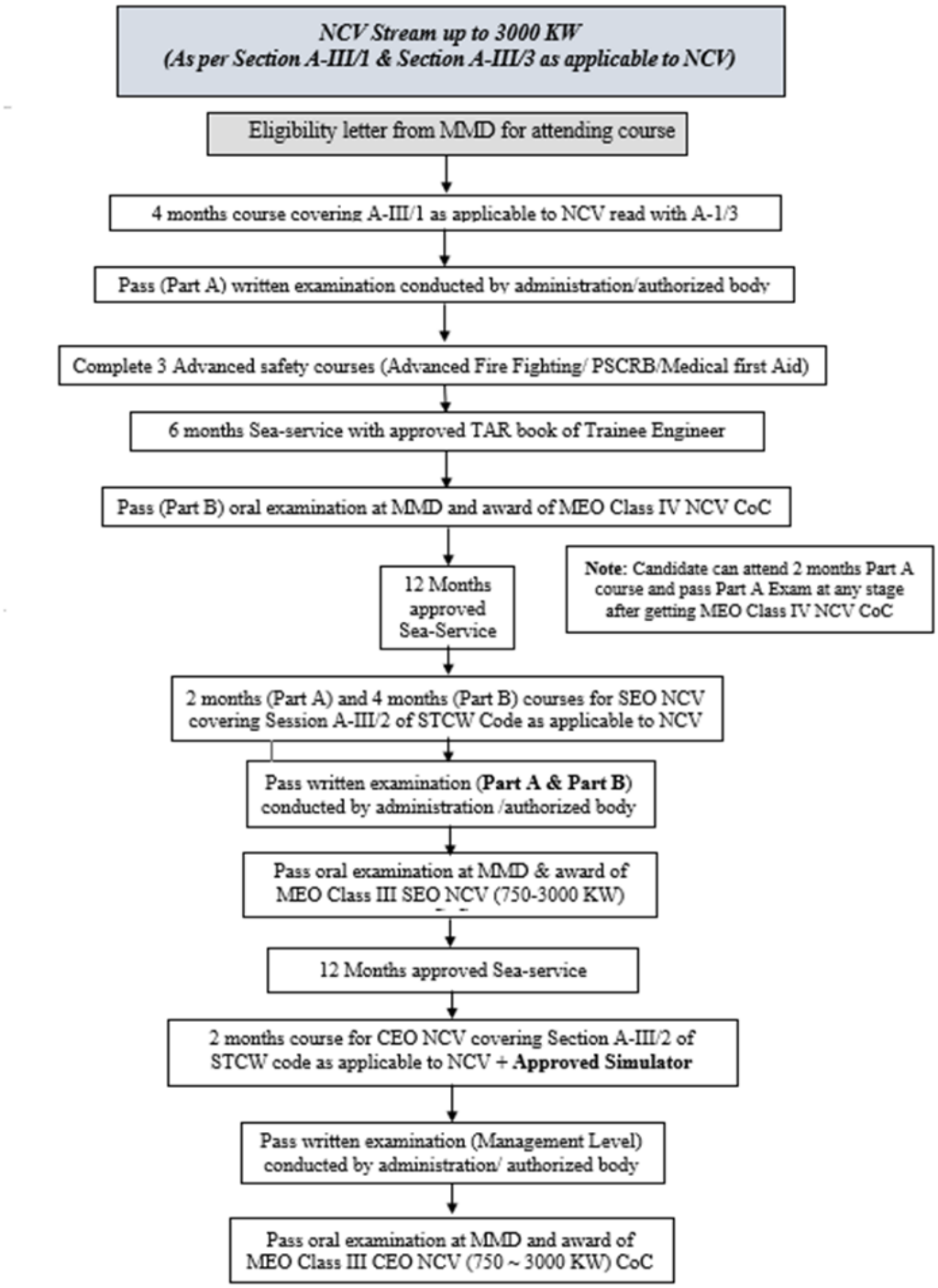
Flow diagram No.III/11-1 showing the different categories of intake to the NCV certification scheme.



Indicates new or modified requirement

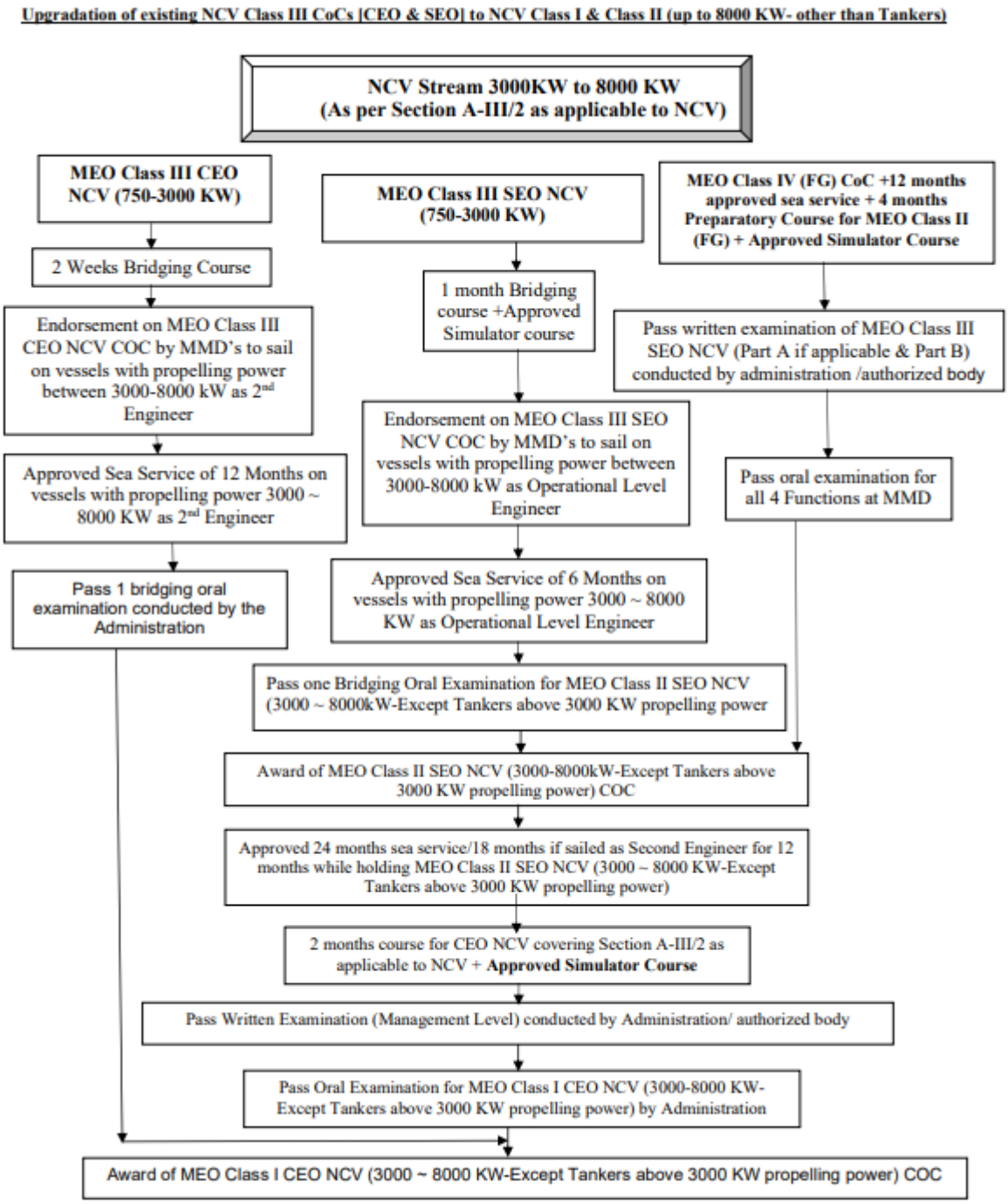
Flow Diagram (FD) - 2

Certification process for NCV Certificates of Competency (Upto 3000KW).



Flow Diagram (FD) - 3

Certification process for NCV Certificates of Competency (Upto 8000KW) and up gradation of existing Certificate holders (Upto 3000KW).



MEO NCV SEO Part 'B'
up to 8000KW (other than Tankers)

Additional competency required: Engine room simulator (Management level) – 5 days

Function 4B: Subject 1: MARINE ENGINEERING KNOWLEDGE GENERAL
[90 hours]

EKG -01	**MAIN TOPICS:** Technology of Materials, properties and characteristics of Metals, Materials, Liquids, Gases and Vapours in machinery on board Ships	Minimum Allotted Hours
	DETAILED SYLLABUS: **Process Technology, Properties and Characteristics of different Metals [Ferrous and Non-Ferrous]** **Iron and Carbon Family** 1. The principle difference between steels produced by the open-hearth and the Bessemer processes /Oxygen impingement Method 2. how cast iron is produced 3. the effect of adding carbon to pure iron, ranging from 100% ferrite to 100% cementite 4. the approximate carbon content and uses of: a. - mild steel - medium carbon steel b. - high-carbon steel - cast iron **Testing and Properties of Materials / Characteristics:** Destructive Tests 1. How **Tensile testing** of a metal specimen is carried out and reasons for same. 2. The principles of **hardness testing.** The relative hardness of brass, mild steel, spheroidal graphite cast iron and nodular cast iron 3. The purpose of an **impact test** 4. The factors which affect the tendency to brittle fracture / ductile to brittle transition 5. What is meant by **creep** /metals affected by creep / **creep test** /creep cracks 6. Metal failure due to **fatigue.** What is meant by fatigue limit / **fatigue test** –reasons for same 7. The factors which affect the fatigue limit 8. The factors which govern the life of a component 9. The precautions to be taken to avoid fatigue failure 10. The **bend test**	12

Non-destructive examination for cracks/ defects within the metal

Heat Treatment of Metals:

1. in simple terms, what is meant by the upper and lower critical temperature ranges
2. the process and the effect on a medium-carbon steel **of hardening and tempering**
3. the purpose and process **of annealing**
4. the difference between annealing **and normalizing** and their applications
5. what is meant by work hardening
6. Surface hardening methods
7. Laser hardening

Alloying Elements in Irons and Steels_

The principal reasons for adding the following elements:

- cobalt
- nickel
- chromium
- molybdenum
- vanadium
- tungsten
- copper
- manganese
- silicon
- titanium

Non-ferrous Metals_

- manganese
- phosphorus
- aluminium
- zinc

Non-metallic Materials_

- nitrile rubber
- neoprene
- P.T.F.E.
- epoxy resin
- rubber
- asbestos
- cotton
- silicon
- silicon nitride
- glass-reinforced plastics
- Composites
- Elastomers
- Ceramics

Liquids -Properties of Liquids

- Critical Temperature and Critical Pressure
- Viscosity is a measure of the resistance to flow.
- The Structure of Liquids
- What Kinds of Materials Form Liquids at Room Temperature?
- Vapor Pressure
- Melting Point and Freezing Point
- Boiling Point

	Properties of Gases / Vapours Pressure Measurement of pressure Temperature Thermal equilibrium and temperature measurements Gases include CO, N^2, NO, HCl, O3, HCN, H2S, CO2, N2O, NO2, SO2, NH3, PH3, BF3, SF6, CH4, C2H6, C3H8, C4H10, CF2Cl2.	
EKG- 02	**MAIN TOPICS:** **CARGO Handling Equipment and Deck Machinery**	
	DETAILED SYLLABUS: **CARGO HANDLING EQUIPMENTS USED:** **POWER provisions besides steam, electric:** **Hydraulic drives** 1. Hydraulic Systems – providing means of distributing power 2. A typical hydraulic circuit 3. Hydraulic fluids used 4. Deterioration / Contamination of oils 5. Types of pumps used 6. Types of Hydraulic Motors used 7. Safeties **Electric Power:** 1. Types of Motors used 2. The principles of a coil-operated brake suitable for winches and other deck machinery 3. The application of the Ward-Leonard system to the control of deck machinery. 4. The basic principles of a Ward-Leonard drive for a deck crane. **Steam Drives:** 1. Reciprocating drives / Steam Generation/ Slide valves/ poppet valves / etc. for reversal of rotary operation 2. Speed Control 3. Line circuit to various Winches on Deck , Anchor Windlass , Mooring Winches 4. Warming up of lines 5. Condensate draining 6. Expansion provision 7. Materials used for Piping Arrangements 8. Safety and Braking devices 9. Insulation / Lagging	6

	DECK MACHINERIES Warping Winches and Capstans 1. The purpose and setting of a torque-limit relay in the control system of a warping winch or capstan, including the provision for emergency heavy pulls 2. The speed variation necessary when handling slack ropes 3. The possible effect on the generators if direct on-line cage motors are used for winches 4. The principle of a three-speed cage winch motor, how the cage motor has been applied to windlass operation 5. The principle of a slip-ring motor drive to a warping winch, including: - reversing- overload- torque limiting - speed control - fail-safe braking 6. Functions and Mechanism of Automatic Control of Cargo Handling Equipment's 7. The duties of an automatic mooring winch. 8. The principle of the ways in winch a grab is operated. **DERRICKS AND WINCHES AND CRANES** **Equipment's:** Derricks, Winches, Wires / Rigging of wires, Pulley blocks / Shackles / Swivel Blocks, Deck Cranes- Jibs. Function of each Actuator **Handling:** 1. what is meant by the luffing and slewing movements of a crane 2. how dynamic braking is applied to the slewing movement 3. the principle of the union-purchase cargo-handling system and the variations of winch speed required **ANCHOR WINDLASS** 1. Anchor Handling 2. how the speed of lowering is controlled on the cable lifter of a windlass 3. the need for the various speeds of a windlass 4. Housing of Anchors 5. Chains & Chain Lockers 6. Locking arrangements for Chain 7. Hawse pipe / Spurling Pipe / Bow stopper / 8. Brake Arrangement	
EKG -03	**MAIN TOPICS:** **Construction details, principles involved and Operation of All Auxiliary Machineries of Engine Room**	Minimum Allotted Hours
	DETAILED SYLLABUS: **Pumps:** 1. Types of Pumps 2. Each Pump Characteristics [suction and discharge] 3. Functional Duties 4. Selection of Material for Components	18

	5. Tailor made [design] to perform specific duties 6. Catering to pressure energy and Volumetric flow **Pumping Systems**: 1. Ballast- tank ballast pumping system 2. The safeguards necessary with tank pumping systems 3. The fittings provided in order to prevent errors when pumping 4. BWM System **Bilge** 1. Lists the pumps with connections into the bilge main 2. The arrangement of the main and bilge injections 3. The purpose and procedure for using the bilge injection 4. MARPOL Regulations / Requirements **Fire Main** 1. The number and source of supply to the fire main for given ships 2. How and when fire pumps should be tested 3. The uses to which a fire main can be put 4. The purpose of the fittings on a fire main **Fuel System** 1. Layout of the fuel system 2. Using different grades of fuel – distillate /residual / lighter grades- Gas oil 3. Requirement of Pre-heat temperatures for correct viscosity at fuel injection point. 4. Airless solid injection method for efficient combustion 5. Fuel pump design- Pressure control / Material 6. Storage and handling 7. Centrifuging 8. Deployment of suitable Duplex filters [mesh –micron size] in the fuel line 9. System leading to the engine fuel injectors. 10. Safety precautions – sheathed protection of high pressure line and system components 11. Knowledge of fuel specifications /characteristics 12. Removal of cat-fines from system prior to entry into fuel system 13. Fuel Analysis report prior usage – Lab Analysis. **Lubricating Oil System:** 1. Layout of System the different lubrication systems used in diesel engines and the demands each puts on the oil 2. The reasons for using different grades of Lubricating Oil – Straight mineral /detergent / additives 3. The possible causes of oxidation of lubricating oil temperature control 4. How to detect and possibly remedy the presence of: Rust particles; Heavy oxidation;	

	Loss of oiliness; Abrasive particles; Water; Other source of contamination 5. Means of recognizing deterioration of the lubricating oil 6. The frequency with which oil samples should be taken for analysis. 7. Test kits provided on board - for onboard testing / periodicity of test. 8. How lubricating oil is conveyed to top end, bottom end and main bearing in large-bore slow-speed diesel engines 9. The type of lubrication oil film produced in top end, bottom end and main bearings 10. How engine builders attempt to improve the lubrication of top end bearings 11. The condition which may lead to an explosion in a crankcase. 12. The means by which crankcase explosions can be avoided. **Fresh Water Systems:** 1. name the media commonly used for cooling in: a. fuel valves b. diesel engine cylinders c. exhaust valves d. Turbo chargers e. Pistons f. scavenge air The care necessary when fresh water is used as a coolant A means by which scale deposits from fresh water can be removed Importance of maintaining diesel engine thermal efficiency. Test carried out to ascertain condition of cooling media / and Treatment accordingly meeting required parameters. / Corrective action taken from test readings a. Implications of out of limit readings from water test. b. Identify sources and types of contamination and its effect. c. Cooling arrangement in exhaust v/v, fuel injectors, piston crown, jackets, Scavenge air [coolers], turbochargers, etc.– design side Additives - The action of an anti-corrosion oil as an additive in cooling water **Air Compressors:** 1. Types of Compressors for Marine Applications 2. Constructional details-Components -its Material and Configuration 3. Principle of Operation 4. P-V Curves 5. Why Isothermal compression preferred 6. Multi Stage operation 7. Volumetric Efficiency /Free Air Delivery 8. Safety devices **Refrigeration and Air-conditioning Plants:** 1. Types of Units in general for Marine Applications 2. Constructional details- Components – its Material and Configuration	

	3. Principle of Operation: 4. A practical refrigeration cycle, on a pressure- enthalpy diagram, indicating ▪ compression, cooling, throttling and evaporation for both large-scale ▪ domestic refrigeration plants: • Simple terms the principles of a vapour absorption refrigerator • Lists the properties that the ideal refrigerant would possess The factors which govern the selection of refrigerant for use in shipboard systems • Lists the refrigerants commonly used in shipboard uses and explains why they are chosen • Future Refrigerants: R 134a ; R 152a ; HC 600a and blends ; 407a Eco –friendly • Green House Effects A line diagram of a typical modern vapour-compression marine refrigeration plant • Shows on a diagram of the plant the position of the components, controls and other equipment required for its operation • The function of each of the components, controls, etc., and briefly describes their operation **Ventilation System:** 1. The need for adequate ventilation in machinery spaces 2. Vital to health and well-being of Engine Room personnels 3. General requirements for ventilation formulated 4. Heating for colder areas / Provisions made / Precautions to avoid discomfort 5. Incorporation of Humidification and De-humidification arrangements 6. Comfort zone 7. Mechanical supply and exhaust ventilation 8. Air filtering equipments 9. Ductings 10. Arrangement of shut-off flaps , louvers 11. Insulation 12. Nos. of Air changes per hour through forced draught / exhaust fans depending 13. the Volumetric size of the Machinery space	
EKG -04	**MAIN TOPICS:** Construction details, Management of Auxiliary Boiler including fuel and Air System and action in case of Emergencies	Minimum Allotted Hours

	DETAILED SYLLABUS: **Design Features and Operating Mechanisms:** **Marine Steam Boilers:** High Pressure and Low pressure Type / Smoke tube type and Water Tube type **Boiler Constructional details:** 1. Materials 2. Furnace layout 3. Tube layout 4. Water drum / Steam Drum 5. Supports 6. Mountings 7. Foundation **Management – Oil-fired systems / Fuel Air ratio Control:** 1. Burner Assembly / Burner front 2. Forced draught air / Air Dampers 3. Automatic Combustion Systems / Photo cells for flame monitoring 4. Auto Control 5. Manual Control 6. Safety devices **Safety Valves:** 1. The number of safety valves which must be fitted to a boiler 2. A drawing of an improved high-lift safety valve, explains the function of each component: 3. The materials from which components of safety valves are made 4. The maintenance required for a safety valve 5. The adjustment and setting of a safety v/vs 6. The principle of operation of a full-bore safety valve **Boiler Water Level:** 1. The procedure to ensure that the water level gauge in a boiler is functioning correctly 2. The principles of construction of a plate-type water gauge 3. The principles of remote water level gauge 4. Why feed-check valves are non-return valves and are fitted with a double shut-off facility **Other Mountings:** **Boiler Defects:** 1. The possible causes of deformation of heating surfaces in a boiler 2. Briefly the hydraulic testing of a boiler 3. The preferred method of taking a boiler out of service for examination /survey 4. The procedure for blowing down a boiler 5. The process of electrochemical corrosion	12

	6. The effect of dissolved oxygen in boiler water 7. The effect of excessive acidity of boiler water 8. The initial treatment given to fresh water and to seawater before being supplied to a feed water system 9. How seawater could enter a boiler **Water Treatment:** 1. The purpose of treatment of feed water 2. In principle how the above objective is achieved 3. Types & names the chemicals used 4. In general terms how the corrosion described in the above objective can be reduced **Water Testing** 1. The use of litmus paper 2. The following test procedures: a. Alkalinity to phenolphthalein b. Total alkalinity c. Caustic alkalinity d. Chloride e. Sulphite f. Phosphate g. Hardness h. Ph value i. Dissolved oxygen j. Total dissolved solids k. Hydrazine The approximate acceptable results of the tests in the above objective related to the type of boiler likely to be encountered **Emergency Operations:** 1. Change over from Auto Control to Manual Control 2. Emergency shutdown – flame failure, low water level, Uptake hi-back pressure	
EKG -05	**MAIN TOPICS:** Oily water separator, incinerator, sewage treatment plant, preparedness for pollution prevention particularly while bunkering	Minimum Allotted Hours
	DETAILED SYLLABUS: **Oily Water Separator System:** 1. Summarizes the International Convention for the Prevention of Pollution from Ships 1973 and Protocol of 1978 and the implications related to marine engineering processes 2. In principle, how bilge and ballast water are discharged 3. The requirements for oily-water separators	12

	4. How the mode and type of pump used affects the contamination of oily water 5. How the temperature, relative density and size of oil particles affect the separation process 6. The principles of the operation of a three-stage automatic oily-water separator 7. Why and where pressure-relief devices are fitted to a separator 8. The function of a coalescer 9. The principles and purpose of a separator probe 10. How the automatic valve is controlled and operated 11. Lists the safeguards in an oily-water separator system 12. The automatic cleaning of an oily-water separator 13. The purpose of the oil record book and how it is used 14. Surveillance and performance assessment of Oily Water Separators 15. How the temperature, relative density and size of oil particles affect the separation Process **Sewage and Sludge*:*** 1. The implications of the International Convention relating to the discharge of sewage 2. A sewage retention system 3. Why vacuum transportation systems are used 4. The processes in a biological treatment plant 5. How the sludge from a biological treatment plant is disposed of 6. Why biological treatment should be kept working continuously 7. Names the contaminants which would impair the treatment process 8. The operation of chemical treatment plants 9. Lists the waste materials that can be incinerated 10. How liquid and solid waste are prepared for **Incinerator:** 1. Types of Incinerators 2. Why Incinerators are used? 3. Marpol Convention – Annexe I – Oil Pollution Prevention at Sea /Port 4. Capable of dealing with waste oil, oil-water mixtures, rags, galley waste etc. 5. Operations 6. Component layout 7. Safeties 8. Emission 9. Collection of dry ash from chamber and storage on board / discharge to shore receptacles. **Preparedness for Pollution Prevention whilst Bunkering:** 1. IMO Regulations 2. Port Regulations 3. SOPEP 4. Preplanning 5. Calculations / Safety margin re-capacity	

	6. Local Agents informed 7. Liaison with Bunker Suppliers 8. Discuss Bunker Procedures / Delivery Rate	
EKG -06	**MAIN TOPICS:** Thrust Blocks, Shafting, Bearings, Stern Tubes, Propellers And Ship-side fitting	Minimum Allotted Hours
	DETAILED SYLLABUS: **Thrust Block:** 1. How the propeller thrust is transmitted to the ship's structure 2. Principle of operations 3. Locating of a thrust block assembly in a slow speed engine 4. Medium/high speed engines. 5. The principle of the tilting pad / types of pads 6. A section through a thrust block, showing the flow of lubricating oil 7. Importance of clearances between collar and pads / periodic checks 8. Adjustments for wear out of pads **Shafting**: 1. Alignment 2. The effect of a ship's normal service demands on the alignment of propulsion shafts etc. 3. In principle, how shafting is lined up initially 4. How, after installing the intermediate shafts, the bearings are fitted to their correct heights 5. How the main engine is lined up to the shafting 6. Stern Tube Alignment 7. The sources and nature of the stresses in the: -intermediate shafts - thrust shaft - propeller shaft 8. Given a drawing of a water-lubricated stern tube as fitted in a ship with its tailshaft and propeller, 9. The materials used for the bearings in the above objective 10. Lub.oil lubricated stern Tube arrangement / working principle 11. How the propeller is secured to the tailshaft 12. A coupling arrangement which would allow outward removal of the tailshaft 13. The defects which may occur in a tailshaft and stern tube 14. The bearing materials used in the stern-tube described above the lubrication system in the stern-tube described above how water is detected and removed from the lubricating oil 15. The typical seals used at each end of the tailshaft 16. The maximum period allowed between examinations 17. The maximum wear down for an oil-lubricated stern-tube	12

	Controllable-pitch Propellers 1. The reasons for using controllable-pitch propellers 2. Given a diagrammatic arrangement, how the pitch of a propeller is controlled 3. The safeguards installed for a controllable-pitch propeller **Bow and stern thruster** **Ship-side fitting:** 1. Sea Suction / Connections 2. Overboard Discharges 3. ICCP 4. Sacrificial Anodes 5. Sal Log 6. Echo Sounders **7.** Bilge Keel	
EKG -07	**MAIN TOPICS:** Constructional details and management of Steering Gear; Single Failure Criteria; Emergency Steering and Mandatory drills	Minimum Allotted Hours
	DETAILED SYLLABUS: **Constructional details / Requirements as per Regulations:** 1. Design and Construction as per rules and regulations of IMO, Classification 2. Society, Flag Administration 3. Detailed machinery plans, calculations, specification of all scantlings, materials. 4. Their influence [scantlings and materials] pertaining to the load bearing and Torque 5. Transmitting components and hydraulic pressure retaining parts together with 6. Proposed rated torque and all relief valve settings. **Steering Gear Control Systems:** 1. The basic control system for a steering gear 2. The action of a telemotor transmitter and receiver 3. The principle of operation of an electrical telemotor 4. How a ship is steered if there is a failure in the telemotor system [emergency steering- local control] **Steering Gear Power Units:** 1. Fixed Delivery and Variable Delivery Pumps 2. How, in a Hele-Shaw pump, the volume and direction of oil discharge are controlled	6

	3. How, in a Swash plate pump, the volume and direction of oil discharge are controlled 4. How oil losses from power units are replenished. **Piping Circuit / Oil Reservoirs [Replenishing Tanks] / Isolating valves, Relief valves** 1. Common piping or independent piping for single failure criteria 2. Adequate Capacity of Oil Reservoirs / Storage Tanks 3. Manually Operated or Automatically valves for isolation or automatic change over during emergency operation; 4. Shock Relief Valves –Safety of System due to excess pressure build in circuit 5. All isolating or bypass valves for emergency operation 6. Function of a Rapson Slide 7. Linear motion of the rams converted into a rotary motion of the Rudder vide the 8. Tiller Arm and Rudder Stock **Rudder Actuators (Steering Gear)** 1. A diagrammatic arrangement of a two ram / four-ram steering gear, illustrating: Connections from two hydraulic oil power units. Emergency hand pump connection for local control **Rotary vane unit** 1. Fixed and Moving Vanes / Nos. of Pressure Chambers 2. Vane fixtures / Sealing Arrangements 3. Design features to meet Torque requirements **Operational Functions of Steering Gear System** 1. How a standby power unit is prevented from being motored 2. The procedure for charging a hydraulic steering gear system 3. The actions of hunting gear, a rudder carrier bearing, including bearing surfaces, provision for lubrication, gland, attachment of tiller to rudder stock and allowance for bearing wear down 4. Materials from which the main components in the above objectives are made 5. Steering requirements as per IMO Regulations and Flag Administration in General **Single Failure Criteria:** Provisions made in the Steering Gear System , that there is no loss of Steering capabilities at any given time due to a Single failure **100% Redundancy** – Provision of Duplicate Units – identical-each unit consisting of a separate oil replenishing tank with float switches, a power unit [pump], separate piping circuit with automatically solenoid operated isolating v/vs. Failure of one, will automatically bring the other identical unit into operation and will meet the IMO Regulations of providing 100% Torque.	

	[For e.g: in a tanker, chemical tanker or gas carrier of 10,000 tonnes gross tonnage and upwards, including other ships of 70,000 tonnes and above in the event of loss of steering capacity it should be regained in not more than 45 seconds and that where the control is by hydraulic telemotor a second independent control system must be available for immediate use. **Ships of 100,000 DWT and above – regulation requirements-** **Mandatory Drills / Tests** Must be carried out, and the records maintained on steering gear drills and checks a. At least 12 hours prior to departure / Arrival ports / while at sea b. At three-monthly intervals c. Check List /Operating Instructions d. Emergency steering drills shall take place atleast once every three months **Start Up and Shut down of Steering Gear System**	
EKG -08	**MAIN TOPICS:** Operation and Testing of Pneumatic, hydraulic and Electronic Control Systems.	Minimum Allotted Hours
	DETAILED SYLLABUS: **Operation and Testing of Pneumatic Control Systems:** 1. Advantage of Control Systems 2. Open Loop and Closed Loop Control Systems 3. Process Control Theory / P+I Controllers , P+I+D Control 4. Signal Transmitting devices / electro –pneumatic Converters 5. The function of a nozzle-flapper arrangement 6. A proportional controller 7. A two-term controller 8. A three-term controller 9. Split range Control 10. Cascade Control Controllers 1. The principles of operation of an electro pneumatic controller 2. Electronic controller- various 3. Pneumatic controller- various [fuel-air ratio / viscosity 4. How to adjust it to give variation to the proportional band 5. The principles of a fuel-air ratio controller 6. The action of a viscosity controller 7. Performs routine test and maintenance procedures on the controllers covered by all the above objectives. Control Circuits / Operations 1. A single-element control for cooling water and lists its applications 2. A split-range control system for a fuel-valve coolant 3. Why two-element control is sometimes used in cooling systems	3

4. A two-element cascade control system for piston cooling
5. A control system for lubricating oil temperature
6. A control system for purification of boiler fuel oil
7. The principles of control of air conditioning
8. The principles of control of a refrigerated chamber
9. The principles of control of the interface level of an oily-water separator
10. The lighting-up sequence of an automatic combustion system for an auxiliary boiler
11. Perform routine test, maintenance and fault-finding procedures for the control systems covered by the above objectives
12. Testing of pneumatic , and electronic control systems

Air Supply

1. The need for instrument air of good quality
2. How the required quality of air can be provided
3. How water is removed from the air
4. The means of drying air
5. A diagrammatic layout of an air system for control and instruments
6. The principles of the following:
   - automatic drain
   - auto-unloader
   - filter regulator

Monitoring Systems / Testing

1. The sequence of alarm signals, to include:
   a. fleeting alarm condition
   b. first alarm in a series of alarms
   c. different light intensities and flashing periods
   d. audible alarms

Routine checking of alarm systems
The basic principles of an alarm scanner and data logger
The uses of information obtained from a data logger

Operation and Testing of Hydraulic Systems

Hydraulic Circuits

1. Explain a simple hydraulic circuit / Closed and Open Circuit
2. How to interpret a hydraulic circuit
3. Graphic symbols used in the circuitry
4. Type of equipment's used

Operating and Testing of Hydraulic Control Systems [inclusive of electrical controls within the system] in the Hydraulic Circuit

1. Simulation of Safety devices – both hydraulically and electrically operated
2. Knowledge of Circuitry for Trouble shooting.

Start –up and Shut down of Hydraulic Power System

1. Pre-checks prior starting plant

	2. Proper shut-down to protect machinery from being operated inadvertently especially Deck machinery **Operations and Testing of Electronic Control Systems** **Electronics Controls** 1. Advantages / High Speed of signal transmission 2. Explain how to: / and purpose of : a. Generate proportional action to the error or deviation between measured value and Desired value b. Use of potentiometer for amplified output c. Use of d.c.currents within a range / use of resistors d. Use of transistors where d.c input is converted to a.c by use of a chopper –type amplifier e. Proportional and integral action **Control System & Troubleshooting / Testing:** Motors, Electrical survey requirements, Calibrate and adjust transmitters and controllers, Control system fault finding. a. Function test of electrical. Electronic control equipment and safety devices. b. Troubleshooting of monitoring systems - Test and calibration of sensors and transducers of monitoring system. c. Software version control - Programmable logic controllers (PLC), Microcontrollers, Digital techniques. **Maintenance & repair of the following:** Electrical and electronic systems operating in flammable areas, carrying out safe maintenance and repair procedures, Detection of machinery malfunction, location of faults and action to prevent damage. Electrical interference / Suppressors	
EKG -09	**MAIN TOPICS:** Properties of Fuels and Lubricants used and monitoring their quality	Minimum Allotted Hours
	DETAILED SYLLABUS: **Physical and Chemical Properties of Oils_** 1. How density measurements are adjusted when the fuel temperature is other than 15° C 2. Viscosity in simple terms 3. The effect on its viscosity of raising the temperature of an oil 4. The approximate viscosities required for satisfactory atomization and combustion 5. Typical curves of viscosity against temperature 6. Lists factors affected by viscosity 7. ‘Viscosity index’ 8. Upper and lower flashpoints 9. The classification of dangerous fuels	6

10. The range of flashpoints for kerosene and vaporizing oils
11. Marine fuels have a minimum closed-cup flashpoint of 66° C
12. The range of flashpoints or the approximate closed-cup flashpoint for:

a. petrol
b. kerosene
c. diesel oil
d. heavy fuel oil

Lubricating oil

The difference between higher and lower calorific values and their uses
In principle, how calorific values are determined: by experiment and by calculation

- The approximate higher calorific values of: Fuel oil, Diesel oil
- Pour point - the importance of the pour point
- The cloud point and its significance
- 'Carbon residue'
- How the quantity of ash in a fuel is determined
- Names and describes the possible constituents of ash
- Names other common tests regularly carried out in laboratories on fuels

Characteristics of Fuel Oil

Outline the various physical and chemical characteristics associated with fuel oil such as:

1. Density
2. Viscosity
3. Flash Point
4. Pour Point
5. Carbon Residue
6. Ash in Fuel
7. Water in Oil
8. Sulphur
9. Vanadium and Sodium
10. Aluminum and Silicon
11. Sediments
12. Compatibility
13. Specific Energy
14. Ignition Quality

Oil Purification

1. an oil settling tank, naming all the fittings
2. the use of the fittings of a settling tank
3. oil filtration methods, giving the particle size which each method is capable of filtering out
4. the reasons for installing filter coalescers
5. how a lubricating oil filter coalescer works
6. the sequence of operation of an automatic oil-filter module
7. the principles of an oil and water centrifuge
8. the adjustments which have to be made when oils of different densities are being pressured and explains why
9. the factors which govern the limiting particle size in a large bowl centrifuge

10. the operation of a self-cleaning purifier

Contaminants including microbiological infection

Treatment of fuels including storage, blending, pretreatment and handling

Monitoring quality
Shore side and shipboard sampling and testing and interpretation of results.

LUBRICANTS

1. lubricating oils are produced from both paraffin and asphalt base crude oils
2. a typical closed-cup flashpoint for a lubricating oil
3. a compounded oil and its uses
4. the disadvantages of using fatty oils in steam machinery
5. what is meant by, and the effects of, dilution of crank-case oil
6. why additives are used in lubricating oils
7. the effect of elevated temperature on the oxidation of the lubricating oil
8. how oxidation affects lubricating oils
9. the purpose and application of additives related to: corrosion, detergency, dispersal, pour point, foaming, viscosity, extreme pressure, emulsifying

Properties of various types/grades of lubes

Lubrication Problems and Testing

Shore side and shipboard sampling and testing / interpretation of test results

1. The point at which a sample of lubricating oil for testing should be taken
2. How alkalinity can be checked
3. How to test for: dispersiveness, contamination with water
4. How viscosity can be checked
5. The factors which contribute towards the formation of tin oxides in white metal bearings
6. The effect of tin oxides present in bearings
7. What can be used to prevent or alleviate the problem of tin oxides in bearings
8. The possible causes of microbial degradation of lubricating oils
9. The symptoms of microbial degradation
10. The means by which microbial degradation may be prevented or remedied
11. The test to be performed ashore in a laboratory analysis, commonly requested by a chief engineer
12. Lists the properties normally examined in a laboratory analysis
13. Performs or witness appropriate laboratory tests

	14. Relates typical laboratory analysis to sources of problems on board ship 15. The action to be taken to overcome the problems referred to in the above objective	
EKG -10	**MAIN TOPICS:** Regulations on Fuel and Ballast Systems	Minimum Allotted Hours
	DETAILED SYLLABUS: **Fuel Systems**: Annex I – MARPOL 73/78 – Regulation for Prevention of Oil Pollution. **General:** 1. Application 2. Hazards / Hazard Areas identified 3. Installation Trials 4. Safety Principles **Ship Arrangements and System Design: As approved by Class** 1. Material Selection 2. Location and Separation of Spaces 3. General Pipe design /High pressure Lines Protection/ Requirements 4. System Configuration / marking and Labelling 5. Storage 6. Bunkering System and Distribution System inside and outside Machinery spaces 7. Ventilation System 8. Fuel Filters 9. Purging Arrangements / Drainage 10. Fire Protection 11. Fire Detection / Alarm System 12. Fire extinction **Clean Fuel Regulations:** 1. Reducing Emissions of Particulates, sulphur oxides and oxides of nitrogen 2. Fuel contents limits [Low sulphur fuel regulations] – Compliant fuel 3. Impact on Environment 4. Annexes covered- VI 5. Individual Countries – coastal boundary / in port requirements/adherence and established shipping lanes **Ballast Systems:** **General:** 1. Ballast water for stability, balance and structural strength 2. Operation in shallow waters, air draught requirements 3. Safe and efficient operation for ocean going ships 4. Ballast water contents	3

	5. Exposure to unprepared environments 6. Economic harm **Ship specific Arrangement for storing Ballast / System Design** **Meeting Statutory Regulation Requirements as in force now & later** 1. Why Ballast Water of Concern? 2. IMO adoption of Ballast Water management 3. What needs to be done? 4. What is Ballast Water exchange? **Guidelines** 1. Control and manage BW sediments 2. New treatment technologies – Guidelines 3. Standards for BW exchange and Treatment 4. Ballast Water Management Plan & Retrofit Installations approved by Flag **Administration** 1. Record Book 2. Certification- An International BWM Certificate 3. Safety assessment of treatment systems.	

Function 4B: Subject 2: MARINE ENGINEERING KNOWLEDGE (MEK)-(MOTOR)
[90 hours]

EKM -01	**MAIN TOPICS:** Working principle and construction details of marine diesel engines, turbochargers, gearing, clutches and ancillary equipment, starting and reversing and control system	Minimum Allotted Hours
	DETAILED SYLLABUS: **Working principle** Otto cycle, Diesel cycle, Dual cycle, Cycle of operation, 2Stroke/4Stroke engine, valve timing, CI engine, SI engine **Construction details of marine diesel engines including 2 stroke engines in detail**. Bedplate, 1. Entablature A-frame, Tie-Bolts Holding down bolts, Chocks 2. Piston, Piston rings, 3. Liner, 4. Cylinder head cover, Exhaust and inlet valves, Crank shaft, 5. Cam shaft, 6. Chain drive, 7. Bearings, connecting rods, Cross head and crosshead bearing. 8. Fly wheel and any other components. **Turbocharger** Types of turbo charger, Construction, Types of turbo charging; Pulse type and constant pressure type, Turbo charger system. **Gearing** Advantage of gearing, Reduction gearing, Epicyclic gearing **Clutches** Type of clutches, Fluid coupling, Pneumatic clutch, Plate type clutch **Ancillary Equipment** 1. Air compressor 2. Fuel pump, fuel injectors, fuel timing /adjustment, fuel cut off arrangements, VIT control etc. 3. Cooling water systems and Lubricating systems. **Starting and reversing in detail for 2 stroke engines** Means of starting and reversing the engines, explain various methods for reversing (Lost motion, axial movement of the camshaft	48

	Controls System What is a controller, Open loop, close loop, Two step controller, Proportional action, Integral action, Derivative action, Type of controller, Level controller, Pressure controller, Temperature controller, Split range, Cascade control, Actuator, Valve positioner, "Fail safe" strategies. **Governors** Need for Governors, Speed governor Load governor, Hydraulic governor, electronic governor, Droop, Load sharing.	
EKM -02	**MAIN TOPICS:** Safe and efficient operation of large bore and medium speed diesel engine; determination of shaft power and recognition of irregularity in performance of machinery and plant. Operation, monitoring and evaluation of engine performance and capacity	Minimum Allotted Hours
	DETAILED SYLLABUS: **Safe and efficient operation of large bore and medium speed diesel engine:** Explain the difference between large bore and medium speed diesel engines. Explain the operation of above mentioned engine for propulsion and aux. engine. Operation, monitoring and evaluating engine performance and capacity; Remote control arrangements **Explain the followings with various features.** a. Fuel oil and lubricating oil system of main and aux. engine. b. F/W cooling. Piston cooling arrangement. c. Multiengine propulsion arrangements. d. Any other system relevant to propulsion plant. **Various way to monitor:** Temperature, Pressure their upper limit and lower limits, Condition monitoring such as vibration analysis, Trend analysis etc, with help of these along with NOx and SOx emission engine performance and capacity to be explained. **Determination of shaft power and recognition of irregularity in performance of machinery and plant.** Determination of Shaft power, How many way shaft power can be calculated: Power card, Turbo charger rpm and temperature, Fuel pump Index. **Recognition of irregularity in performance of machinery and plant:** How to recognize irregularity in performance of machinery and plant: What all the various parameters to be checked, Various indicator card analysis, e.g power card, draw card, compression card, light spring diagram(for medium speed engine cards are taken electronically)Peak pressure variation, Temperature and pressure variation at different stages.	18

EKM -03	**MAIN TOPICS:** Planning and scheduling of engine operation, standing instruction for taking over, handing over routine and emergency operation during watch keeping	Minimum Allotted Hours
	DETAILED SYLLABUS: **Planning and scheduling of engine operation:** Explain for near coastal vessel, after obtaining voyage plan, planning is to be done, what is the away time from port, what is ship's plying area, as per company procedure and regulation about reserve fuel and emission restriction how much fuel to be demanded, passage rpm restriction, optimum operation of engine, action if engine is to be run at low rpm for prolong period, demanding lubricating oil as per requirement/ emission restriction, changing procedure from high sulphur fuel to low sulphur fuel. If any repair/routine to be attended, spare required during voyage, also mention what all the routines are to be done during any stoppage. **Standing instruction for taking over and handing over routines:** Explain about UMS, bridge control as most of the NCV runs on bridge control but engine room remains manned. What all the necessary checks to be made before taking over watch. What are routines can be carried out? **Emergency operation during watch keeping:** Explain action to be taken for the following, a) Oil mist detector alarm. b) Scavenge fire. c) Air line explosion. d) Bridge control and engine room control for main engine fails. e) Any other emergency operation.	9
EKM -04	**MAIN TOPICS:** Efficient operation, surveillance, performance assessment and maintaining safety of propulsion plant.	Minimum Allotted Hours
	DETAILED SYLLABUS: **Surveillance, performance assessment and efficient operation propulsion plant;** Name the machineries and various system require for propulsion plant, what all the regular checks to be made for each machinery, performance of each machinery to be assessed for their optimum operation. Explain about fuel treatment. Explain, how performance of each machinery, affect the efficient operation of propulsion plant. Explain the followings: Properties of fuel oil how it affects the performance of propulsion plant. Properties of lubricating oil, requirements of different additives, various types of lubrication, effective way of lubricating the bearings for efficient operation of propulsion plant	6

EKM -05	**MAIN TOPICS:** Operating limits of propulsion plant	
	DETAILED SYLLABUS: **Operating limits of propulsion plant.** Explain operating limits of various machinery of propulsion plant. a) Main engine maximum continuous rating, normal continuous rating, how much % more of MCR an engine can be run and for how long. b) Liner wear and limits. Liner ovality limit c) Crank shaft deflection and limit. d) Connecting rod top end bearing and bottom end bearing ovality limits. e) Various other operating limits as mentioned by manufacturer such as temperature limit for m/e lube oil, thrust bearing, main bearing, cross head bearing clearance limit. Other operating limit as and when necessary to be mentioned.	9

Function 6: Subject 1: MARINE ENGINEERING PRACTICE [60 hours]

MEP -01	**MAIN TOPICS:** General Principles involving repairs	Minimum Allotted Hours
	DETAILED SYLLABUS: **General Principles involving repairs:** Marine Engineering practices – safe working practices in machinery room and other enclosed spaces. Appropriate planning, specification, material and equipment for maintenance and repairs including statutory and class verifications	9
MEP -02	**MAIN TOPICS:** Maintenance of Marine Auxiliaries	Minimum Allotted Hours
	DETAILED SYLLABUS: Maintenance of Marine Auxiliaries: 1. Knowledge of normal operating conditions and parameters and detection of machinery. Malfunction, location of faults and action to prevent damage. 2. Detection of faults of machinery by visual inspection, NDT methods and other advanced systems such as vibration monitoring (condition monitoring). Inspection and adjustment of equipment. 3. Modern approach to machinery reliability methods and their execution. Principles of Taro technology. 4. Overhauling of main engine, auxiliary engine, pumps, air compressors, separators, heat exchangers, fresh water generators, deck machinery, refrigeration and air conditioning machinery, auxiliary boiler and allied machinery and testing of such machinery and testing of such machinery after overhaul. 5. Organizing and carrying out of maintenance by CSM, planned and preventive maintenance keeping in mind the technical, legislative and safety procedural requirements. Principles of tribology and its practices. 6. Hull inspection, maintenance and repairs of vessel in Dry dock.	42
MEP -03	**MAIN TOPICS:** Safe working practices	Minimum Allotted Hours
	DETAILED SYLLABUS: **Safe Working Practices:** 1. Precautions against fire and explosion. Checking for explosive / toxic conditions, source of ignitions, and requirement of hot work permit before undertaking repairs. 2. Mechanical safety in workshops, lifting gear and the need of protective gear. 3. Dangerous properties of substances including toxicity.	9

Function 5: Subject 1: MARINE ELECTRO TECHNOLOGY [90 hours]

MET -01	**MAIN TOPICS:** The Electric circuit ,Ohm's Law ,Kirchhoff's Law ,simple series and parallel circuits .The Superposition and Thevenin's theorems	Minimum Allotted Hours
	DETAILED SYLLABUS: 1. Conductors, insulators, resistors, voltage and current. 2. Law of resistance, factors affecting resistance of conducting material 3. Ohm's law, D. C. series and parallel circuits, 4. EMF, electrical potential difference 5. Kirchhoff's Law 6. Simple series and parallel circuits, 7. Superposition and Thevenin's theorems	3
MET -02	**MAIN TOPICS:** Electrolytic action and secondary cell	Minimum Allotted Hours
	DETAILED SYLLABUS: 1. Safe – handling and using batteries. 2. Advantages of batteries and its uses on board ship. 3. Primary and Secondary cell 4. Series and parallel connection of batteries 5. Emergency and essential power fed by batteries 6. Faraday's law of electrolysis 7. Lead Acid Battery action, construction features, design requirements 8. Polarization of battery 9. Rating of batteries, charging and discharging of batteries 10. Alkaline batteries, Nickel-Cadmium batteries. 11. Battery maintenance and different charging systems.	3
MET -03	**MAIN TOPICS:** Electrostatics, series and parallel circuits involving capacitors, Energy stored in a capacitor	Minimum Allotted Hours
	DETAILED SYLLABUS: 1. Static Electricity 2. Laws of Electrostatics 3. Electrostatic field, Electrostatic induction 4. Capacitor, Capacitance, charging of capacitors, capacitors leakage 5. Electrostatic charge, dielectric stress, dielectric constant 6. Capacitor rating, energy stores in capacitor, series and parallel circuits 7. RC Time constant 8. Polarized and non polarized capacitors	3
MET -04	**MAIN TOPICS:** Magnetic circuits, Magneto motive force, Permeability, Reluctance, Simple magnetic circuits, Typical B/H and U/B curves .Energy stored in an electric field.	Minimum Allotted Hours

	DETAILED SYLLABUS: 1. Nature of a magnetic field, magnetism, lines of flux 2. Ferromagnetic materials, Electromagnetism 3. Flux and flux density, magneto motive force, magnetic field strength 4. Permeability, reluctance, relationship between B and H 5. Magnetic circuits, Air gap fringing and laminated core 6. Energy stored in electric circuit 7. Eddy current and hysteresis	3
MET -05	**MAIN TOPICS:** A. C. Circuits. Effect of inductance and capacitance on the circuit Simple Series and parallel circuits; Relationship between resistance, reactance and impedance, Power factor, Power in single phase and three phase a. c. circuits	Minimum Allotted Hours
	DETAILED SYLLABUS: 1. Development of SINE wave. 2. Effective value, average value and RMS value 3. Phase angle, voltage, current and frequency calculation 4. Inductance, Inductive reactance 5. Capacitance and Capacitive reactance 6. Impedance, Impedance in R-L circuits, R-C circuits and R-L-C circuits 7. Power triangle, apparent power, true power, reactive power and power factor 8. Power in single phase and three phase circuits	9
MET -06	**MAIN TOPICS:** A. C. Machines the principles, constructional details and protection of salient pole, cylindrical and brushless alternators. The emf equation and automatic voltage regulation for an alternator. A. C. Switch gear, Generator Protection; Parallel operation of Alternators	Minimum Allotted Hours
	DETAILED SYLLABUS: 1. Main source of power requirements on ship, power generation of ship 2. Working principle of alternators 3. Construction details of alternators – Salient pole and cylindrical rotors 4. Damper windings, 5. Alternator rating 6. Operational control of synchronous generators 7. Single generator true power, reactive power 8. Parallel operation of generators, 9. Sychroscope, synchro-lamps, synchronizing with voltmeter 10. Speed droop, effect of speed droop on operation of generators in parallel. 11. Multiple generators – true power and reactive power 12. Automatic voltage regulator, error sensing and static AVR 13. EMF equation, coil pitch, distribution factor, voltage regulation	15

	14. Main circuit breaker, arcing phenomenon, methods of interruption of arc. 15. Magnetic circuit breakers, thermal circuit breakers, MCB, MCCB, ACB 16. Alternator protection – over current, short circuit, over/under voltage, over/under frequency, earth leakage, reverse power	
MET -07	**MAIN TOPICS:** A.C. Motors: The principles, construction details and protection of induction motors. Slip, rotor. Slip rotor e.m.f. and frequency, Torque Speed equations. Wound, slip ring, cage and double wound type motors. Starting methods.	Minimum Allotted Hours
	DETAILED SYLLABUS: 1. A. C. motor – Types of motor 2. Induction motor – advantages and disadvantages comparison with D. C. motors 3. Working principle, rotating magnetic field theory, construction of motors 4. Synchronous speed, frequency, slip, torque, torque speed curve of induction motors 5. Power flow in motors 6. Effect of rotor resistance in motors, double cage induction motor 7. Speed control of induction motors – Pole changing method, Electro- hydraulic drive, Wound-rotor resistance control of induction motors, Ward-Leonard d.c. motor drive, By stator voltage control, By keeping voltage by frequency ratio constant (Variable-frequency induction motor control) 8. Motor starters – DOL, star-delta starter, auto-transformer starter, soft starter 9. Motor protection – temperature, over current, short circuit current, single phasing	15
MET -08	**MAIN TOPICS:** Transformers: The emf equation and efficiency. Auto transformers and current transformers	Minimum Allotted Hours
	DETAILED SYLLABUS: 1. Transformer – operating principle, construction 2. EMF equation of transformers, 3. Elementary theory of ideal transformer 4. Theory of transformer working on load 5. Equivalent resistance, equivalent reactance, equivalent circuit of transformer 6. Leakage flux, short circuit test, open circuit test, voltage regulation 7. Efficiency of transformer, losses in transformer, all day efficiency. 8. Instrument transformers	12

MET -09	**MAIN TOPICS:** Rectification, distribution, circuit protection, batteries, deck machinery, insulation testing	Minimum Allotted Hours
	DETAILED SYLLABUS: 1. Insulated neutral and neutral earth system for power distribution, 2. Circuit protection – Circuit breakers, fuses, preferential trips, earth leakage indication and protection 3. Batteries – storage, safety precautions, maintenance 4. Deck machinery drives, starting arrangements 5. Maintenance of motors – overhauling, insulation resistance testing	6
MET -10	**MAIN TOPICS:** Electronics: Semiconductors, Junction diodes, junction transistors and their operating Characteristics, Simple Transistor circuits	Minimum Allotted Hours
	DETAILED SYLLABUS: 1. Conductors, Insulators and Semiconductors 2. Types of semiconductors, doping, Intrinsic and Extrinsic semiconductors 3. N-type semiconductors and P-type semiconductors, effect of battery 4. PN junction, forward bias and reverse bias. 5. Junction diode, characteristics of junction diodes 6. Halfwave, fullwave rectifiers, filter circuits 7. Junction transistors – BJT and FET, transistor characteristics 8. Simple transistor circuits – example - temperature sensor alarm circuit	6
MET -11	**MAIN TOPICS:** Control Systems: Simple Theory of all control systems, location of common faults and action to prevent damage. Trouble shooting of monitoring system	Minimum Allotted Hours
	DETAILED SYLLABUS: Process control, controlled condition, Local and remote control. 1. Elements and measurements of a control system. 2. Definition and control terminology. 3. Open loop and close loop control systems and their operation. 4. Types of control actions – two step or on/off control, proportional control, Integral control and Derivative control. 5. Proportional band, effect of change in proportional band, Gain or proportional control. 6. PI control, PD control and PID control action. 7. Actuators, Transducers. 8. Ships control systems. 9. Location of common faults, actions to prevent damage, trouble shooting of monitoring systems	15

Function 3: Subject 1: NAVAL ARCHITECTURE & SHIP CONSTRUCTION
[60 hours]

NA-01	**MAIN TOPICS:** CENTRE OF GRAVITY	Minimum Allotted Hours
	DETAILED SYLLABUS: • Determination of the position of the centre of gravity of a ship in new condition • The effect on the position of the centre of gravity of adding, removing & shifting gravity. • Stiff and tender ships. • The effect of shift of a cargo or solid ballast • Free surface effect	3
NA-02	**MAIN TOPICS:** TRANSVERSE STABILITY	Minimum Allotted Hours
	DETAILED SYLLABUS: • Knowledge of the righting couple when a ship is inclined by an external force. • The transverse and longitudinal metacentric height, • Stiff and tender ships.	3
NA-03	**MAIN TOPICS:** CALCULATION OF AREAS AND VOLUMES	Minimum Allotted Hours
	DETAILED SYLLABUS: • The computation of areas of volumes by Simpson's first and second rules.	3
NA-04	**MAIN TOPICS:** TRIM	Minimum Allotted Hours
	DETAILED SYLLABUS: The Calculation of : • Changes of trim • Moment to change trim per centimeter, the position of the centre of floatation being given • The use of stability curves and data supplied to a ship • Effect of bilging and flooding of a compartment on the ship with regard to increase in draft and • Concept of permeability.	9
NA-05	**MAIN TOPICS:** STABILITY AND HYDROSTATIC CURVES	Minimum Allotted Hours

	DETAILED SYLLABUS: • Use of stability, hydrostatic and stress data supplied to ship • Curves of stability and factors affecting the shapes of the curve. • Carriage of deck cargo and its influence on stability and structural stresses.	3
NA-06	**MAIN TOPICS:** DAMAGE STABILITY	Minimum Allotted Hours
	DETAILED SYLLABUS: The effect on the following of a ship, in the event of damage • Trim and • Stability	3
NA-07	**MAIN TOPICS:** RESISTANCE AND POWERING, PROPELLERS AND RUDDERS	Minimum Allotted Hours
	DETAILED SYLLABUS: A. Resistance & power calculations. B. Propellers • Propeller thrust, • Measurement of pitch, • Cavitation C. Rudders • Simple rudder theory, • Various types of rudders & their applications.	6
NA-08	**MAIN TOPICS:** SHIP CONSTRUCTION	Minimum Allotted Hours
	DETAILED SYLLABUS: • The principle structural members of a ship, • Proper names of various parts. • The construction of the midship section of single deck and tween deck ships and • The construction of liquid/dry bulk carriers, including container and passenger ships. • Construction and stiffening of watertight bulkhead including collision bulkhead. • The construction of rudders and methods of attachment. • The construction, stiffening and closing arrangement of hatchways and superstructure.	12

NA-09	**MAIN TOPICS:** WELDING AND TYPES OF WELDED JOINTS	Minimum Allotted Hours
	DETAILED SYLLABUS: • General ideas on welding processes and • Precautions to be taken when such processes are carried out on board • Knowledge of basic joints used in welding and preparation of it. • Defects in the welding process • NDT of weld joints	9
NA-10	**MAIN TOPICS:** STRESSES ON SHIP AND ARRANGEMENTS TO WITHSTAND THE STRESSES	Minimum Allotted Hours
	DETAILED SYLLABUS: • Stresses and strains in ships in a seaway or due to loading or ballasting. • Local and special stiffening. • The parts of a ship which are specially strengthened to withstand local and general stresses or to offset the effects of excessive corrosion.	3
NA-11	**MAIN TOPICS:** CLASSIFICATION OF SHIPS	Minimum Allotted Hours
	DETAILED SYLLABUS: • An outline knowledge of classification of ships/classification societies	3
NA-12	**MAIN TOPICS:** DAMAGE REPORTING	Minimum Allotted Hours
	DETAILED SYLLABUS: • Knowledge of writing a report of damage sustained during a voyage. • Directing effective repairs.	3

Function 3: Subject 2: SHIP SAFETY AND ENVIRONMENTAL PROTECTION
[90 hours]

SSEP–01	**MAIN TOPICS:** CERTIFICATES AND DOCUMENTS	Minimum Allotted Hours
	DETAILED SYLLABUS: **Certificates -** Certificates and other documents required to be carried on a ship, how they are obtained and period of their validity. • Statutory Certificates • Classification Certificates • Other Certificates / License • Bodies responsible for issuance of certificates.	9
SSEP–02	**MAIN TOPICS:** LOAD LINES	Minimum Allotted Hours
	DETAILED SYLLABUS: **Load lines -** Responsibilities under the relevant requirements of the International Conventions on load lines, load line marks, Entries and reports in respect of freeboard, draught and allowances. • Verification of Load line marks • Dual Load line	3
SSEP–03	**MAIN TOPICS:** SOLAS	Minimum Allotted Hours
	DETAILED SYLLABUS: **SOLAS -** Knowledge of the relevant requirement of the International Convention for the Safety of `Life at Sea. ➢ Main Objective of SOLAS ➢ Overview of the contents of chapters of SOLAS • General Prevision • Construction- Subdivision and stability, machinery and electrical installation • Fire protection, Fire detection and extinction • Life Saving appliances • Radio Communications • Safety of navigation • Carriage of cargo • Carriage of Dangerous goods • Nuclear Ships • Management of the safe operation of ships • Special measures to enhance maritime Safety • Additional Safety measures for bulk carriers • Verification of Compliance	12

	• Safety measures for ships operating in Polar Water • Safe Carriage of Industrial Personnel	
SSEP–04	**MAIN TOPICS:** Pollution Prevention	Minimum Allotted Hours
	DETAILED SYLLABUS: **Pollution Prevention -** Knowledge of the M. S. (Prevention of the Pollution of the sea by Oil) Rules, including the keeping of the records and period of record preservation. Thorough knowledge of prevention of pollution of the marine environment and anti-pollution procedures and precautions including EEDI, EEXI and CII. Effects of operational or accidental pollution on Marine environment and application of MARPOL 73/78, all Annexes. Anti-pollution equipment and anti-pollution drills, Familiarity with SOPEP manual. Oily Bilge Separator. Oil discharge monitoring system for cargo space of tankers. Incinerator. Sewage system. Garbage Management Plan. Air pollution prevention.	24
SSEP–05	**MAIN TOPICS:** Health	Minimum Allotted Hours
	DETAILED SYLLABUS: **Health -** Crew Accommodation, hygiene, welfare of crew, Inspections and reports, Maritime Declaration of Health, Port Health requirements pertaining to BIMMS conference.	3
SSEP–06	**MAIN TOPICS:** Safety	Minimum Allotted Hours
	DETAILED SYLLABUS: **Safety -** Outline knowledge of the Acts and Regulations as they affect the management of the ship including Life Saving Appliances and Fire Fighting Equipment's, Musters, Drills, Closing of Opening in Hull, and watertight Bulkheads. Safe working practices.	15
SSEP–07	**MAIN TOPICS:** ISM Code	Minimum Allotted Hours
	DETAILED SYLLABUS: **ISM Code -** Basic knowledge of ISM Code. a. Good watchkeeping practices. Importance of periodic maintenance schedules, musters, drills, and equipment checklist. Maintaining of ship records. Regular logging of various ship parameter readings. Interpretation of variance if any. Maintain and confirm regularly the effectiveness of life saving appliances, fire-fighting appliances and anti pollution equipment's	15

	b. Develop and regularly execute through drills the various emergency plans such as Engine Room Flooding, spill of oil, ship running aground, collision, fire on board the ship, loss of steering. **c.** Knowledge of personal management. Organisation of Training on board ships. Duties allocated to crew.	
SSEP–08	**MAIN TOPICS:** Use Leadership and Managerial skills	Minimum Allotted Hours
	DETAILED SYLLABUS: **Use Leadership and Managerial Skills:** a. Knowledge of shipboard Personnel Management and Training - Engineer and Manager, Human Resource Management, Training and Development, Maintenance Management. b. Knowledge of International Maritime Conventions and recommendations and related National Legislations - The ISM Code, STCW Convention, ILO's MLC 2006. c. Ability to apply task and workload management – Communication, Team building, Planning and co-ordination, Personal assignments, Time and resource constraints, Prioritization d. Knowledge and ability to apply effective resource management - Allocation, assignment and prioritization of resources, Effective communication on board and ashore, Decisions reflect consideration of team experience. e. Knowledge and ability to apply decision-making techniques - Management processes and functions, negotiating skills, Situation, and risk assessment, Identify and generate options, Select course of action, Evaluation of outcome effectiveness. f. Development, implementation, and oversight of standard operating procedures - Project planning and controlling. g. Shore Power or Cold ironing, h. Alternate Fuels: Methane LNG, Hydrogen etc.	9

SUBJECT – ENGINEERING MANAGEMENT

MEO Class I NCV (Upto 8000 KW other than Tankers)

FUNCTION: Controlling the operation of the ship and care for persons on board at the management level.

COMPETENCE: Monitor and control compliance with legislative requirements and measures to ensure safety of life at sea, security and protection of the marine environment.

MODULE: M 1	MAIN TOPICS: Knowledge of Indian Merchant Shipping Act, International Treaties & Conventions relevant to Shipping Rules. Indian Coast Guard, it's structure and operations	Minimum Allotted Hours
	DETAILED SYLLABUS: **1. Knowledge of, Indian Merchant Shipping Act, National and International legislation. Indian Coast Guards, its structure, and operations.** **1.1 Explain National legislation and international legislation; and method of adoption of the above legislations** (i) Explain about Indian Merchant Shipping Act and various rules under it (ii) Define the following conventions (a) International Convention for the Safety of Life at Sea (SOLAS) (b) International Convention on Load Lines (LL), (c) Special Trade Passenger Ships Agreement (STP), (d) International Convention for Safe Containers (CSC), (e) Explain various conventions on Liability and Compensation (f) International Convention on Maritime Search and Rescue (SAR), (g) Convention on the International Regulations for Preventing Collisions at Sea (COLREG), (h) International Convention on Standards of Training, Certification and Watch keeping for Seafarers (STCW), (i) International Convention for the Prevention of Pollution from Ships, (MARPOL) (j) Marine Environment: (k) The Hong Kong International Convention for the Safe and	21

	Environmentally Sound Recycling of Ships, 2009 (the Hong Kong Convention); (l) Liability and Compensation for Ship-Source Marine Pollution: CLC 1969, 1992, HNS. (m) International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (INTERVENTION) (n) International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC), iii. International Convention on Salvage (SALVAGE), a. Define adopting a convention b. Explain various conventions on Liability and Compensation c. Explain Signature, ratification, acceptance, approval and accession d. Explain that the Amendments will be made to the regulations as and when required e. Explain that the enforcement of IMO conventions depends upon the Governments of Member Parties. f. Relationship between Conventions and interpretation g. Defines Uniform law and conflict of law rules h. Discuss legislation on Sox and NOx emissions, EEDI, EEXI, CII i. Explain United Nations Convention on the Law of the Sea: Territorial Sea and contiguous zone, straits used for international navigation, archipelagic states, exclusive economic zone, continental shelf, high seas, protection and preservation of the marine environment, settlement of disputes **1.2 Indian Coast Guard, it's structure and operations.** **1.3 International Maritime Organization (IMO) and IMO's Conventions Related to Safety, Related to Pollution, Related to Liability and Compensation and Related to other subjects.** Explain that IMO is the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships. (i) Maritime Safety: (a) Recommendations on the safe transport of dangerous cargoes and related activities in port areas (b) Fire Protection, fire detection and fire extinction (Summary of SOLAS Chapter II-2) (c) Implementation, Control and Coordination (d) Casualties (e) Applicable IMO instruments on casualty matters (f) Port State Control (g) Surveys, Verifications and Certification (h) The IMO ship identification number scheme	

	(i) Improvement of navigational safety. (j) Stability and Subdivision (k) Safety regulations for different types of ships (l) Other Safety Topics	

MODULE : M 2	**MAIN TOPICS:** ISO 9001:2008, ISM Code, Shipboard Internal Audits / Verification Audits and Certification.	Minimum Allotted Hours
	DETAILED SYLLABUS: **ISO 9001-2015, ISM Code, – Ship board internal audit** (i) Interpret and understand the ISM Code with the inter-relationship to the ISO 9001:2008 (ii) An Introduction to Quality and Safety Management Systems. (iii) An Introduction to the "Guidelines on the Application of the ISM Code" and its relationship to ISO 9001:2008, ISO 14001, OH&S systems and ISPS. (iv) Types of Audits – 1st, 2nd and 3rd Party fully explained with practical case studies. (v) Auditing Techniques: Planning - Preparation - Performance - Reporting and Follow-up - Close Outs. (vi) Writing Audit Findings as Audit Reports including accidents, incidents and hazardous occurrences. (vii) Corrective and Preventive Action and being able to identify Major and Minor Non-Conformances and Observations. (viii) Requirements to become a Lead Auditor for Quality, Safety, Environmental and Security Management Systems. (ix) Quality Management System certification requirements. (x) ISM certification requirements (DOC and SMC) Domestic SMS and DOC. (xi) Interactive training, combining lectures and videos with practical application of the techniques and requirements in team role-play scenarios.	15
MODULE : M 3	**MAIN TOPICS:** Ship's Hull and Machinery Surveys and Maintenance of up-to-date statutory and other related certificates. Classification Societies and their functions: CSM, CHS & Special Survey Programme.	Minimum Allotted Hours
	DETAILED SYLLABUS: Classification societies and their functions. Certificates and documents as per international convention. (i) Explain flags of convenience (ii) Explain the need and duties of classification society & Discuss about classification (iii) Classification surveys	15

	(a) Explain Continuous survey of machinery and other methods of machinery surveys (b) Explain Continuous survey of hull and other methods of hull surveys (c) Explain Enhanced special survey programmes (iv) Assignment, maintenance, suspension and withdrawal of class (v) Ship inspections for first entry into Indian flag - Explain Section 27(1) of the M.S. Act and Rule 5 of the M.S. (Registration of Indian Ships) Rules, 1960, either by the Mercantile Marine Department (MMD) or the Indian Register of Shipping (IRS). - discusses MSL Branch Circular 2 of 2008 **SOLAS Convention:** i. Explain briefly sections of the convention ii. Chapter XIII – Verification of Compliance iii. Chapter XIV – Safety measures for ships operating in Polar Water iv. Chapter XV - Safe Carriage of Industrial Personnel v. SOLAS updates and amendments: vi. Explain about the various amendments made from time to time, vii. Discuss about the latest amendments and their applicability with validity dates etc. **Explain about initial survey, periodical survey, renewal survey, intermediate survey, annual survey, additional survey** i. **Explains** Harmonized system of ship survey and certification MARPOL brought amendment. ii. Tacit acceptance in LL Convention and SOLAS Convention, BWMC also part of HSSC iii. Types of ship survey iv. List of certificates required on board ship relating to harmonized system of survey and certification v. Explain general survey requirements.	
MODULE : M 4	**MAIN TOPICS:** Ship's Safety, Security and Pollution Prevention. Knowledge of related Conventions Codes and GOI Rules.	Minimum Allotted Hours
	DETAILED SYLLABUS: **1. Ship surveys and inspections for port state control / flag state control and compliance for NCV vessels.** **1.1** Explain that Port State Control (PSC) is the inspection of foreign ships in national ports to verify that the condition of the ship and its equipment comply with the requirements of international regulations and that the ship is manned and operated in compliance with these rules. i. Discusses Update on implementing Port State Control Directive applicable from time to time	12

	ii. Define that Flag State refers to the authority under which a country exercises regulatory control over the commercial vessel which is registered under its flag. iii. Define the duties of a Flag State and explain the role of the Flag State iv. Flag State responsibilities as defined by the International Chamber of Shipping (ICS) & The International Shipping Federation (ISF) v. Explain that Flag States should participate in the IMO Member State Audit Scheme vi. Discusses various Commitments under MOU vii. Explain the Relevant instruments used by MOU authorities viii. Explain Inspection Procedures, Rectification and Detention ix. Discusses Provision of information by authorities x. Explain Operational violations xi. States that any Authority may propose amendments to the Memorandum, and the enforcement of amendments **1.2 Explain about initial survey, periodical survey, renewal survey, intermediate survey, annual survey, additional survey** i. Explains Harmonized system of ship survey and certification ii. Tacit acceptance in LL Convention iii. Types of ship survey iv. List of certificates required on board ship relating to harmonized system of survey and certification v. Explain general survey requirements	
MODULE : M 5	**MAIN TOPICS:** Budgeting: Understanding fixed and consumable cost, Voyage Expenses, Repair Cost Analysis, Dry-docking Cost Analysis, Economizing of Fuel/Lub Oil Consumption.	Minimum Allotted Hours
	DETAILED SYLLABUS: **Budgeting** (i) Explain that Cost value analysis (CVA) is an effective way to reduce the costs (ii) Fixed and consumable costs (iii) Explain Voyage expenses are all expenses unique to a particular voyage, including any bunker fuel expenses, port fees, cargo loading and unloading expenses, canal tolls, agency fees and commissions. (iv) Explain about Dry-dock and repair cost analysis (v) Explain Down time realization (vi) Economizing of Fuel/Lub Oil Consumption.	9
MODULE : M 6	**MAIN TOPICS:**	Minimum Allotted Hours

	Emergency Preparedness: Emergency Preparedness for oil pollution, Fire, Collision, Grounding and Accidents involving personnel. Root Cause Analysis and Reporting Procedures.	
	DETAILED SYLLABUS: **Emergency Preparedness:** (i) Emergency preparedness for - oil spill, fire, flooding, collision, grounding and accident involving personnel (ii) Study of emergency and damage control plans (a) Damage control involves all aspects of damage that a ship may encounter. (b) The vital damage control systems aboard ship include - Communications, Emergency power, Pumping system, Fire main, Drainage system. (iii) Details of the measures used and adopted (iv) Maintenance and drills to be conducted (v) Define damage control strategies - Line of action before the damage occurs, Reduce the effects of damage after it has occurred, Emergency repairs to damage caused by accident, Restoration of services to ship after damage has occurred. (vi) Validate damage control tactics - Trained personnel, Available equipment & materials, desired results. Supervise the maintenance, sharing higher responsibilities, co-ordinate with authorities and owners. (vii) Case studies of accidents; root cause analysis & Reporting procedures (viii) Risk assessment prior commencement of work - Define risk assessment, define risk management, Discuss Company Responsibility, Different methods for hazard identification and assessment of the risks, Discuss the benefits of risk management. (ix) Detection/ Breakdowns/ repairs/ restoration: (a) Failure of cross-head bearing/ main bearing/ bottom end bearings of main engine (b) Breakage of chain drives of main engine (c) Breakdown on turbo chargers (d) Breakdown of main air conditioning and fridge system (e) Collapse/ failure of multiple boiler water tubes (f) Major contamination of main L.O. sump – Action/ handling/ rectification. **Severe flooding of engine room bilges**: i. Action ii. Handling iii. Rectification.	21

MODULE : M 7	**MAIN TOPICS:** Ship's Stability: Ship's Stability incl at dry-docking time -Damage Stability - flooding / grounding.	Minimum Allotted Hours
	DETAILED SYLLABUS: **Ship Stability:** (i) Explain Ship stability- during dry docking (ii) Explain damage stability during flooding and grounding. (iii) Explain Counter measures to be taken to maintain stability during the above (iv) Define and explain IMO Regulations on ship stability; control of trim, stability & stress (v) Define and Explain International Intact Stability Code - Explain the International Code on Intact Stability 2008 (2008 IS CODE), presents mandatory and recommendatory stability criteria and other measures for ensuring the safe operation of ships, to minimize the risk to such ships, to the personnel on board and to the environment (vi) Explain probabilistic method of damage stability assessment -describe struck ship damage in ship collisions.	18
MODULE : M 8	**MAIN TOPICS:** Inventory Management including spares/stores/lead time, Inventory of lub-oil, fuel oil. Availability, quality and management of same.	Minimum Allotted Hours
	DETAILED SYLLABUS: **Inventory management, including:** (i) Spares, stores - Explain quantity of inventory called the safety stock, explain when to re-order spares or stores, Explain the formula ROP = SSQ + (QUD x ALT) (ii) Explain what is a Lead time. (iii) Explain about calculating the bunker requirements and maintaining the level Inventory of Fuel oil (iv) Explain Inventory of lub oil, Use of low TBN cylinder oil for low sulphur fuel (v) Explain and details Management of quality of above (vi) Discusses of certain relevant case studies **Economizing of fuel consumption** (i) Explain Effective power balancing; Propulsive characteristics of Diesel Engines including speed, output and fuel consumption Explain Bunker management, Explain the use of low sulphur fuel, Change over procedures (ii) Explain the current version of ISO 8217 fuel standards (iii) Explain factors affecting vessel's performance, Discusses about load diagrams	9

MODULE : M 9	**MAIN TOPICS:** Log books and Records: Record making, keeping and its interpretation for complete engine room with regard to maintenance/operation/personnel	Minimum Allotted Hours
	DETAILED SYLLABUS: **Records** (i) Record making, keeping and its interpretation for complete engine room with regard to maintenance & operation (ii) C/E s standing orders / night order book / updation of circulars, New ORB & GRB entries and other records as per MARPOL requirements. (iii) Maintenance records of Main & Auxiliary Machinery. Plant Maintenance System. World Health Organization & International Labour Organization: i. World Health Organization (WHO) - Explain that The United Nations public health arm. Monitors disease outbreaks, assesses the performance of health systems around the globe ii. (Maritime Labor Certificate and Declaration of Maritime Labor Compliance: briefly describes Regulation 5.1.3 - Maritime labor certificate and declaration of maritime labor compliance and applicability of MLC to Coastal Vessels.	9
MODULE : M 10	**MAIN TOPICS:** Practical Electricity Electronics and Control System with stress on high voltage on ships and electrical propulsion.	Minimum Allotted Hours
	DETAILED SYLLABUS: **Practical electricity and electronics** **(i) High voltage on ships** (a) Define the high voltage & HV Systems on vessels & advantages of high voltage applications (b) Explain about the safety requirements while working on the high voltage systems (c) Explain Effects of short circuit and protection against short circuit (d) Busbar arrangements and insulation requirements (e) Benefits of HV systems, Explain typical marine HV systems with diagrams (f) Protection system for DG & TG, motor protection, describe HV cargo switch board (g) Procedure for meggering high voltage systems, Major Risk Factors in HV systems (h) Discuss inter electrode capacitances and HV inductances (i) Benefits of HV systems, Explain typical marine HV systems with diagrams **(ii) Electrical propulsion** (a) Concept of Electrical Propulsion (b) Explain about the Azipod propulsion systems	15

	(c) Discusses the advantages and disadvantages of electrical propulsion system (d) Use of synchronous motor for electrical propulsion (e) Explain with the sketches, the construction of Azipod section. (f) Discusses the maintenance requirement for such arrangement (g) Discusses about the speed control by varying the frequency (Pulse Width Modulation) (iii) **Sulfur Hexafluoride (SF6) and vacuum circuit breakers** (a) Discusses the various circuit breakers normally used (b) Use of SF6 and vacuum circuit's breakers and their advantages are discussed in regard to high voltage application. (c) Arc sustaining and quenching methods are explained.	
MODULE : M 11	**MAIN TOPICS:** Training of trainers. Chief Engineer as trainer for engine room staff with stress on discipline, motivation, mentoring and communication.	Minimum Allotted Hours
	DETAILED SYLLABUS: **Training of trainers. Chief Engineer as trainer for engine room staff:** (i) Skills needed for the chief engineer to be a trainer – Comprehension, Conceptualization, Creativity and Conduct (ii) personal qualities of chief engineer as trainer - Personal skills, confidence, voice modulation, adjusting to environment, ability to listen, theatrical skills, flexible, cools headed, desire to learn, ability to relate, sense of humor (iii) Explain the training process (a) Determine (Requires Comprehension skill) (b) Design and Development (Requires Conceptualization and Creativity skill) (c) Deployment (Requires Conduct skill) (d) Determine (Requires Comprehension skill) (iv) Details the Discipline required on board and the need for counselling (v) Explain Housekeeping, need for safety and hygiene. (vi) Explain the Need analysis and development (vii) Explain that by being a role model others can be motivated (viii) Details the importance of Mentoring (ix) Encouraging group participation and explain the advantage of group discussion and its outcome (x) Motivation as an effective tool.	9
MODULE : M 12	**MAIN TOPICS:** Marine Insurance- general principles and types of insurance covers and P & I Clubs / charter party.	Minimum Allotted Hours

	DETAILED SYLLABUS: **P&I Clubs, - principles of protection & indemnity Insurance – types of P&I cover available – their modes of operation** (i) Explain the principle of indemnity and insurance - Growth of third-party liabilities, Mutuality, Moral hazard, Willful misconduct. (ii) Explain the different covers available under P & I - cargo insurance, protection and indemnity insurance, death and personal injury on board etc., running down clause and fixed or floating objects, repatriation of sick or injured crew and hospital expenses, Loss of personal effects of the crew, loss of damage to cargo, liability for stowaways, liability for oil pollution and other types of pollution, legal liability for wreck removal. (iii) Explain the modes of operation (iv) Charter party, and role of Chief Engineer in compliance of charter party (a) Explain time charter, voyage charter & bare boat charter (b) The *importance* of correct labelling of bunker (c) Chief engineer's role in collecting samples and sending the sample fuel, lubricating oil for analysis on periodical basis (d) Chief engineer's responsibilities in maintaining the machinery to enable smooth voyage to meet the charter party requirements. (v) Marine insurance - discuss marine insurance act, Essentials of the valid marine insurance contract, Contract of indemnity, Insurable interest, Fair dealing, Sea worthiness, Non deviation, Legality of the venture, Condition of the cargo, General consideration, general principles of insurance, Institute time clauses, types of marine insurance covers, Particular and General Average Act. (vi) Salvage: (a) Explain that Marine salvage is the process of rescuing a ship, its cargo, or other property from peril. (b) Classification of salvage - Offshore salvage, Harbour salvage, Cargo and equipment salvage, Wreck removal, afloat salvage, Clearance salvage. (c) Types of salvage - contract salvage, pure salvage, naval salvage. (d) discuss ship salvage and the law	15
MODULE : M 13	**MAIN TOPICS:** Organizational behaviour, Effective resource management, Development of standard operating procedures, Workload management	Minimum Allotted Hours

	and application of decision-making techniques. Crises management – need of leadership in crises. Importance of drills.	
	i. DETAILES SYLLABUS: ii. Human relations and modern management principles. iii. Organizational behaviour -Understand how perceived behaviour of organization and individuals is influenced iv. Understand how perceived behaviour of organization and individuals is influenced v. Explore the methods by which the behaviour of members of organization are constrained and influenced vi. Discuss the nature of information and communication in relation to Organization and their environment vii. Describe the types and nature of conflicts in organization viii. Awareness & appreciation of cross / multi-cultural aspects of man management on board ships ix. Workload management, Planning and coordination, Personnel assignment / Delegation x. Time and resource Constraints, Prioritization, Effective resource management xi. Allocation, assignment, and prioritization of resources xii. Effective communication on board and ashore xiii. Decisions reflect consideration of team experience xiv. Assertiveness and leadership, including motivation xv. Obtaining and maintaining situation awareness xvi. Decision-making techniques, Situation and risk assessment / risk management xvii. Crisis management on board ships, Human behaviour in crisis, Leadership in crisis xviii. Importance of emergency drills xix. Leadership and managerial skills xx. Explain that Leadership is a combination of character traits and learned skills xxi. States the importance of effective interpersonal communication xxii. Explain about team building and motivational skills, good *managerial skills* - develop the practice of sound record keeping, encourage team work - present case study, erase 'us' from 'them' feeling, facilitate rather than dictate, daily and weekly plan for both administrative and creative tasks xxiii. Explain work delegation and its importance xxiv. Explain and demonstrate how to handle stress xxv. Explain how to set target or goals xxvi. Personality development xxvii. Explain about choosing competent subordinates xxviii. Explain the need for demonstrating high moral standards xxix. Role plays and importance of being a role model	27

	xxx. Present case studies, power point slides available	
MODULE : M 14	**MAIN TOPICS:** Machinery performance testing and interpretation of results and application of corrective actions, knowledge of planned maintenance system and repair management.	Minimum Allotted Hours
	DETAILED SYLLABUS: **Machinery performance testing and interpretation of the results.** (i) Planned maintenance schedule. (ii) Main engine and auxiliary engines performance and testing. (iii) Condition monitoring of equipment. (iv) Vibration analysis. (v) Application of corrective actions. Repairs and repair management. (vi) Management of repairs by ship staff and workshops.	6
MODULE : M 15	**MAIN TOPICS:** Latest development in main propulsion and auxiliary machinery.	Minimum Allotted Hours
	Detailed Course: **Engine developments** (i) Smart engines, Camshaft less main engines and other diesel engine developments (a) explain the electronic governor (b) explain the common rail system for fuel injection (c) control system for the camshaft less engines (ii) New developments in tribology (a) explain lubrication of bearings and latest developments (b) alpha cylindrical lubricator system Explained (c) Discusses about Fuel Dilution in Lubricating Oils and their avoidance, methods available etc. (d) discusses about friction-speed characteristics in regard to lubrication (e) Explain hydrodynamic lubrication of lip seal etc. (iii) Propulsion system developments - discussion and explanation about the developments like contra rotating propellers, wake equalizing ducts, cavity system of propulsion, water jet propulsion, electrical propulsion. (iv) PTO/ PTI system in the conventional diesel electric propulsion etc. (v) Alternate fuels: LNG, Hydrogen, Methane and Ammonia. (vi) SEEMP part 2 and 3. Methods to EEDI, EEXI and CII.	12
MODULE : M 16	**MAIN TOPICS:** Monitor and control Compliance with legislative requirements and measures to ensure safety of life at sea and protection of the marine environment	Minimum Allotted Hours
	DETAILED SYLLABUS:	

	Monitor and control Compliance with legislative requirements and measures to ensure safety of life at sea and protection of the marine environment: (a) Details knowledge of relevant international maritime law embodied in international agreements and conventions (b) Regard shall be paid especially to the following subject: (c) Certificates and other documents required to be carried onboard ships by international conventions, how they may be obtained and the period of their legal validity (d) Responsibilities under the relevant requirements of the International Convention on Load Lines (e) Responsibilities under the relevant requirements of the International Convention for the Safety of Life at Sea (f) Responsibilities under various International Conventions for the Prevention of Pollution from Ships (MARPOL / AFS/ BWM) (g) Responsibilities under the STCW- 78 as amended in 2010. (h) Knowledge of national legislation/ GOI rules for implementing international agreements and conventions (i) Chief Engineer's role in Structural Inspections of various types of ships. Marine environment awareness.	15
MODUL: M 17	**MAIN TOPICS:** Ship Security System	Minimum Allotted Hours
	DETAILED SYLLABUS: **Ship security system** (i) Requirements of SOLAS Chapter XI – 2. (ii) ISPS code - Explain part A and part B of ISPS code regarding mandatory requirements. (iii) Auditing of Ship's Security System. (iv) LRIT (v) Piracy threat and anti-piracy measures - discusses the piracy threat, existing and proposed counter piracy measures (vi) Current Industry Best management practices (from ICS) – Somalia & West Africa (vii) The ILO/IMO Code of practice on security in ports (viii) Acts of piracy and armed robbery against ships (ix) Explain Best Management Practices guidance as per Marine Safety Committee circulars. (x) Importance of Training, drills and exercises in Ship Security.	6
MODUL: M 18	**MAIN TOPICS:** Flag State / Port State Control & compliance for NCV vessels	Minimum Allotted Hours
	DETAILED SYLLABUS: **World Health Organization & International Labour Organization:**	6

	i. World Health Organization (WHO) - Explain that The United Nations public health arm. ii. Monitors disease outbreaks, assesses the performance of health systems around the globe **Maritime Labour Certificate and Declaration of Maritime Labour Compliance**: i. Briefly describes Regulation 5.1.3 - Maritime labour certificate (MLC) ii. and declaration of maritime labour compliance (DMLC) part 1 and part 2 and applicability of MLC to Coastal Vessels.	

Bridging Course from MEO Class III to MEO CLASS II NCV SEO
upto 8000 KW (other than Tankers)

Additional competency required: Engine room simulator (Management level) – 5 days

Function 4B: Subject 1: MARINE ENGINEERING KNOWLEDGE GENERAL
[24 hours]

EKG -01	**MAIN TOPICS:** Technology of Materials, properties and characteristics of Metals, Materials, Liquids, Gases and vapours in machinery on board Ships	Minimum Allotted Hours
	DETAILED SYLLABUS: **Process Technology, Properties and Characteristics of different Metals [Ferrous and Non-Ferrous]** **Heat Treatment of Metals**: 1. in simple terms, what is meant by the upper and lower critical temperature ranges 2. the process and the effect on a medium-carbon steel **of hardening and tempering** 3. the purpose and process **of annealing** 4. the difference between annealing **and normalizing** and their applications 5. what is meant by work hardening 6. Surface hardening methods 7. Laser hardening **Alloying Elements in Irons and Steels_** The principal reasons for adding the following elements: - cobalt - nickel - chromium - molybdenum - vanadium - tungsten - copper - manganese - silicon - titanium **Non-ferrous Metals_** - manganese - phosphorus - aluminum - zinc	3

EKG- 02	**MAIN TOPICS:** CARGO Handling Equipment and Deck Machinery	
	DETAILED SYLLABUS: **CARGO HANDLING EQUIPMENTS USED:** **DECK MACHINERIES** Warping Winches and Capstans 1. The purpose and setting of a torque-limit relay in the control system of a warping winch or capstan, including the provision for emergency heavy pulls 2. The speed variation necessary when handling slack ropes 3. The possible effect on the generators if direct on-line cage motors are used for winches 4. The principle of a three-speed cage winch motor, how the cage motor has been applied to windlass operation 5. The principle of a slip-ring motor drive to a warping winch, including: - reversing - overload - torque limiting - speed control - fail-safe braking 6. Functions and Mechanism of Automatic Control of Cargo Handling Equipment's 7. The duties of an automatic mooring winch 8. The principle of the ways in winch a grab is operated **DERRICKS AND WINCHES AND CRANES** Equipment's: Derricks, Winches, Wires / Rigging of wires, Pulley blocks / Shackles / Swivel Blocks, Deck Cranes- Jibs. Function of each Actuator Handling: 1. what is meant by the luffing and slewing movements of a crane 2. how dynamic braking is applied to the slewing movement 3. the principle of the union-purchase cargo-handling system and the variations of winch speed required **ANCHOR WINDLASS** 1. anchor Handling 2. how the speed of lowering is controlled on the cable lifter of a windlass 3. the need for the various speeds of a windlass 4. housing of anchors 5. chains &chain lockers 6. locking arrangements for chain 7. hawse pipe / spurling pipe / bow stopper / Brake Arrangement	3

EKG -04	**MAIN TOPICS:** Construction details, Management of Auxiliary Boiler including fuel and Air System and action in case of Emergencies	Minimum Allotted Hours
	DETAILED SYLLABUS: **Boiler Constructional details:** 1. Materials 2. Furnace layout 3. Tube layout 4. Water drum / Steam Drum 5. Supports 6. Mountings 7. Foundation **Safety Valves:** 1. The number of safety valves which must be fitted to a boiler 2. A drawing of an improved high-lift safety valve, explains the function of each component: 3. The materials from which components of safety valves are made 4. The maintenance required for a safety valve 5. The adjustment and setting of a safety v/vs 6. The principle of operation of a full-bore safety valve **Boiler Water Level:** 1. The procedure to ensure that the water level gauge in a boiler is functioning correctly 2. The principles of construction of a plate-type water gauge 3. The principles of remote water level gauge 4. Why feed-check valves are non-return valves and are fitted with a double shut-off facility **Other Mountings:** **Boiler Defects:** 1. The possible causes of deformation of heating surfaces in a boiler 2. Briefly the hydraulic testing of a boiler 3. The preferred method of taking a boiler out of service for examination /survey 4. The procedure for blowing down a boiler 5. The process of electrochemical corrosion 6. The effect of dissolved oxygen in boiler water 7. The effect of excessive acidity of boiler water 8. The initial treatment given to fresh water and to seawater before being supplied to a feed water system 9. How seawater could enter a boiler	6

	Water Treatment: 1. The purpose of treatment of feed water 2. In principle how the above objective is achieved 3. Types & names the chemicals used 4. In general terms how the corrosion described in the above objective can be reduced **Water Testing** 1. The use of litmus paper 2. The following test procedures: a. Alkalinity to phenolphthalein b. Total alkalinity c. Caustic alkalinity d. Chloride e. Sulphite f. Phosphate g. Hardness h. Ph value i. Dissolved oxygen j. Total dissolved solids k. Hydrazine **Emergency operations:** 1. Change over from Auto Control to Manual Control 2. Emergency shutdown – flame failure, low water level, Uptake hi-back pressure	
EKG -05	**MAIN TOPICS:** Oily water separator, incinerator, sewage treatment plant, preparedness for pollution prevention particularly while bunkering	Minimum Allotted Hours
	DETAILED SYLLABUS: ***Sewage and Sludge:*** 1. The implications of the International Convention relating to the discharge of sewage 2. A sewage retention system 3. Why vacuum transportation systems are used 4. The processes in a biological treatment plant 5. How the sludge from a biological treatment plant is disposed of 6. Why biological treatment should be kept working continuously 7. Names the contaminants which would impair the treatment process 8. The operation of chemical treatment plants 9. Lists the waste materials that can be incinerated 10. How liquid and solid waste are prepared for	3

	Preparedness for Pollution Prevention whilst Bunkering: 1. IMO Regulations 2. Port Regulations 3. SOPEP 4. Preplanning 5. Calculations / Safety margin re-capacity 6. Local Agents informed 7. Liaison with Bunker Suppliers 8. Discuss Bunker Procedures / Delivery Rate	
EKG -06	**MAIN TOPICS:** **Thrust Blocks, Shafting, Bearings, Stern Tubes, Propellers And Ship-side fitting**	Minimum Allotted Hours
	DETAILED SYLLABUS: **Thrust Block:** 1. How the propeller thrust is transmitted to the ship's structure 2. Principle of operations 3. Locating of a thrust block assembly in a slow speed engine 4. Medium/high speed engines. 5. The principle of the tilting pad / types of pads 6. A section through a thrust block, showing the flow of lubricating oil 7. Importance of clearances between collar and pads / periodic checks 8. Adjustments for wear out of pads Shafting: 1. Alignment 2. The effect of a ship's normal service demands on the alignment of propulsion shafts etc. 3. In principle, how shafting is lined up initially 4. How, after installing the intermediate shafts, the bearings are fitted to their correct heights 5. How the main engine is lined up to the shafting 6. Stern Tube Alignment 7. The sources and nature of the stresses in the: - intermediate shaft - thrust shaft - propeller shaft. 8. Given a drawing of a water-lubricated stern tube as fitted in a ship with its tailshaft and propeller, 9. The materials used for the bearings in the above objective 10. Oil lubricated stern Tube arrangement / working principle 11. How the propeller is secured to the tailshaft 12. A coupling arrangement which would allow outward removal of the tailshaft 13. The defects which may occur in a tailshaft and stern tube 14. The bearing materials used in the stern-tube described above the lubrication system in the stern-tube described above how water is detected and removed from the lubricating oil 15. The typical seals used at each end of the tail shaft 16. The maximum period allowed between examinations	3

	17. The maximum wear down for an oil-lubricated stern-tube Bow and stern thruster	
EKG -08	**MAIN TOPICS:** Operation and Testing of Pneumatic, hydraulic and Electronic Control Systems.	Minimum Allotted Hours
	DETAILED SYLLABUS: Controllers 1. The principles of operation of an electro pneumatic controller 2. Electronic controller- various 3. Pneumatic controller- various [fuel-air ratio / viscosity 4. How to adjust it to give variation to the proportional band 5. The principles of a fuel-air ratio controller 6. The action of a viscosity controller 7. Performs routine test and maintenance procedures on the controllers covered by all the above objectives. **Air Supply** 1. The need for instrument air of good quality 2. How the required quality of air can be provided 3. How water is removed from the air 4. The means of drying air 5. A diagrammatic layout of an air system for control and instruments 6. The principles of the following: - automatic drain- auto-unloader - filter regulator **Operation and Testing of Hydraulic Systems** **Hydraulic Circuits** 1. Explain a simple hydraulic circuit / Closed and Open Circuit 2. How to interpret a hydraulic circuit 3. Graphic symbols used in the circuitry 4. Type of equipment's used Operating and Testing of Hydraulic Control Systems [inclusive of electrical controls within the system] in the Hydraulic Circuit **Maintenance & repair of the following:** Electrical and electronic systems operating in flammable areas, carrying out safe maintenance and repair procedures, Detection of machinery malfunction, location of faults and action to prevent damage. Electrical interference / Suppressors	3

EKG -09	**MAIN TOPICS:** Properties of Fuels and Lubricants used and monitoring their quality	Minimum Allotted Hours
	DETAILED SYLLABUS: **Characteristics of Fuel Oil** Outline the various physical and chemical characteristics associated with fuel oil such as: 1. Density 2. Viscosity 3. Flash Point 4. Pour Point 5. Carbon Residue 6. Ash in Fuel 7. Water in Oil 8. Sulphur 9. Vanadium and Sodium 10. Aluminum and Silicon 11. Sediments 12. Compatibility 13. Specific Energy 14. Ignition Quality • Contaminants including microbiological infection • Treatment of fuels including storage, blending, pre-treatment and handling • Properties of various types/grades of lubes • Lubrication Problems and Testing • Shore side and shipboard sampling and testing / interpretation of test results	3

Function 4B: Subject 2: MARINE ENGINEERING KNOWLEDGE (MOTOR) [24 hours]

EKM - 01	**MAIN TOPICS:** Working principle and construction details of marine diesel engines, turbochargers, gearing, clutches and ancillary equipment, starting and reversing and control system	Minimum Allotted Hours
	DETAILED SYLLABUS: **Working principle** Otto cycle, Duel cycle, **Turbocharger** Types of turbo charger, Construction, Types of turbo charging; Pulse type and constant pressure type, Turbo charger system. **Starting and reversing in detail for 2 stroke engines** Means of starting and reversing the engines, explain various methods for reversing (Lost motion, axial movement of the camshaft **Governors** Need for Governors, Speed governor Load governor, Hydraulic governor, electronic governor, Droop, Load sharing.	9
EKM - 02	**MAIN TOPICS:** Safe and efficient operation of large bore and medium speed diesel engine; determination of shaft power and recognition of irregularity in performance of machinery and plant. Operation, monitoring and evaluation of engine performance and capacity	Minimum Allotted Hours
	DETAILED SYLLABUS: **Safe and efficient operation of large bore and medium speed diesel engine;** **Various way to monitor:** Temperature, Pressure their upper limit and lower limits, Condition monitoring such as vibration analysis, Trend analysis etc, with help of these along with NOx and SOx emission engine performance and capacity to be explained. **Determination of shaft power and recognition of irregularity in performance of machinery and plant.** Determination of Shaft power, How many ways shaft power can be calculated: Power card, Turbo charger rpm and temperature, Fuel pump Index. **Recognition of irregularity in performance of machinery and plant:** How to recognize irregularity in performance of machinery and plant: What all the various parameters to be checked, Various indicator card analysis, e.g power card, draw card, compression card, light spring diagram (for medium	3

	speed engine cards are taken electronically) Peak pressure variation, Temperature and pressure variation at different stages.	
EKM - 03	**MAIN TOPICS:** Planning and scheduling of engine operation, standing instruction for taking over, handing over routine and emergency operation during watch keeping	Minimum Allotted Hours
	DETAILED SYLLABUS: **Emergency operation during watch keeping:** Explain action to be taken for the following, a) Oil mist detector alarm. b) Scavenge fire. c) Air line explosion. d) Bridge control and engine room control for main engine fails. e) Any other emergency operation.	6
EKM - 04	**MAIN TOPICS:** Efficient operation, surveillance, performance assessment and maintaining safety of propulsion plant.	Minimum Allotted Hours
	DETAILED SYLLABUS: **Surveillance, performance assessment and efficient operation propulsion plant;** Name the machineries and various system require for propulsion plant, what all the regular checks to be made for each machinery, performance of each machinery to be assessed for their optimum operation. Explain about fuel treatment. Explain, how performance of each machinery, affect the efficient operation of propulsion plant.	3
EKM - 05	**MAIN TOPICS:** Operating limits of propulsion plant	Minimum Allotted Hours
	DETAILED SYLLABUS: **Operating limits of propulsion plant.** a) Main engine maximum continuous rating, normal continuous rating, how much % more of MCR an engine can be run and for how long. b) Liner wear and limits. Liner ovality limit c) Various other operating limits as mentioned by manufacturer such as temperature limit for m/e lube oil, thrust bearing, main bearing, cross head bearing clearance limit.	3

Function 6: MARINE ENGINEERING PRACTICE
Subject 1:12 hours

MEP -01	**MAIN TOPICS:** General Principles involving repairs	Minimum Allotted Hours
	DETAILED SYLLABUS: **General Principles involving repairs:** Appropriate planning, specification, material and equipment for maintenance and repairs including statutory and class verifications	6
MEP -02	**MAIN TOPICS:** Maintenance of Marine Auxiliaries	Minimum Allotted Hours
	DETAILED SYLLABUS: Maintenance of Marine Auxiliaries: 1. Modern approach to machinery reliability methods and their execution. Principles of Taro technology. 2. Hull inspection, maintenance and repairs of vessel in Dry dock.	3
MEP -03	**MAIN TOPICS:** Safe working practices	Minimum Allotted Hours
	DETAILED SYLLABUS: **Safe Working Practices:** 1. Dangerous properties of substances including toxicity.	3

Function 5: Subject 1: MARINE ELECTRO TECHNOLOGY [24 hours]

MET -06	**MAIN TOPICS:** hines the principles, constructional details and protection of salient pole, cylindrical and brushless alternators. The emf equation and automatic voltage regulation for an alternator. A. C. Switch gear, Generator Protection; Parallel operation of Alternators	Minimum Allotted Hours
	DETAILED SYLLABUS: 1. Multiple generators – true power and reactive power 2. Automatic voltage regulator, error sensing and static AVR 3. EMF equation, coil pitch, distribution factor, voltage regulation 4. Main circuit breaker, arcing phenomenon, methods of interruption of arc. 5. Magnetic circuit breakers, thermal circuit breakers, MCB, MCCB, ACB 6. Alternator protection – over current, short circuit, over/under voltage, over/under frequency, earth leakage, reverse power	3
MET -07	**MAIN TOPICS:** A.C. Motors: The principles, construction details and protection of induction motors. Slip, rotor. Slip rotor e.m.f. and frequency, Torque Speed equations. Wound, slip ring, cage and double wound type motors. Starting methods.	Minimum Allotted Hours
	DETAILED SYLLABUS: 1. Speed control of induction motors – Pole changing method, Electro-hydraulic drive, Wound-rotor resistance control of induction motors, Ward-Leonard d.c. motor drive, by stator voltage control, by keeping voltage by frequency ratio constant (Variable-frequency induction motor control) 2. Motor starters – DOL, star-delta starter, auto-transformer starter, soft starter 3. Motor protection – temperature, over current, short circuit current, single phasing	3
MET -08	**MAIN TOPICS:** Transformers: The emf equation and efficiency. Auto transformers and current transformers	Minimum Allotted Hours
	DETAILED SYLLABUS: 1. Leakage flux, short circuit test, open circuit test, voltage regulation 2. Efficiency of transformer, losses in transformer, all day efficiency. 3. Instrument transformers	3
MET -09	**MAIN TOPICS:** Rectification, distribution, circuit protection, batteries, deck machinery, insulation testing	Minimum Allotted Hours
	DETAILED SYLLABUS: 1. Insulated neutral and neutral earth system for power distribution,	6

	2. Circuit protection – Circuit breakers, fuses, preferential trips, earth leakage indication and protection 3. Batteries – storage, safety precautions, maintenance 4. Deck machinery drives, starting arrangements 5. Maintenance of motors – overhauling, insulation resistance testing	
MET -11	**MAIN TOPICS:** Control Systems: Simple Theory of all control systems, location of common faults and action to prevent damage. Trouble shooting of monitoring system	Minimum Allotted Hours
	DETAILED SYLLABUS: 1. Types of control actions – two step or on/off control, proportional control, Integral control and Derivative control 2. Proportional band, effect of change in proportional band, Gain or proportional control 3. PI control, PD control and PID control action. 4. Actuators, Transducers, 5. Ships control systems 6. Location of common faults, actions to prevent damage, trouble shooting of monitoring systems	9

Function 3: Subject 1: NAVAL ARCHITECTURE & SHIP CONSTRUCTION [12 hours]

NA-04	**MAIN TOPICS:** TRIM	Minimum Allotted Hours
	DETAILED SYLLABUS: THE CALCULATION OF: • The use of stability curves and data supplied to a ship • Effect of bilging and flooding of a compartment on the ship with regard to increase in draft and • Concept of permeability.	3
NA-05	**MAIN TOPICS:** STABILITY AND HYDROSTATIC CURVES	Minimum Allotted Hours
	DETAILED SYLLABUS: • Curves of stability and factors affecting the shapes of the curve. • Carriage of deck cargo and its influence on stability and structural stresses.	1.5
NA-06	**MAIN TOPICS:** DAMAGE STABILITY	Minimum Allotted Hours
	DETAILED SYLLABUS: The effect on the following of a ship, in the event of damage • Stability	1.5
NA-07	**MAIN TOPICS:** RESISTANCE AND POWERING, PROPELLER AND RUDDER	Minimum Allotted Hours
	DETAILED SYLLABUS: Resistance & power calculations. Rudder • Simple rudder theory, • Various types of rudders & their applications.	3
NA-09	**MAIN TOPICS:** WELDING AND TYPES OF WELDED JOINTS	Minimum Allotted Hours
	DETAILED SYLLABUS: • Defects in the welding process • NDT of weld joints	3

Function 3: Subject 2: SHIP SAFETY AND ENVIRONMENTAL PROTECTION [90 hours]

SSEP–01	**MAIN TOPICS:** CERTIFICATES AND DOCUMENTS	Minimum Allotted Hours
	DETAILED SYLLABUS: **Certificates -** Certificates and other documents required to be carried on a ship, how they are obtained and period of their validity. • Classification Certificates • Other Certificates / License • Bodies responsible for issuance of certificates.	6
SSEP–04	**MAIN TOPICS:**	Minimum Allotted Hours
	DETAILED SYLLABUS: **Pollution Prevention -** Thorough knowledge of prevention of pollution of the marine environment and anti-pollution procedures and precautions including EEDI, EEXI and CII. Incinerator. Sewage system. Garbage Management Plan. Air pollution prevention.	6
SSEP–07	**MAIN TOPICS:** ISM Code	Minimum Allotted Hours
	DETAILED SYLLABUS: **ISM Code -** knowledge of ISM Code. Knowledge of personal management. Organisation of Training on board ships. Duties allocated to crew.	3
SSEP–08	**MAIN TOPICS:** Use Leadership and Managerial skills	Minimum Allotted Hours
	DETAILED SYLLABUS: **Use Leadership and Managerial Skills:** a. Knowledge of shipboard Personnel Management and Training - Engineer and Manager, Human Resource Management, Training and Development, Maintenance Management. b. Knowledge of International Maritime Conventions and recommendations and related National Legislations - The ISM Code, STCW Convention, ILO's MLC 2006. c. Ability to apply task and workload management – Communication, Team building, Planning and co-ordination, Personal assignments, Time and resource constraints, Prioritization	09

	d. Knowledge and ability to apply effective resource management - Allocation, assignment and prioritization of resources, Effective communication on board and ashore, Decisions reflect consideration of team experience. e. Knowledge and ability to apply decision-making techniques - Management processes and functions, Negotiating skills, Situation and risk assessment, Identify and generate options, Select course of action, Evaluation of outcome effectiveness. f. Development, implementation, and oversight of standard operating procedures - Project planning and controlling. g. Shore Power or Cold ironing, h. Alternate Fuels: Methane LNG, Hydrogen etc.	

Annexure 'D'

SUBJECT – ENGINEERING MANAGEMENT

Bridging course from MEO Class III CEO to MEO CLASS I (NCV) (upto 8000 KW other than Tankers)

FUNCTION: Controlling the operation of the ship and care for persons on board at the management level.

COMPETENCE: Monitor and control compliance with legislative requirements and measures to ensure safety of life at sea, security and protection of the marine environment.

MODULE : M 1	MAIN TOPICS: Knowledge of Indian Merchant Shipping Act, International Treaties & Conventions relevant to Shipping Rules. Indian Coast Guard, it's structure and operations	Minimum Allotted Hours
	DETAILED SYLLABUS: **1. Knowledge of, Indian Merchant Shipping Act, National and International legislation. Indian Coast Guards, its structure and operations.** **1.1 Explain national legislation and international legislation; and method of adoption of the above legislations** i. Marine Environment: (a) The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 (the Hong Kong Convention) (b) Liability and Compensation for Ship-Source Marine Pollution: CLC 1969, 1992, HNS. (c) International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (INTERVENTION) (d) International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC), (e) International Convention on Salvage (SALVAGE), ii. Define adopting a convention iii. Explain various conventions on Liability and Compensation iv. Explain Signature, ratification, acceptance, approval and accession v. Explain that the Amendments will be made to the regulations as and when required vi. Explain that the enforcement of IMO conventions depends upon the Governments of Member Parties. vii. Relationship between Conventions and interpretation viii. Defines Uniform law and conflict of law rules ix. Discuss legislation on Sox and NOx emissions, EEDI, EEXI, CII x. Explain United Nations Convention on the Law of the Sea: Territorial Sea and contiguous zone, straits used for international navigation, archipelagic states, exclusive economic zone, continental shelf, high	6

	seas, protection and preservation of the marine environment, settlement of disputes **1.2 Indian Coast Guard, it's structure and operations.** **1.3 International Maritime Organization (IMO) and IMO's Conventions Related to Safety, Related to Pollution, Related to Liability and Compensation and Related to other subjects.** Explain that IMO is the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships. (i) Maritime Safety: (a) Recommendations on the safe transport of dangerous cargoes and related activities in port areas (b) Fire Protection, fire detection and fire extinction (Summary of SOLAS Chapter II-2) (c) Implementation, Control and Coordination (d) Casualties (e) Applicable IMO instruments on casualty matters (f) Port State Control (g) Surveys, Verifications and Certification (h) The IMO ship identification number scheme (i) Improvement of navigational safety. (j) Stability and Subdivision (k) Safety regulations for different types of ships (l) Other Safety Topics	
MODULE : M 2	**MAIN TOPICS:** ISO 9001:2008, ISM Code, Shipboard Internal Audits / Verification Audits and Certification.	Minimum Allotted Hours
	DETAILED SYLLABUS: **ISO 9001-2015, ISM Code, – Ship board internal audit** (i) ISM certification requirements (DOC and SMC) Domestic SMS and DOC. (ii) Interactive training, combining lectures and videos with practical application of the techniques and requirements in team role-play scenarios.	3
MODULE : M 3	**MAIN TOPICS:** Ship's Hull and Machinery Surveys and Maintenance of up-to-date statutory and other related certificates. Classification Societies and their functions: CSM, CHS & Special Survey Programme.	Minimum Allotted Hours
	DETAILED SYLLABUS: **Classification societies and their functions. Certificates and documents as per international convention.** (i) Assignment, maintenance, suspension, and withdrawal of class (ii) Ship inspections for first entry into Indian flag - Explain Section 27(1) of the M.S. Act and Rule 5 of the M.S. (Registration of Indian Ships) Rules, 1960, either by the Mercantile Marine	6

	Department (MMD) or the Indian Register of Shipping (IRS). - discusses MSL Branch Circular 2 of 2008 **SOLAS Convention:** (iii) Explain briefly sections of the convention (iv) Chapter XIII – Verification of Compliance (v) Chapter XIV – Safety measures for ships operating in Polar Water (vi) Chapter XV - Safe Carriage of Industrial Personnel (vii) SOLAS updates and amendments: (viii) Explain about the various amendments made from time to time, (ix) Discuss about the latest amendments and their applicability with validity dates etc. **Explain about initial survey, periodical survey, renewal survey, intermediate survey, annual survey, additional survey** (i) Explain Harmonized system of ship survey and certification MARPOL brought amendment. (ii) Tacit acceptance in LL Convention and SOLAS Convention, BWMC also part of HSSC (iii) Types of ship survey (iv) List of certificates required on board ship relating to harmonized system of survey and certification (v) Explain general survey requirements.	
MODULE : M 4	**MAIN TOPICS:** Ship's Safety, Security and Pollution Prevention. Knowledge of related Conventions Codes and GOI Rules.	Minimum Allotted Hours
	DETAILED SYLLABUS: 1. Ship surveys and inspections for port state control / flag state control and compliance for NCV vessels. Explain that Port State Control (PSC) is the inspection of foreign ships in national ports to verify that the condition of the ship and its equipment comply with the requirements of international regulations and that the ship is manned and operated in compliance with these rules. i. Define the duties of a Flag State and explain the role of the Flag State ii. Explain the role of the Flag State iii. Flag State responsibilities as defined by the International Chamber of Shipping (ICS) & The International Shipping Federation (ISF) iv. Explain that Flag States should participate in the IMO Member State Audit Scheme v. Discusses various Commitments under MOU vi. Explain the Relevant instruments used by MOU authorities vii. Explain Inspection Procedures, Rectification and Detention viii. Discusses Provision of information by authorities ix. Explain Operational violations	3

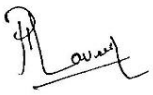
	x. States that any Authority may propose amendments to the Memorandum, and the enforcement of amendments	
MODULE : M 7	**MAIN TOPICS:** Ship's Stability: Ship's Stability including at dry-docking time -Damage Stability - flooding / grounding.	Minimum Allotted Hours
	DETAILED SYLLABUS: **Ship Stability:** (a) Explain probabilistic method of damage stability assessment. (b) Describe struck ship damage in ship collisions.	3
MODULE : M 8	**MAIN TOPICS:** Inventory Management including spares/stores/lead time, Inventory of lub-oil, fuel oil. Availability, quality and management of same.	Minimum Allotted Hours
	DETAILED SYLLABUS: **Economizing fuel consumption** (i) Explain Effective power balancing; Propulsive characteristics of Diesel Engines including speed, output and fuel consumption (ii) Explain Bunker management, Explain the Use of low sulphur fuel, Change over procedures (iii) Explain the current version of ISO 8217 fuel standards. (iv) Explain factors affecting vessel's performance, Discusses about load diagrams	3
MODULE : M 10	**MAIN TOPICS:** Practical Electricity Electronics and Control System with stress on high voltage on ships and electrical propulsion.	Minimum Allotted Hours
	DETAILED SYLLABUS: **Practical electricity and electronics** (a) Explain Effects of short circuit and protection against short circuit (b) Busbar arrangements and insulation requirements (c) Benefits of HV systems, Explain typical marine HV systems with diagrams (d) Protection system for DG & TG, motor protection, describe HV cargo switch board (e) Procedure for meggering high voltage systems, Major Risk Factors in HV systems (f) Discuss inter electrode capacitances and HV inductances (g) Benefits of HV systems, Explain typical marine HV systems with diagrams (h) Discusses about the speed control by varying the frequency (Pulse Width Modulation)	6

	(i) Sulfur Hexafluoride (SF6) and vacuum circuit breakers (j) Discusses the various circuit breakers normally used (k) Use of SF6 and vacuum circuit's breakers and their advantages are discussed in regard to high voltage application. (l) Arc sustaining and quenching methods are explained	
MODULE : M 12	**MAIN TOPICS:** Marine Insurance- general principles and types of insurance covers and P & I Clubs / charter party.	Minimum Allotted Hours
	DETAILED SYLLABUS: **P&I Clubs, - principles of protection & indemnity Insurance – types of P&I cover available – their modes of operation** Salvage: (a) Explain that Marine salvage is the process of rescuing a ship, its cargo, or other property from peril. (b) Classification of salvage - Offshore salvage, Harbour salvage, Cargo and equipment salvage, Wreck removal, Afloat salvage, Clearance salvage. (c) Types of salvage - contract salvage, pure salvage, naval salvage. (d) Discuss ship salvage and the law.	3
MODULE : M 13	**MAIN TOPICS:** Organizational behavior, Effective resource management, Development of standard operating procedures, Workload management and application of decision-making techniques. Crises management – need of leadership in crises. Importance of drills.	Minimum Allotted Hours
	DETAILED SYLLABUS: **Human relations and modern management principles.** (i) Understand how perceived behaviour of organization and individuals is influenced (ii) Explore the methods by which the behaviour of members of organization are constrained and influenced (iii) Discuss the nature of information and communication in relation to Organization and their environment **Leadership and managerial skills** (i) Explain about team building and motivational skills, good *managerial skills* - develop the practice of sound record keeping, encourage team work - present case study, erase 'us' from 'them' feeling, facilitate rather than dictate, daily and weekly plan for both administrative and creative tasks, Explain how to set target or goals (ii) Personality development a. Role plays and importance of being a role model b. Present case studies, power point slides available	9

MODULE : M 15	**MAIN TOPICS:** Latest development in main propulsion and auxiliary machinery.	Minimum Allotted Hours
	Detailed Course: **Engine developments** i. Smart engines - a. explain the electronic governor b. explain the common rail system for fuel injection c. control system for the camshaft less engines ii. New developments in tribology; explain hydrodynamic lubrication of lip seal etc. iii. PTO/ PTI system in the conventional diesel electric propulsion etc. iv. Alternate fuels: LNG, Hydrogen, Methane and Ammonia. v. SEEMP part 2 and 3. Methods to EEDI, EEXI and CII.	6
MODULE : M 16	**MAIN TOPICS:** Monitor and control Compliance with legislative requirements and measures to ensure safety of life at sea and protection of the marine environment	Minimum Allotted Hours
	DETAILED SYLLABUS: **Monitor and control Compliance with legislative requirements and measures to ensure safety of life at sea and protection of the marine environment:** (a) Knowledge of national legislation/ GOI rules for implementing international agreements and conventions (b) Chief Engineer's role in Structural Inspections of various types of ships. Marine environment awareness.	3
MODULE : M 17	**MAIN TOPICS:** Ship Security System.	Minimum Allotted Hours
	DETAILED SYLLABUS: **Ship security system** (i) Current Industry Best management practices (from ICS) – Somalia & West Africa (ii) The ILO/IMO Code of practice on security in ports (iii) Acts of piracy and armed robbery against ships	3
MODULE : M 18	**MAIN TOPICS:** Flag State / Port State Control & compliance for NCV vessels.	Minimum Allotted Hours
	DETAILED SYLLABUS: **World Health Organization & International Labour Organization:** 1) World Health Organization (WHO) - Explain that The United Nations public health arm. 2) Monitors disease outbreaks, assesses the performance of health systems around the globe	6

	Maritime Labour Certificate and Declaration of Maritime Labour Compliance: 1) Briefly describes Regulation 5.1.3 - Maritime labour certificate (MLC) **2)** and declaration of maritime labour compliance (DMLC) part 1 and part 2 and applicability of MLC to Coastal Vessels.	

This Circular annexed to the DGS Order No.9 of 2024 is issued with the approval of the competent authority.



(Praveen Nair)
Engineer & Ship Surveyor cum Dy.DG(Technical)

9वीं मंज़िल, बीटा बिल्डिंग, आई थिंक टेक्नो कैम्पस, कांजुर गाँव रोड, कांजुरमार्ग (पूर्व) मुंबई- 400042
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