Annexure – I

Syllabus for MEO Class IV Preparatory Course

Duration: One month (4 weeks, 20 working days, 120 contact hours)

The Marine Engineer Officer (MEO) Class-IV Preparatory Course shall be designed to prepare candidates for the Written and Oral Examinations leading to the award of the Marine Engineer Officer Class-II Certificate of Competency (CoC) in accordance with the requirements of Regulation III/1 and the relevant provisions of the STCW Convention, 1978, as amended, including the associated sections of the STCW Code.

The course shall be conducted as a fully offline programme over a duration of twelve (4) weeks, comprising 20 working days and 120 contact hours.

The course shall comprise the following syllabus:

Marine Engineering Knowledge – General (Function 4: Marine Engineering at the Operational-Level):
Detailed study of marine boilers, covering the different types of boilers used on board ships and their applications, constructional features, boiler mountings and accessories, combustion systems and burners, safety devices, and automatic control systems. Boiler feed water arrangements, including feed pumps and deaerators, along with boiler water treatment practices aimed at preventing scale formation, corrosion, and carryover. Steam plant systems, including the principles of operation of marine steam turbines, steam distribution arrangements, and auxiliary steam services. It also covers the operation of condensers, vacuum generation and maintenance and condensate recovery processes essential for efficient steam plant operation. Basic awareness of alternative fuels: methyl/ethyl alcohol, ammonia, hydrogen etc, covering characteristics, hazards, and bunkering precautions.

Knowledge of various auxiliary machinery and systems commonly found on board ships, such as marine pumping systems and pumping arrangements, fuel oil treatment systems including heaters, filters, and service tanks, lubricating oil systems and their monitoring, and fresh water generation systems including evaporators and reverse osmosis plants. The operation and maintenance of shipboard refrigeration and air-conditioning systems. Engineering watchkeeping practices, detailing the duties and responsibilities of the engineering officer in charge of a watch. Procedures for engine room watchkeeping in both manned engine rooms and unattended machinery spaces (UMS), monitoring of machinery parameters and alarm systems, maintenance of engine room logs and reporting procedures, and adherence to safe watchkeeping practices, including proper watch handover procedures to ensure the safe and efficient operation of the ship's machinery.

Marine Engineering Knowledge – Motor (Function-4: Marine Engineering at the Operational Level):

Detailed knowledge of marine diesel engines used for ship propulsion and auxiliary power generation. The principles of operation of two-stroke and four-stroke diesel engines**,** covering the thermodynamic cycle, combustion process, and operational characteristics. The construction and

working of major engine components are studied in detail, including pistons, cylinder liners, piston rings, crankshafts, camshafts, connecting rods, and bearings, with emphasis on their functions, materials, and maintenance requirements. Fuel injection systems, including conventional fuel pumps and modern common rail injection systems, as well as the operation and role of engine governors and electronic control systems in maintaining engine speed and performance. The working principles and operation of turbochargers, scavenging arrangements, and air supply systems that support efficient combustion and engine performance. The course shall cover engine performance and operational practices, including the interpretation of indicator diagrams and methods of engine performance analysis.

Introduction of engine monitoring systems, key operating parameters, and performance indicators used to assess engine condition and efficiency. Procedures for starting, reversing, maneuvering, and stopping main engines are studied with reference to safe and efficient operation under different operating conditions. Study of engine safety devices, such as alarms, trips, and automatic shutdown systems designed to protect machinery and ensure safe operation. Maintenance and troubleshooting of marine diesel engines**,** identification and rectification of common engine faults, routine maintenance procedures, and the use of diagnostic techniques to detect abnormalities. The concept and application of engine condition monitoring and preventive maintenance practices are also covered, enabling engineering officers to maintain engine reliability, prevent failures, and ensure efficient operation of ship propulsion machinery.

Marine Engineering Knowledge (Steam) – (Function-4: Marine Engineering at the Operational Level): Principles of steam generation, thermodynamics, heat transfer and the Rankine cycle; construction, operation, maintenance and performance of marine boilers, including water-tube and fire-tube boilers, superheaters, economisers, air preheaters, boiler mountings, safety devices and automatic combustion control systems; construction, operation and maintenance of steam turbines, reduction gearing, condensers, feed-water and condensate systems, deaerators, feed pumps, circulating pumps, lubrication systems and associated auxiliary machinery; boiler water treatment, feed-water chemistry, corrosion prevention, scale control and boiler blow-down procedures; fuel oil systems, combustion equipment, burner management, boiler efficiency and energy conservation; operating procedures, watchkeeping, start-up and shut-down procedures, fault diagnosis, preventive maintenance and emergency operation of steam propulsion plants; safety precautions, statutory requirements, pressure vessels, safety valves and high-pressure steam systems; and environmental protection measures, including pollution prevention and compliance.

Marine Electro-Technology (Function-5: Electrical, Electronic and Control Engineering at the Operational Level):

Fundamentals of basic electrical engineering, including essential electrical principles such as voltage, current, resistance, power, and energy, along with the application of Ohm's law and Kirchhoff's laws in electrical circuits. Characteristics and applications of AC and DC electrical circuits, forming the foundation for understanding shipboard electrical systems.

Study of electrical machines commonly used on board ships, focusing on the construction, working principles, and operation of generators and alternators, as well as AC and DC motors used for driving various shipboard machinery and auxiliaries. Motor control systems and starting arrangements, including different starting methods and protective features. Maintenance, inspection, and fault diagnosis of electrical machines to ensure reliable and safe operation.

Shipboard electrical power low and high voltage systems, including the generation and distribution of electrical power on ships. Design and operation of main and emergency switchboards, electrical distribution networks, and essential protection systems such as circuit breakers, relays, and other electrical safety devices. The operation and maintenance of emergency generators, emergency power supply systems, battery installations, and uninterruptible power supply to ensure continuity of essential services during power failures.

Fundamentals of electronic components and circuits, such as diodes, transistors, and basic electronic assemblies. The functioning and application of sensors, transducers, and measuring instruments used for monitoring machinery parameters are also studied. Engine control and monitoring systems, as well as automation systems**,** including the use of programmable logic controllers (PLC) in shipboard machinery control and integrated automation systems, which play a vital role in improving efficiency, safety, and reliability in modern marine engineering operations. Cyber-risk awareness - basic cyber hygiene, vulnerabilities in automation and engine control systems.

Marine Engineering Practice (Function-6: Maintenance and Repair at the Operational Level):

Safe and effective use of various hand tools and precision measuring instruments such as micrometers, vernier calipers, dial gauges, and feeler gauges. Operation and applications of common machine tools, including lathes, drilling machines, milling machines, and grinding machines, along with basic fitting and machining techniques used for fabrication, repair, and maintenance of shipboard components.

Study of metals, alloys, and composite materials commonly used on board ships, their mechanical and chemical properties, and their suitability for different marine environments. Study of heat treatment processes, such as annealing, normalizing, hardening, and tempering, and their applications in improving the strength, durability, and performance of engineering materials.

Welding and thermal cutting techniques used in shipboard repairs and fabrication, principles and practices of gas welding and arc welding, as well as various thermal cutting methods. Welding defects, methods of inspection and quality control, and the necessary safety precautions to be observed during welding and cutting operations.

Use of Planned Maintenance Systems (PMS), techniques of condition monitoring and fault diagnosis, and systematic overhauling procedures for major marine machinery and equipment. The study of lubrication systems and basic tribology principles, enabling engineering officers to ensure proper lubrication, reduce wear and friction, and maintain the reliability and efficiency of shipboard machinery.

Ship Construction and Stability (Function-3: Controlling the Operation of the Ship and Care for Persons on Board (Operation Level)):

Ship construction, structural strength, and stability including the different types of ships and their structural arrangements, and the general layout of a vessel’s hull and internal structure. Study of hull construction methods, including various framing systems such as longitudinal and transverse framing, as well as the design and function of major structural components including decks, bulkheads, double bottom tanks, and other supporting members. Overview of the materials used

in ship construction, with emphasis on their strength, durability, and suitability for marine environments.

The concept of longitudinal strength and the ability of the hull structure to withstand various loads encountered at sea. Study of shear forces and bending moments acting along the hull girder, as well as the structural stresses that arise due to different loading conditions and sea states. The principles of ship stability, including the concepts of buoyancy, center of gravity, and center of buoyancy, and their influence on a vessel's ability to remain upright. Study of metacentric height, righting moments, and factors affecting stability such as free surface effects and shifting of weights. Damage stability, including the effects of flooding and compartmentalization on the ship's survivability in the event of hull damage.

Damage control procedures, focusing on the causes of flooding and structural damage and the measures required to control and minimize their impact. Methods of flooding control, the use of pumps and watertight closures, and procedures for emergency repairs and temporary strengthening of damaged structures to maintain the safety and seaworthiness of the vessel until permanent repairs can be carried out.

Ship Safety and Environmental Protection (SSEP) (Function-3: Controlling the Operation of the Ship and Care for Persons on Board (Operation Level)):

Study of fire prevention and firefighting causes and prevention of fires in machinery spaces, classification of fires, and the selection of appropriate fire-fighting medium. Fire detection and alarm systems, as well as the operation and maintenance of fixed fire-fighting systems, including carbon dioxide (CO_2), foam, water mist, and dry powder systems commonly installed on board ships. Study of life-saving appliances and survival equipment, including the types, construction, and operation of lifeboats, life rafts, and rescue boats, as well as personal life-saving appliances such as lifejackets and immersion suits and radio lifesaving appliances such as SART and EPIRB. The use of launching appliances, survival procedures, and the responsibilities of ship personnel during emergency abandonment situations.

Study of oil pollution prevention equipment, such as oily water separators and oil discharge monitoring systems, as well as sewage treatment plants and garbage management practices on board ships. Measures for air pollution prevention, including emission control requirements and compliance with international environmental standards. Ballast Water Management System and its equipment. Operational-level competence in BWMS including operation, maintenance, logging alarms etc.

Emergency procedures and contingency management, covering engine room emergency situations such as machinery failure, fire, flooding, and other operational emergencies. Procedures for blackout prevention and restoration of power, emergency operation of steering gear, and the conduct of emergency drills and contingency planning to ensure preparedness and effective response during critical situations.

Knowledge of international maritime conventions and regulatory frameworks governing ship safety and environmental protection. Key provisions and objectives of the International Convention for the Safety of Life at Sea (SOLAS), the International Convention for the Prevention of Pollution from Ships (MARPOL), the Standards of Training, Certification and Watchkeeping for Seafarers (STCW) Convention, the International Safety Management (ISM) Code, Maritime Labour Convention (MLC) and the International Convention on Load Lines, enabling marine engineers to understand their responsibilities in maintaining compliance with international