

SEMESTER-VII

UG11P3701	SIMULATOR AND SIMULATION LABORATORY	54 HRS
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Engine Simulator Lab Exercise:

Description of basic engine functions and their simulation introduced in Engine Room Simulator.

Manual engine operation from engine room station, Remote stations-i.e. Control room and Navigation bridge. Safety and interlocks in UMS-ships and effect of malfunction of main engine auxiliaries. Trouble shooting of main engine and other auxiliary systems.

Training on Diesel Engine Operation and Maintenance Software:

Different modes of operation – standard mode, Live run mode and Lesson mode of a four stroke, three cylinder medium speed marine engine.

Using following experiments are to be performed:

1. To start and stop the engine;
2. To change engine's load and speed;
3. To change ambient operating conditions;
4. To simulate engine faults in varying degrees;
5. To mix different simulations;
6. To watch engine operation parameters;
7. To watch functions inside the cylinder;
8. To simulate the engine sound which varies with speed;
9. To carry out maintenance and repairs;
10. To try out different maintenance strategies;
11. To print engine data
12. To use lesson facility.

Diesel Engine Combustion Gas Monitoring Simulator:

1. Familiarising with two stroke diesel engine and its associated auxiliaries with regard to various parameters and systems like fuel oil system, L.O. System, Jacket cooling water system, etc in 19 screens of two monitors (Trainee module).

2. Starting the plant and checking the systems
 3. Engaging the turning and turning the Engine on T/G.
 4. Giving command from Bridge telegraph and acknowledging the command on E.R. telegraph.
 5. Blowing through the engine, significance of blowing through engine.
 6. Starting the M/E and running in compliance with the Bridge requirement (communicated by telegraph)
 7. Capturing the engine performance in the form of Power card, Draw card, and fuel pump pressure card. Analyzing the cards.
 8. Changing the fuel quality (like sulphur etc) and observing its effects on exhaust emission.
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9. Study the effect of VIT
 10. Starting and running the engine from ECR, BRIDGE AND EMERGENCY STATION.
 11. FAULT FINDING WITH THE HELP OF PARAMETERS reading and cards
(Power card, Draw card , Fuel pump pressure)

Like: 1) Early injection (2) Late injection (3) Leaky piston ring (4) T/C filter fouled (5) Air cooler Air side/Water side fouled (6) Cylinder liner cracked.

SEMESTER VII

UG11P3702	TECHNICAL PAPER AND PROJECT	72 HRS
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Note: The cadets should write a technical paper under guidance of one faculty member of the institute. The paper will be assessed by a committee and the cadets will present the paper to another committee consisting of external assessors for evaluation. Final marks will be calculated from the both external and internal assessment.

SEMESTER-VII

UG11T3701	SHIP OPERATION AND MANAGEMENT	72 HRS
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OBJECTIVE: *To teach the students about management of ships and impart knowledge on statutory regulation.*

Brief History of Shipping: Modern shipping Practice. Marine vehicles and cargo, care of cargo against damage. Development in Shipping and cargo handling. Containerization & Multimodal transportation, Factors affecting universal adoption of Multimodal Transport. Liner and tramp shipping services.

4 Hrs

Conference Systems: Organisation & concerns Shippers Council. Theory of freight rates and fares. Rate fixation machinery and government control. Advantages and Disadvantages of conference vessels.

4Hrs

Chartering and Charter Parties: Different types of Chartering and their differences. Important Clauses of Charter Party, such as Lien; Tanker Chartering and Tanker Charter Party.

6 Hrs

Bill of Lading: Function, Uniqueness and related problems. Carriage of goods by sea act. Cargo Surveys and protests.

6 Hrs

Marine Insurance: Underwriting and loss adjusting principles applied to Marine cargo insurance. Hull / machinery policy, particular average. General average, P & I Clubs – making claims.

10 Hrs

Shipping Companies: Organisational structure, Restructuring on the basis of functional coherence, ship management companies. Turnaround strategy for sick shipping companies. Ownership of vessels, Shipping Company and its administration.

10 Hrs

Capitalization and Finance: Characteristics, cost ratios & allied definition. Sources, Financing package, Lender security, Relation between Insurance & premium, & non-conformity / condition of class. Economics of new and second hand tonnage. Subsidies, procedure & implication of buying & selling new / old vessels.

8 Hrs

Ship Operations : Planning sailing schedules. Influencing factors, Unbalance in sea trade, counter-action, Voyage estimation, Manning of ships, engagement & discharge of crew. Economic factors.

6 Hrs

Commercial Shipping Practice: Freight Rate; Factors affecting Freight rate. Changing Chartering type to take advantage of the market. 4 Hrs

Indian Merchant Shipping Act : Registration of ship, Ship’s papers. Port Procedures. Pilotage, Flags of convenience, Flag state and flags of discrimination and their effects on shipping. Action of Master/Seafarer when Vessels are in distress. Shipping casualties penalties under Merchant Shipping Act. Shipping Board; Dock Labour Board Seaman’s Welfare. Marine Fraud : Genesis and Prevention. Indian Shipping : Current scenario and few case studies like revival of a company etc. Inland Water Transportation in India.

14 Hrs

REFERENCE BOOKS:

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| 1. | Shipping practice | - Stevens |
| 2. | Managing ships | - John M. Downard |
| 3. | Advanced shipboard management | - Capt. Dara E. Driver |
| 4. | Indian Merchant Shipping Act, 1958 | |
| 5. | Ship Operations and Management | -Tony Dixon |
| 6. | Legal Principles in Shipping Business | - Sir David Steel |
| 7. | Marine insurance - Chris Adams | |
| 8. | Inland Vessel act, 1997 and Rules | - (Latest Amendment) |
| 9. | Ship Operations | - Dr. K. V. Hariharan |
| 10. | Multi Model Transportation | - Dr. K.V. Hariharan |

SEMESTER - VII

UG11T3702	ADVANCED MARINE CONTROL ENGINEERING AND AUTOMATION	72 HRS
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OBJECTIVE: To Provide Knowledge about Advanced Control Theory of Automation and Control Engineering in ships.

Introduction to System Analysis:

Formation of Mathematical models for Mechanical, Electrical, Thermal and liquid level system by using Laplace transform, Transfer functions using block diagram and signal flow graph, Mason's gain formula. 6 Hrs

Transient Response Analysis:

Test input signals, Time domain analysis of 1st and 2nd order closed loop system. Steady state errors in terms of close loop transfer functions, Stability of linear system by pole location and Routh-Hurwitz criteria, Root-loci of 2nd order system, effect of adding poles and zeros in system. 8 Hrs

Hrs

Frequency-Domain Analysis of Linear Systems:

Bode plots, Polar Plots, Concept of resonance frequency of peak magnification. Nyquist criteria, measures of relative stability – phase and gain margins. 8 Hrs

Controllers and Compensation Techniques: Response with P, PI & PID Controllers, PID controller design, Two Step (On – Off) Control, Modulating Control, Ratio and Cascade Control, Improvement of system performance through compensation, Lead, lag and lead-lag compensation, Compensation on Root-locus approach. 8 Hrs

State-Variable Analysis of Control System:

Basic concepts & state model, different state models of state variable approach, controllability and observability. 8 Hrs

Hrs

Digital Control Systems:

Z-transform, Inverse Z transform, Digital & Discrete time systems and signals, Role of Z transform in linear difference equations, stability of Discrete-time system. 8 Hrs

Hrs

Non-Linear Systems:

Common Nonlinearities, Phase-plane analysis, Describing function analysis, Stability analysis-Liapunov method.

8
Hrs

Application of Controls on Ships:

Marine Boiler – Automatic parallel cross loop combustion control, Boiler feed water control - two and three-element type, Boiler automatic starting and stopping sequence, Central cooling water system (HT and LT), Steering Gear control system with Auto Pilot, Direct reversing cam less engine control system, Purifier automatic de-sludging control system, Cargo handling crane operation control system, Electric circuit reading, Instruments for UMS classification. Dual-fuel Boiler Combustion Control System.

18 Hrs

REFERENCE BOOKS:

1. Gopal M, “Digital Control System & State Variable”, TMH.
2. Kuo B. C, “Digital Control System”, Oxford.
3. Nagrath I J & Gopal M, “Control Systems Engineering”, New Age International.
4. D.A. Taylor, “Marine Control Practice”, Butter worth & Co (Publishers) Ltd., London.
5. Ogata K, “Modern Control Engineering”, PHI.
6. Roy Choudhury, D, “Control System Engineering”, PHI.
7. Gibson J E, “Nonlinear Control System”, McGraw Hill Book Co
8. Instrumentation & Control Marine – G.T.Roy

SEMESTER-VII

UG11T3703	IMO - MARITIME CONVENTIONS AND CLASSIFICATION SOCIETIES	54 HRS
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OBJECTIVE: *To understand the legal structure and framework of the shipping industry and the 'international' aspect and complexity of regulating such a dynamic industry*

- 1 History of Shipping, Shipping powers (Historical to present day)
- 2 Ancient and medieval shipping laws, Evolution of modern shipping laws
- 3 Choice of courts and jurisdiction, Laws of the seas (UNCLOS)
- 4 International maritime regulatory bodies e.g. IMO, MSC, MEPC, UNCTAD, IACS
- 5 International conventions e.g. SOLAS, MARPOL, STCW, MLC, Ballast Water Convention, Ratification of conventions and force of law. Understanding of total quality management and ISM. Coastal state and Flag state jurisdictions, casualty investigations and role of coastal and flag state. Merchant Shipping Act and MS Rules.
- 6 International conventions e.g. Civil liability, Fund convention, wreck convention, Salvage convention, Bunker convention. Why limitation of liability in shipping?
- 7 Important shipping organizations e.g., Intertanko, Intercargo, ITF, MPA
- 8 Important shipping organizations e.g., ILO, ICS, ISC, PSC, Flag States: Role of Flag and PSC as per UNCLOS, Regional MOU's, risk based port state inspections, difference between port state detentions and arrest.
- 9 Role of 'BIMCO', 'The Baltic Exchange', Lloyds of London
- 10 Description and role of Classification societies and Recognized Organizations and the differences. Types of Class and Statutory Surveys, relation between class and statutory surveys, survey cycles.

REFERENCE BOOKS:

1. Guilf. D, Shipping Interdiction and the Law of the Sea, Cambridge University Press.
2. Bruce Farthing and Mark Brownrigg, Farthing on International Shipping, LLP.
3. G. Pamborides, International Shipping Law: Legislation and Enforcement, Springer.

SEMESTER – VII

UG11T3704	ADVANCED MARINE TECHNOLOGY	72 HRS
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OBJECTIVE: To provide the latest technology and operation incorporated in different types of Tankers Car carrier, Bulk carrier and UMS operation to students

Bridge Control Systems and UMS Operations: Bridge Control system for propulsion engine and control flow diagram, Bridge indicator panel for engine room machineries, Emergency operation for propulsion engine, UMS requirements & operation.

8 Hrs

Study of LPG and LNG Ships: Various controls of deck equipments including pneumatic and electronic equipments. Study of re-liquefaction plants & its operation, Study of structure of various types of tanks for LNG and LPG vessels, IG and Pure Nitrogen gas systems for gas tankers, Glycol systems, Electric motor room and compressor room safeties. Study of compressors and compressor safety devices and other safety devices in Gas tankers. Cargo pumping system and its operation, cargo operations. Boil-off gas supply system for Boilers and IC Engines.

20 Hrs

Chemical Tankers: Classification, Construction, Pumps for chemicals, Tank cleaning procedures, IG systems for Chemical Tankers, Controls and safety devices associated with loading and discharging . Tank gauging systems.

10 Hrs

Oil Tankers: Types & classification, Construction, Cargo & Crude Oil Washing operation, I.G Systems, Pumping arrangements and safety devices associated with loading & discharging. Automatic Unloading System (AUS), Cargo Oil Pump Turbine (COPT) Lube Oil system.

10 Hrs

Car Carrier: Construction, Ventilation, Fire Fighting system, Stability, Strength considerations, RO-RO arrangement.

4 Hrs

Bulk Carrier: Construction, Stress considerations with regard to loading & discharging, Condition assessment system, Enhanced survey, Safety considerations, Stability considerations.

5 Hrs

Latest Engine Technology: Intelligent Engines, Condition monitoring, Common rail fuel injection w.r.t electronic fuel injection, Exhaust emission and control – Technology incorporated, NOx Technical file, EIAPP certificate. SEEMP, EEDI and EEOI.

15 Hrs

REFERENCE BOOKS:

1. Shipboard Operations H. I. Lavery
2. Marine Diesel Engines C. C. Pounder
3. Liquefied Gas Handling Principles on Ships and in terminals McGuire & White
4. Tanker Safety Guide Liquefied Gas: International Chamber of Shipping
5. International Safety Guide for Oil Tankers and Terminals (ISGOTT): International Chamber of Shipping

SEMESTER – VII

UG11T3705	ENGINE ROOM MANAGEMENT	72 HRS
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***OBJECTIVE:** To enable the student to acquire knowledge for operation and maintenance of marine machinery and take care of engine room environment.*

Engine Room Resource Management:

Effective communication, allocation of resources, planning & co-ordination, workload management, time & resource constraints. Personal relationship onboard ship, working in multi-cultural environment, situational awareness concept.

2 Hrs

Preparation of Engine:

Full knowledge of preparing Main Engine , A.E, Boiler , all auxiliary engines for sailing from port and port operation . First Start Arrangements. Change over procedures of fuel and other systems in engine room machinery main engine, aux. engine and boiler for operation in ECA (Emission Control Areas), EU (European Union) & US.

5 Hrs

Maintenance:

Preparing maintenance schedule for all machineries like Main Engine, Alternator, Compressor, Purifier, Evaporator, steering gear, electrical machinery and all other engine machineries. Overhauling procedure for various Aux. M/c., Maintenance of Continuous running pumps – (FO,

LO, FW, SW). PMS Maintenance of Hydraulic Jacks/Tools, including use of Engine Makers specific tools/equipments.

5 Hrs

Breakdown Operations:

Preparation of engines for emergency operation. Emergency repair for engine room machineries. Emergency steering. Propulsion Engine-Unit Cut-out /part load operation, slow speed, super slow speed running precautions. Safety/emergency procedures for change-over from remote/automatic to local control of all systems.

5 Hrs

Spare parts Management: Preparing spares inventory, Sending spares requisition on ship, Maintenance of E.R. Spares, Just –in – Time (JIT) concept, ABC Analysis, Consumable store list requisition- as per IMPA & ISSA Catalogue Code Nos, Monitoring daily consumptions, Bunker estimates.

5 Hrs

Monitoring of Engine Performances:

Taking indicator cards and interpretation of card, trouble shooting from engine parameters like pressure & temperature and behaviour like vibration and noise, crank case inspection, Engine and propeller design curve criteria & analysis for modern propulsion engines use of mist detector and other safety features.

5 Hrs

Management of Engine Room Crew:

Criteria for composing the engine room watch. Operation & Watch requirements. Fitness for duty. Protection for marine environment. Requirement for certification; minimum knowledge requirement for certification-theoretical, practical; Duties & responsibilities concerning safety & protection of environment. Requirements for watch keeping duties. Physical training & experience in watch-keeping routine; Main and aux. Machines, Pumping systems, Generating plant. Safety and emergency procedures. First aid.

5 Hrs

Safe Engineering Watch Keeping:

Routine pumping operations of fuel oil, ballast water, fire pump and cargo pumping system.

Interpretation of functional tests on communication and control system. Maintenance of machinery space ,log book and the significance of readings taken. Safety precautions, observation & immediate action to be taken in event of fire or accident, with particular reference to oil systems

5 Hrs

Engineering Watch (Underway):

General, Taking over watch, Periodic checks of machinery, Engine Room Log, Preventive repair and maintenance; Bridge notification. Navigation in congested water and during restricted visibility, calling the attention of the Chief Engineer Officer, Watch-keeping personnel
5 Hrs

Engineering Watch (Unsheltered anchorage):

Conditions to be ensured. Watch-keeping (in Port-) Watch arrangements; Taking over the watch; Keeping a watch. Oil, Chemical & Gas Tankers-Principles, characteristics of Cargo; Toxicity hazards; Safety equipments; Protection of Personnel.
5 Hrs

Pollution Prevention Methods: Bilge water, garbage and sludges management

5 Hrs

Marine Environment:

Marine Environmental awareness, marine ecology, seas & coastal areas, discharges to sea & their environmental impact, accidental & operational discharges, emissions to air from ships, other pollutants, proactive measures to control pollution & maintain environment. Responsibilities under the relevant requirements of the International Convention for the prevention of Pollution from ships – Annex-I, II, III, IV, V & VI of MARPOL.MARPOL, 73/78 (All Annexes, equipment requirements & their operations, documentation, including necessary record books), Ballast Water Management Convention 2004, Antifouling convention 2001, National Legislations of other countries like Oil Pollution Act 1990.Emission control areas (ECA) . Procedures and arrangement on board for complying with regulatory requirements in these areas Emergency situations, actions to be taken for protecting & safe-guarding environment.

6 Hrs

Deck Machinery:

Various types of deck machinery used in ships e.g. Winches and Windlass and their requirements. Operation and maintenance. Deck Cranes. Hydraulic deck machinery; hydraulic motors, line filters and systems. Hydraulic power packs for operating submersible cargo pumps (Framo type) in Oil & Chemical tankers.

4 Hrs

Dry Docking:

Planning, entering, docking, inspection, maintenance and repairs. Surveys, certification. Undocking and report writing.

5 Hrs

Safety Requirements:

Safety Requirements for working on ship board electrical system including isolation of all electrical plants.

2 Hrs

Safe Working Practices:

Risk Assessment, ISO 31000 - risk management. Risk assessment formats for “specified activity” used on board vessels personal protective equipment, Emergency procedure Entering Enclosed or confined spaces, permit to work systems, Lifting equipments, Hot work, Hazardous substances, Safety measures for safe working environmental and for using hand tools, machine tools, powered hand tools. Materials used for construction, fabrication and repair of system and components

3 Hrs

Use of various types of sealants and packings including oil seals, mechanical seals, labyrinth seals

2 Hrs

REFERENCE BOOKS:

1. Question & Answers of Marine Diesel Engines - John Lamb
2. Marine Electrical Practice - G. O. Watson
3. Marine Auxiliary Machines - D. W. Smith
4. Running & Maintenance of Marine Machinery - IME publication

SEMESTER-VII

UG11T3706	MARINE MACHINERY AND SYSTEM DESIGN	90 HRS
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OBJECTIVE: To impart knowledge as to how understanding of basic engineering subjects such as mechanics, strength of materials, fluid mechanics, etc. Leads to development and design of components and thereby various marine systems on board ships

Design Considerations: Lecture on Following design considerations: Manufacturing methods, Castings, Forgings, Fabrication & Plastic Moulding: Machining Tolerances, surface Finishes: Available materials, Production methods, Economics, Aesthetic appeal. Initial and Servicing costs, Analysis of force.

5 Hrs

Marine Machinery Component Design: Design of marine machinery components like safety valves, Reducing valves, springs, Journal bearings, Thrust bearings. Design of lifting equipment e.g. Engine room overhead Crane, Crank Shaft, Piston and Connecting Rod & other valves.

15 Hrs

Advanced Design of Marine Systems Design:

Power Transmission system including Thrust Blocks, Intermediate shaft and Tail-End Shaft
Water cooling systems including pumps, filters, Heat exchangers for Diesel and Steam engine plants.

Lubricating Oil systems including Pumps, Purifiers.

Electro-hydraulic Steering gear system including Rudder, Rudder stock, Tiller arm , ram & cylinder .

Marine Diesel Engine Air starting systems including Air receivers, Compressors and Air starting valves.

Marine Diesel Engine Scavenge and Exhaust system.

Marine Diesel Engine Fuel Injection system including Fuel pumps and Fuel-injectors.

Design of Steam Turbine Plants.

Design of Gas Turbine Plants.

Life boat and it's launching device.

Refrigeration Plant.

Bulk CO₂ system (High pressure and Low pressure System)

Fire fighting system including emergency fire pump.

60 Hrs

Note :- Latest developments and IMO requirements are to be considered in each design project

Computer Aided Design : Analysis of stress, strain, vibration, thermal stress, deflection through method of Finite Element Analysis by use of various software like AUTO – CAD, Pro-engineer, NX, Solid Edge.

10 Hrs

REFERENCE BOOKS:

1. Machine Design -Pandya & Shah
2. Marine Engineering -Harrington

3. IMO & Classification society Publications
4. Design of Machine Elements – V.B.Bhandari, TMH

SEMESTER – VII

UG11E3701 TO UG11E3704	ELECTIVE	72 HRS
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NOTE: Cadet will select any one Elective subject from the following

CODE	SUBJECT
UG11E3701	ADVANCED MARINE HEAT ENGINES
UG11E3702	ENVIRONMENTAL SCIENCE AND TECHNOLOGY
UG11E3703	ADVANCED MATERIAL SCIENCE AND SURFACE COATING ENGINEERING
UG11E3704	RENEWABLE ENERGY SOURCES AND APPLICATIONS