

**Vocational Higher Secondary  
Education (VHSE)**

**Second Year**

**MARINE TECHNOLOGY**

*Reference Book - Teachers' Version*



Government of Kerala  
Department of Education

State Council of Educational Research and Training (SCERT),  
KERALA  
2016

## **Foreword**

Dear Teachers

This reference book (**Teachers' Version**) is intended to serve as a transactional aid to facilitate classroom transaction and as a ready reference for teachers of Vocational Higher Secondary Schools. It offers some guidelines for the transaction of the course content and for undertaking the practical work listed in the course content. As the curriculum is activity based, process oriented and rooted in constructivism focusing on the realisation of learning outcomes, it demands higher level proficiency and dedication on the part of teachers for effective transaction.

In the context of the Right- based approach, quality education has to be ensured for all learners. The learner community of Vocational Higher Secondary Education in Kerala should be empowered by providing them with the best education that strengthens their competences to become innovative entrepreneurs who contribute to the knowledge society. The change of course names, modular approach adopted for the organisation of course content, work-based pedagogy and the outcome focused assessment approach paved the way for achieving the vision of Vocational Higher Secondary Education in Kerala. The revised curriculum helps to equip the learners with multiple skills matching technological advancements and to produce skilled workforce for meeting the demands of the emerging industries and service sectors with national and global orientation. The revised curriculum attempts to enhance knowledge, skills and attitudes by giving higher priority and space for the learners to make discussions in small groups, and activities requiring hands-on experience.

The SCERT appreciates the hard work and sincere co-operation of the contributors of this book that includes subject experts, industrialists and the teachers of Vocational Higher Secondary Schools. The development of the teachers' version of reference books has been a joint venture of the State Council of Educational Research and Training (SCERT) and the Directorate of Vocational Higher Secondary Education.

The SCERT welcomes constructive criticism and creative suggestions for the improvement of the book.

With regards,

**Dr. J. Prasad**  
Director  
SCERT, Kerala

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## ABOUT THE COURSE

Among the different vocational courses 'Marine Technology' has a great relevance. Being a country with a vast coastline of about 8000 Km; fishing, water transportation and allied industries play an important role, in providing employment to a majority of the population as well as sustaining the economy with the foreign exchange earned from the export of various fisheries products.

Among the maritime status of India, Lateral holds a remarkable position in fisheries sector. The coast of Kerala constitutes approximately 10 percent of India's total coastline. This coastline of 590 km and the Exclusive Economic Zone (EEZ) extends up to 200 nautical miles far beyond the continental shelf, which covers an area of 218536 sq km provide opportunities in traditional fishing in inshore waters from ages. Water transportation is also increasing in Kerala. Kerala has a large number of boats, ships and vessels and thus provides job opportunities for lakhs.

The course 'Marine Technology' enables a VHS student to acquire skill to do maintenance, different service works, fault finding and rectification in different On board and In board engines. He may work as a technician/supervisor in marine workshops or plants, or he can start a service centre of his own.

This 2 year course has 4 modules. After the completion of first module he gets a skill certificate in 'Basic Marine Work shop practice'.

The second module deals with servicing of OBMs and after completion he will get a Skill certificate as 'Out Board Motor Servicing'.

The third module is about servicing of Marine diesel engines and gets a skill certificate in 'Marine Diesel Engine Servicing'.

The last module is about marine equipments and navigational aids. The certificate issued will be a skill certificate in 'Marine vessel equipment servicing', Welding and NDT'.

After the successful completion of the 2 year course one can continue his study for B Sc (Fisheries), B Sc (Nautical Technology) and B Sc (Nautical Science).

He can also study mathematics as an additional subject and he can also join for Various B-Tech courses especially "B.E. Marine Engineering".

The following courses are also studied by the learner who opt this streams;

- Diploma in Marine Electrical and Electronic Engineering
- Diploma in Marine Engineering
- Diploma in Nautical Science
- General Purpose Rating (GP Rating)
- Marine Diesel Mechanic
- Diploma in Marine Fitter Technology

The prominent institutes one can join for further studies are;

- CIFNET
- Indian Maritime University( Cochin, Chennai, Mumbai, Calcutta)
- Maharashtra Academy of Engineering & Educational Research
- Marine Engineering and Research Institute
- International Maritime Institute
- Birla Institute of Technology & Science
- College of Engineering, Anna University
- University of Madras
- Annamalai University
- Chennai School of Ship Management
- Cochin Shipyard
- Kunjali Marakkar School Of Marine Engineering, CUSAT
- Euro Tech, Ernakulam

### **JOB ROLES**

<b>GOVT/ SEMI GOVT</b>	<b>PRIVATE SECTOR</b>	<b>SELF</b>
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SECTOR			EMPLOYMENT
1.	Laboratory technical assistant in VHSE	1. Marine engineer	<ul style="list-style-type: none"> <li>• NDT</li> <li>• In Board Motor service provider</li> <li>• Battery service centre</li> </ul>
2.	Boat mechanic in water transportation department	2. Marine fitter	
3.	Engine Mechanic in KSINC	3. Service engineer in shipyard	
4.	Workshop technician in KSRTC	4. In Board Motor technician	
5.	In Board Motor technician Matsyafed	5. Welder in Automobile workshop	
6.	Diesel mechanic in Govt. workshops	6. Welder in Fabrication shop	
7.	Welder in different Govt. sectors	7. NDT Technician in Power plants	
8.	NDT Technician in KSRTC	8. Diesel engine mechanic	
9.	NDT Technician in Cochin	9. Lead acid battery technician	



	refineries		
10.	Service engineer in shipyard		

## **MAJOR SKILLS (WITH SUB SKILLS)**

### **1. MARINE DIESEL ENGINE SERVICING**

- a) Decarbonization
- b) Injector Testing and Servicing
- c) Fault Diagnosis and Rectification
- d) Identification of Pipe Lines

### **2. MARINE EQUIPMENT SERVICING, WELDING AND NONDESTRUCTIVE TESTING**

- a) Maintenance of Auxiliary Machines
- b) Handling of Deck Equipments
- c) Handling of Navigation Aids
- d) Various welding Techniques
- e) Analysis of Welding defects
- f) Major NDT Techniques

## **LEARNING OUTCOMES OF THE COURSE**

After the completion of the course the learner will be able to;

- 1) Identify Heavy vessel diesel engine parts such as exhaust valve, piston, piston rod, cross head, piston rings, fuel injection pump, ports, turbo charger, direct drive, fuel cams for reversing the engine rotation.
  - 1) Testing and servicing of injectors
  - 2) Servicing of fuel injection pump
  - 4) Demonstrate Manual starting systems (rope and handle)
  - 5) Identifies, Categories and explain the working of commonly used fishing boat transmission systems such as epi-cyclic, differential and hydraulic gear boxes.
  - 6) Study of Pressure gauge, temperature gauge and tachometer.
  - 7) Servicing of Centrifugal pump, reciprocating pump, Gear pump and Hand Pump.
  - 8) Servicing of Reciprocating compressor (Single stage and Multi-stage), Centrifugal compressor.
  - 9) Acquire Skill to do Metal arc Welding

- 10) Acquire skill to do Visual Testing, Penetrant Testing, Magnetic-particle Testing and Radiographic Testing(Film interpretation only)
- 11) Do maintenance of various engine troubles in Marine diesel engines.

## COURSE STRUCTURE

This course will consist of 4 modules such as :-

Module No.	Module Name	No.of periods
1	MARINE WORKSHOP PRACTICE	340
2	OUT BOARD MOTOR SERVICING	340
3	MARINE DIESEL ENGINE SERVICING	340
4	MARINE EQUIPMENT SERVICING, WELDING AND NON DESTRUCTIVE TESTING	340

## SYLLABUS

### MODULE-3

#### **Unit 3.1- INTRODUCTION TO MARINE DIESEL ENGINE (Period-20)**

Diesel engine Cycle- Diesel engine description - working of 2 - stroke and 4 Stroke CI engines. - Differences between SI & CI engines

#### **Unit 3.2- MARINE LOW SPEED ENGINE CONSTRUCTION (Periods-60)**

Categorization Of Marine engines – Low, medium & High Speed engines - Necessity of Main & Auxiliary engines in Ships & Vessels - Advantages of 2 stroke low speed engine as Main engine in Marine Ships & Vessels.- Heavy vessel diesel engine construction

#### **Unit 3.3- MARINE DIESEL ENGINES SYSTEMS (Periods-140)**

Fuel system – Fuels used in marine engines - Fuel system in fishing boats- Fuel system in Ships and Vessels- Injector servicing and testing - Servicing of fuel injection pump - Introduction about electronic injector used in high and medium speed diesel engines. - Starting system-different types of starting system- Manual starting systems - Electric starting systems-bendix - Air starting system –air distribution- Cooling system-indirect sea water cooling - Lubrication system (in ships)–forced lubrication system - Grading of Lube oil - Air intake and Exhaust systems - Turbo charger-function- working-Lubrication - Exhaust system - Transmission System - Transmission system in ships- Propulsion System - Stern tube Assembly- lubrication-

Propeller nomenclature, fixed pitch and variable pitch propeller- Steering system used in boats and ships- Important mechanisms in a diesel engine-governor ,decompression mechanism ,blow past mechanism.

**Unit 3.4- MARINE DIESEL ENGINES MAINTENANCE AND TROUBLE SHOOTING (Periods-60)**

Daily maintenance - Periodic maintenance - Preventive maintenance - Break down maintenance - Fault diagnosis and rectification – Propeller efficiency low - Smoke colour -Blue, White and Black - Cavitations in propeller - Engine temperature high - Low mileage - Detonation inside the engine – Decarburization - Valve Clearance adjustment - Cylinder piston clearance - Compression pressure checking low/ high - Crank case explosion - Oil mist detection - Engine oil quality checking – Visual, Viscosity, water, microbial degradation

**Unit 3.5- GAUGES AND METERS (Periods-40)**

Different gauges and meters used in marine engines – Pressure gauge, temperature gauge, tachometer. Different gauges and meters used in marine engines –Ammeter, flow meter, pyrometer, Inclinator, gauge glass, hour meter

**Unit 3.6- VESSEL AND VESSEL TERMINOLOGY (Periods-20)**

Vessel terminology - Engine room lay out - Colour lights and code used in ships

**MODULE- 4**

**Unit 4.1- MARINE AUXILIARY MACHINES (Period-60)**

Auxiliary Machines-Pumps (Centrifugal pump, reciprocating pump, Gear pump and Hand Pump) –Compressor (Reciprocating compressor Single stage, Multi-stage, Centrifugal compressor) - Electrical Generator (Single phase AC and DC generator.) - Power take off (Mechanical, Electrical and Hydraulic)

**Unit 4.2- DECK EQUIPMENTS AND FISHING ACCESSORIES (Periods-40)**

Deck Equipments and fishing Accessories- Mechanical Trawl winch, fishing Accessories- Line Hauler, Power block (open and closed) - Net drum-Gallows - Mast -Derrick and pulleys

**Unit 4.3- NAVIGATION AIDS (Periods-20)**

Navigation aids - GPS, Gyroscope, AIS, VHF Radio, RADAR, Ultra sonic devices (Fathometer, SONAR, Fish finder), Magnetic compass and Gyro compass

**Unit 4.4- LIFE SAVING EQUIPMENTS (Periods- 10)**

Life saving Equipments - Life raft, Life buoy, Life Jacket and Life Boat

**Unit 4.5- WELDING AND WELDING DEFECTS (Periods-110)**

Welding Methods - Fusion welding, Pressure welding, Thermo chemical welding, Gas Welding (Oxy-Acetylene), Arc Welding Methods- SMAW,GMAW/MIG, GTAW/TIG and Submerged arc welding, Different welding positions-Flat, Horizontal, vertical and Overhead, Under water welding and its two types such as Wet (Metal Arc)and Dry ( Flux cored arc), Welding defects -

Lack of penetration, Lack of fusion, Porosity, Slag inclusion, undercut, Overlays, Cracking, Blowholes, Burn through, Excessive penetration, spatter and arc strike

#### **Unit 4.6 NON DESTRUCTIVE TESTS**

**(Periods-100)**

Types of weld test - destructive and non destructive, Different types of non destructive testing - visual inspection, liquid penetrant test, magnetic particle test, radiographic test and ultra sonic test

#### **LIST OF PRACTICALS MODULE 3**

- Identify and categorize the SI & C I engines parts.
- Dismantling and assembling of boat diesel engine and Identification of parts such as exhaust valve, piston rod, cross head, minimum 4 piston rings only, separate fuel injection pump for each cylinder, no transfer port, air induction by turbo charger, direct drive, two set of fuel cams for reversing the engine rotation.
- Dismantling and assembling of fuel injection pump.
- Dismantling and assembling of fuel injector
- Assembling of piston rings in the piston
- Hands on experience on injector servicing
- Hands on experience on injection pump servicing
- Hands on experience on manual starting systems
- Dismantling and assembling of Bendix starting system
- Heat exchanger servicing
- Dismantling and assembling of turbo charger
- Dismantling and assembling of fishing boat transmission system(epi-cyclic).
- Dismantling and assembling of fishing boat transmission system(differential).
- Dismantling and assembling of fishing boat transmission system(reverse and reduction).
- On hand experience of lube oil changing.
- On hand experience of Decarburization in boats.
- Hands on experience on engine Valve Clearance adjustment.

- Hands on experience on engine Cylinder piston clearance checking by using feeler gauge
- Calibration of piston and piston rings
- Hands on experience on engine Compression pressure checking.
- Hands on experience on Engine oil quality checking (Water Content test, pH Test, Viscosity Test, Spot test, Flash point test, Water Crackle test)
- Dismantling and assembling of bourden tube Pressure gauge.

#### **LIST OF PRACTICALS MODULE 4**

- Dismantling and assembling of Centrifugal pump.
- Dismantling and assembling of Reciprocating pump.
- Dismantling and assembling of Gear pump.
- Dismantling and assembling of Hand Pump.
- Dismantling and assembling of Reciprocating compressor (Single stage and Multistage).
- Dismantling and assembling of Centrifugal compressor.
- Dismantling and assembling of Mechanical Trawl winch.
- Identification of navigation aids commonly used in vessels GPS, Gyroscope, AIS, VHF Radio, RADAR, Ultra sonic devices (Fadho meter, SONAR, Fish finder), Magnetic compass and Gyro compass.
- Identification of Life raft, Life bouy, Life Jacket and Life Boat.
- Hands on experience on Shielded Metal Arc Welding (SMAW).
- Identification of welding defects such as undercut, porosity, spatter, arc strike, excessive penetration, cracking, blow holes
- Hands on experience on Visual Inspection test.
- Hands on experience on liquid penetrant test.
- Hands on experience on magnetic particle test
- Hands on experience on Radiographic Test (Film inspection).

- Hands on experience on ultra sonic test.

## **LEARNING OUTCOMES OF MODULE 3**

### **3.1- INTRODUCTION TO MARINE DIESEL ENGINE**

- 3.1.1 Describe thermodynamic cycle behind the working of diesel engines.
- 3.1.2 Explains working of 2 - stroke & 4 strokes CI engines.
- 3.1.3 Differentiates between SI & CI engines.

### **3.2- MARINE LOW SPEED ENGINE CONSTRUCTION**

- 3.2.1 Categorization of Marine engines such as low , Medium & High speed
- 3.2.2 Describe the needs of Main & Auxiliary engines in Ships & Vessels
- 3.2.3 Describe the advantages of 2 stroke low speed engine as Main engine in Marine Ships & Vessels.
- 3.2.4 Identify Heavy vessel diesel engine parts such as exhaust valve, piston rod, cross head, piston rings, separate fuel injection pump for each cylinder, cylinder without transfer port, air induction by turbo charger, direct drive, two set of fuel cams for reversing the engine rotation.

### **3.3- MARINE DIESEL ENGINES SYSTEMS**

- 3.3.1 Explains the different types of fuels used in marine fishing boats (Diesel)and ships (Heavy fuel oil & Marine Diesel oil)
- 3.3.2 Identify the parts, explain their functions and construct the line diagram of fuel system used in fishing boats
- 3.3.3 Identify the parts, explain its functions and construct the line diagram of fuel system used in Ships and Vessels
- 3.3.4 Testing and servicing of injectors
- 3.3.5 Servicing of fuel injection pump
- 3.3.6 Explains the working of electronic injector.
- 3.3.7 Identify different types of starting systems. manual ,electric and air
- 3.3.8 Demonstrate Manual starting systems (rope and handle)
- 3.3.9 Identify and explain the parts and working of bendix electric starting system
- 3.3.10 Identify and explain the parts and working of Air starting system
- 3.3.11 Identification of different parts of indirect sea water cooling sea cock, water pump, heat exchanger thermostat valve and expansion tank and explains the working
- 3.3.12 Able to explain Lubrication system used in ship and marine vessels
- 3.3.13 He able to differentiate different grades of lub oil as per SAE standard.
- 3.3.14 Explains air intake system in Ships and boats. Prepare Line diagrams
- 3.3.15 Identify and Explain turbocharger, its function, working and lubrication.
- 3.3.16 Explains exhaust system in Ships and boats. Prepare Line diagrams and rotary vane type exhaust valve
- 3.3.17 Identifies, Categories and explain the working of commonly used fishing boat transmission systems such as epi-cyclic, differential and hydraulic types

- 3.3.18 Explains the working of ship reversing
- 3.3.19 Draw the propulsion system diagram used in marine vessels and fishing boats.
- 3.3.20 Explains the stern tube assembly and its lubrication in ships and boats
- 3.3.21 Identifies and explain the fixed and variable pitch propeller and its parts.
- 3.3.22 Identify and differentiate the steering system used in boats and ships
- 3.3.23** Explain the role of the governor, decompression mechanism and blow past mechanism

### **3.4- MARINE DIESEL ENGINE MAINTENANCE AND TROUBLE SHOOTING**

- 3.4.1 Explain daily maintenance works in ships and boats.
- 3.4.2 Explain periodic maintenance works in ships and boats.
- 3.4.3 Explain preventive maintenance works in ships and boats.
- 3.4.4 Explain what is break down maintenance
- 3.4.5 Diagnosis and rectify low propeller efficiency.
- 3.4.6 Understand the causes of blue, white and black smokes
- 3.4.7 Explains the cavitation in propeller and its remedy
- 3.4.8 Rectifies the faults related high engine temperature
- 3.4.9 Explain the reasons and rectification of low mileage
- 3.4.10 Diagnose and Rectifies the Detonation inside the engine due to decarburization, un burnt diesel sediments in the combustion chamber
- 3.4.11 Gets skill on engine decarburization
- 3.4.12 Gets skill of engine Valve Clearance adjustment
- 3.4.13 Gets skill of engine Cylinder piston clearance checking
- 3.4.14 Gets skill of engine Compression pressure checking
- 3.4.15 Explains the engine Crank case explosion and its remedy
- 3.4.16 Explains the engine Oil mist detection and its rectification
- 3.4.17** Gets skill of Engine oil quality checking – Visual, Viscosity, water, microbial degradation

### **3.5- GAUGES AND METERS**

- 3.5.1 Explains the need, functions and construction of Pressure gauge, temperature gauge, tachometer.
- 3.5.2** Explains the need, functions of Ammeter, flow meter, pyrometer, Inclinator , gauge glass and hour meter

### **3.6- VESSEL AND VESSEL TERMINOLOGY**

- 3.6.1 Familiar with the technical terms used in the vessels such as ahead, astern, bridge, gang way, stern, stem, starboard, port, ballast
- 3.6.2 Familiar with the Engine room lay out

- 3.6.3** Identify the colour lights used in ship navigation and pipe line colour codes

# **LEARNING OUTCOMES OF MODULE 4**

## **4.1- MARINE AUXILIARY MACHINES**

- 4.1.1 Able to Service Centrifugal pump, reciprocating pump, Gear pump and Hand Pump, and able to explain their working.
- 4.1.2 Able to Service Reciprocating compressor (Single stage and Multistage), Centrifugal compressor and able to explain their working.
- 4.1.3 Explain working and identify parts of Single phase AC and DC generator.
- 4.1.4 Categories Power take off such as Mechanical, Electrical and Hydraulic

## **4.2- DECK EQUIPMENTS AND FISHING ACCESSORIES**

- 4.2.1 Servicing of Mechanical Trawl winch
- 4.2.2 Familiarization with Line Hauler, Power block (open and closed) and Net drum
- 4.2.3 Familiarization with Gallows, Mast and Derrick and pulleys

## **4.3- NAVIGATION AIDS**

- 4.3.1 Familiarization with GPS, Gyroscope, AIS, VHF Radio, RADAR, Ultra sonic devices (SONAR, Fish finder, Fadho meter), Magnetic compass and Gyrocompass

## **4.4- LIFE SAVING EQUIPMENTS**

- 4.4.1 Familiarization with Life saving Equipments such as Life raft, Life bouy, Life Jacket and Life Boat

## **4.5- WELDING AND WELDING DEFECTS**

- 4.5.1 Differentiates between different types of welding methods such as Fusion welding, Pressure welding, Thermo chemical welding
- 4.5.2 Explain Welding Methods-Gas Welding (Oxy-Acetylene)
- 4.5.3 Explain different types of Arc Welding Methods- SMAW,GMAW/MIG, GTAW/TIG and Submerged arc welding
- 4.5.4 Acquire Skill to do Metal arc Welding
- 4.5.5 Explains Under water welding and its two types such as Wet (Metal Arc)and Dry(FLUX cored arc)
- 4.5.6 Understanding various welding positions
- 4.5.7 Explains the welding defects such as Lack of penetration, Lack of fusion, Porosity, Slag inclusion, undercut, Overlays, Cracking, Blowholes, Burn through, Excessive penetration, spatter.

## **4.6 NON DESTRUCTIVE TESTS**

- 4.6.1 Explains welding test like destructive and non destructive
- 4.6.2 Explains the different types of non destructive testing such as visual inspection, liquid penetrant test, magnetic particle test, radiographic test and ultra sonic test
- 4.6.3 Acquire skill to do Visual Inspection test and liquid penetration test



## **Scheme of Work**

<b>Month</b>	<b>Name of Units</b>	<b>Periods</b>
June	Introduction to marine diesel engine	20
June-July	Marine low speed engine construction	60
July – August - September	Marine diesel engines systems	140
September - October	Marine diesel engines maintenance and trouble shooting	60
October	Gauges and meters , Vessel and vessel terminology	60
November	Marine auxiliary machines	60
November	Deck equipments and fishing accessories	40
November - December	Navigation aids	20
December- January	Life saving equipments	10
January - February	Welding and welding defects	110
February - March	NON DESTRUCTIVE TESTS	100

### **Structure of Module 3- Marine Diesel Engine Servicing (Total periods- 340)**

Unit No.	Name of Unit	Periods
3.1	INTRODUCTION TO MARINE DIESEL ENGINE	20
3.2	MARINE LOW SPEED ENGINE CONSTRUCTION	60
3.3	MARINE DIESEL ENGINES SYSTEMS	140
3.4	MARINE DIESEL ENGINES MAINTENANCE AND TROUBLE SHOOTING	60 <b>Unit 4.6 NON DESTRUCTIVE TESTS</b>
3.5	GAUGES AND METERS	40
3.6	VESSEL AND VESSEL TERMINOLOGY	20

**Module 4- Marine Equipment Servicing, Welding and Non Destructive Testing (Total periods-340)**

Unit No	Name of Unit	Period
4.1	MARINE AUXILARY MACHINES	60
4.2	DECK EQUIPMENTS AND FISHING ACCESSORIES	40
4.3	NAVIGATION AIDS	20
4.4	LIFE SAVING EQUIPMENTS	10
4.5	WELDING AND WELDING DEFECTS	110
4.6	NON DESTRUCTIVE TESTS	100

**CLASS ROOM ACTIVITIES**

- Group Discussion
- General Discussion
- Animation Videos
- Power point Presentation
- Chart Preparation
- Assignment
- Seminar
- Project
- Debate
- Comparison

- Multimedia presentation

## **PRACTICAL ACTIVITIES**

- Demonstration
- Identification
- Drawing
- Model making
- Interaction with Experts
- Maintenance
- Servicing
- Welding
- NDT
- Fault Diagnosis and Rectification
- Field visit
- OJT

## **OVER VIEW OF THE MODULE 3 MARINE DIESEL ENGINE SERVICING**

A course in marine technology is incomplete without heavy diesel engine/ ship engine servicing. In this module the learner acquires the skills for servicing multi cylinder diesel engine, its different systems, maintenance works and trouble shooting. He readily familiarized with different gauges and meters found on the engine / control / bridge. He also gets a fair idea about vessel terminology; engine room lay out, colour codes used in Marine vessels.

### **UNIT 3.1 INTRODUCTION TO MARINE DIESEL ENGINE**

An introduction to diesel engine begins with diesel cycle. The diesel cycle is explained on the basis of P-V diagram and T-S diagram. This gives a clear picture about the processes taking place in a diesel cycle. Thereafter the working of two stroke marine diesel engine and four stroke diesel engines are detailed and a comparison between spark ignition (S.I.) engine and compression ignition (C.I.) engine is done.

<b>UNIT NO. 3.1 INTRODUCTION TO MARINE DIESEL ENGINE PRERIODS 20</b>			
<b>Ideas / concepts / skills</b>	<b>Learning outcomes</b>	<b>Suggested activities</b>	<b>Assessment</b>
Diesel engine Cycle	Describe thermodynamic cycle behind the working of diesel engines.	Basic idea about thermodynamic cycle for the working of diesel engines through class room interaction, chart preparation of cycle, seminar	Activity log, charts and seminar report.
Diesel engine description - working of 2 - stroke and 4 Stroke CI engines.	Explains working of 2 - stroke & 4 strokes CI engines.	Demonstration of 2 - stroke & 4 stroke CI engine working using engine cut model, Multimedia presentation	Activity log, Practical activity log

Differences between SI & CI engines	Differentiates between SI & CI engines.	Identification of SI & CI engines parts, categorize SI & CI engines parts.	Practical activity log.
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## **ADDITIONAL INFORMATION**

### **ASSESSMENT ACTIVITIES**

- Class test
- Flow chart preparation
- Identification of engine parts
- Assignment
- Seminar
- Quiz
- **Collection**

### **PORTFOLIO**

## **UNIT 3.2**

### **MARINE LOW-SPEED ENGINE CONSTRUCTION**

Before one should go in detail about marine diesel engines he should know about the categorization of diesel engines into high speed engines, medium speed engines, low speed engines and their differentiation criteria. Eventually the topic leads to the use of low speed engines as Main engines and four stroke engines as auxiliary engines. This paves way to the relevance of the topic advantages of two stroke engines over four stroke engines as main engines onboard ship. The parts of two stroke diesel engines such as exhaust valve, piston and piston rod, cross head, piston rings, fuel injector, fuel pump, turbocharger, fuel cam etc. are covered in detail.

<b>UNIT NO. 3.2 MARINE LOW SPEED ENGINE CONSTRUCTION</b>			<b>PERIODS 80</b>
<b>Ideas / concepts / skills</b>	<b>Learning outcomes</b>	<b>Suggested activities</b>	<b>Assessment</b>

Categorization Of Marine engines –  Low, medium & High Speed engines	Categorization of Marine engines such as low , Medium & High speed	General discussion on low , Medium & High speed	activity log.
Necessity of Main & Auxiliary engines in Ships & Vessels	Describe the needs of Main & Auxiliary engines in Ships & Vessels	General discussion on Main & Auxiliary engines in Ships & Vessels	Activity log.
Advantages of 2 stroke low speed engine as Main engine in Marine Ships & Vessels.	Describe the advantages of 2 stroke low speed engine as Main engine in Marine Ships & Vessels.	General discussion , Seminar on advantages of 2 stroke low speed engine as Main engine in Marine Ships & Vessels	Activity log, seminar report.
Heavy vessel diesel engine construction	Identify Heavy vessel diesel engine parts such as exhaust valve, piston rod, cross head, minimum 4 piston rings only, separate fuel injection pump for each cylinder, no transfer port, air induction by turbo charger, direct drive, two set of fuel cams for reversing the engine rotation.	Multimedia presentation and general discussion about Heavy vessel diesel engine parts such as exhaust valve, piston rod, cross head, minimum 4 piston rings only, separate fuel injection pump for each cylinder, no transfer port, air induction by turbo charger, direct drive, two set of fuel cams for reversing the engine rotation.	Activity log, chart preparation.

## **ADDITIONAL INFORMATION**

### **ASSESSMENT ACTIVITIES**

4. Class test
5. Assignment
6. Group discussion
7. Seminar

### **PORTFOLIO**

## **UNIT 3.3**

### **MARINE DIESEL ENGINES SYSTEMS**

This unit deals with the different types of systems onboard ships and boats. The systems mainly consists of fuel system, starting air system, cooling system, lubrication system, air intake and exhaust system, propulsion system, transmission system, steering system. The fuel system covers the types of fuel oils onboard ship and a detailed study of fuel oil line in ships and boats. The topics such as injector testing and servicing, fuel injection pump diesel governor etc. are included. Starting system and its classifications like manual, electric and air starting systems, blow past, de-compression mechanisms are detailed. A detailed study about indirect sea water cooling system is included in cooling system. Lubrication, its importance and the lube oil system with line diagram gives a clear view about the lubrication of engines, machinery, stern tube, etc. air intake and exhaust system deals with the engine air intake and exhaust lines as well as machinery included in it, the role of turbocharger and its lubrication. The transmission system cover topics like transmission onboard ships, gearboxes such as epi-cyclic, differential, hydraulic gearboxes used. Propeller, its nomenclature and its types are detailed in propulsion system. The manoeuvrability of the vessel and the steering gear arrangements are covered in steering system.

<b>UNIT NO. 3.3 MARINE DIESEL ENGINES SYSTEMS</b>			<b>PRERIODS</b>
<b>100</b>			
<b>Ideas / concepts / skills</b>	<b>Learning outcomes</b>	<b>Suggested activities</b>	<b>Assessment</b>
Fuel system – Fuels used in marine engines	Explains the different types of fuels used in marine fishing boats (Diesel)and ships (Heavy fuel oil & Marine Diesel oil)	Group discussion - Brief description regarding the different types of fuels used in marine fishing boats (Diesel)and ships (Heavy fuel oil & Marine Diesel oil)	Activity log.
Fuel system in fishing boats	Identify the parts, explain its functions and construct the line diagram of fuel system used in fishing boats	Demonstration, multimedia presentation, chart preparation and Group discussion - Brief description of storage tank, fuel valves, fuel feed pump, service tank, filters ( coarse & fine), water separator, fuel pump, fuel injection pump, injector.	activity log, practical activity log, chart preparation
Fuel system in Ships and Vessels	Identify the parts, explain its functions and construct the line diagram of fuel system used in Ships and Vessels	Demonstration, multimedia presentation, chart preparation and Group discussion - Brief description of bunker, storage tank with heating coil, fuel valves, fuel feed pump, service tank with heating coil, water purifiers (2 nos),day tank, flow	activity log, practical activity log, chart preparation



		meter, fuel feed pump filters ( coarse & fine), fuel injection pump, injector.	
Injector servicing and testing	Testing and servicing of injectors	Hands on experience on injector servicing	practical activity log
Servicing of fuel injection pump	Servicing of fuel injection pump	Hands on experience on injector servicing	practical activity log
Introduction about electronic injector used in high and medium speed diesel engines.	Explains the working of electronic injector.	Multimedia presentation, demonstration and description	activity log, practical activity log
Starting system- different types of starting system	Identify different types of starting systems. manual ,electric and air	Demonstration of different types of starting systems.	Practical activitylog
Manual starting systems	Demonstrate Manual starting systems (rope and handle)	Hands on experience on injector servicing	practical activity log

Electric starting systems-bendix	identify and explain the parts and working of bendix electric starting system	Demonstration ,multimedia presentation ,general discussion about bendix starting system	Chart preparation, practical activity log
Air starting system –air distribution	identify and explain the parts and working of Air starting system	Demonstration ,multimedia presentation ,general discussion about Air starting system	Chart preparation, practical activity log
Cooling system-indirect sea water cooling	identification of different parts of indirect sea water cooling sea cock, water pump, heat exchanger thermostat valve and expansion tank and explains the working	Identification , demonstration chart preparation and general discussion about different parts of indirect sea water cooling sea cock, water pump, heat exchanger thermostat valve and expansion tank.	Activity log, chart preparation.
Lubrication system (in ships)–forced lubrication system	Able to explain Lubrication system used in ship and marine vessels	Multimedia presentation, general discussion(forced lubrication, cy. Wall lubrication by lube injector and Lube through con.rod to cross head and inside of piston)	class room activity, practical activity log, Chart preparation
Grading of Lub. oil	To differentiate different grades of lube oil as per SAE standard.	General Discussion (SAE Grading)	Activity Log.

Air intake and Exhaust systems	explains air intake system in Ships and boats. Prepare Line diagrams	Multimedia presentation, general discussion, demonstration and chart preparation (Air filter-Blower-engine room-Air filter-turbo charger-Air cooler-Air manifold-inlet port.)	Activity log, chart preparation
Turbo charger-function- working- Lubrication	Identify and Explain turbocharger, its function, working and lubrication.	Multimedia presentation and demonstration	Activity log, chart preparation
Exhaust system	Explains exhaust system in Ships and boats. Prepare Line diagrams and rotary vane type exhaust valve	Multimedia presentation, general discussion, demonstration and chart preparation (Rotary vane type exhaust valve- Exhaust manifold- turbo charger- Silencer-Selective catalytic converter) and rotary vane type exhaust valve	Activity log, chart preparation
Transmission System	Identifies , Categories and explain the working of commonly used fishing boat transmission systems such as epi - cyclic, differential and hydraulic types	Demonstration, identification, hands on experience, general discussion on commonly used fishing boat transmission systems such as epi - cyclic, differential and hydraulic types	Activity log, Practical activity log, chars preparation.

Transmission system in ships	Explains the engine reversing	Multimedia presentation, General discussion about the ship reversing as engine rotated opposite direction due to the engagements of two types fuel cams.	Activity log
Propulsion System	Draw the propulsion system diagram used in marine vessels and fishing boats.	Demonstration, field visit, multimedia presentation of propulsion system used in marine vessels and fishing boats.	Activity log, Practical log
Stern tube Assembly-lubrication	Explains the stern tube assembly and its lubrication in ships and boats	General discussion, multimedia presentation, demonstration of the stern tube assembly and its lubrication in ships and boats.	Activity log
Propeller nomenclature, fixed pitch and variable pitch propeller.	Identifies and explain the fixed and variable pitch propeller and its parts.	Demonstration, general discussion about the nomenclature of fixed pitch propeller and variable pitch propeller and its working.	Activity log, practical activity log
Steering system used in boats and ships	Identify and differentiate the steering system used in boats and ships	Demonstration, Multimedia presentation, general discussion about the steering system flow diagram like Helm wheel, chain, rudder post and rudder for boats and Helm	Activity log, chart preparation

		wheel (with or without rudder angle indicator), electronic signals, hydraulic pumps, cylinder ram arrangement (2 ram / 4 ram) , tiller, rudder for ships.	
Important mechanisms in a diesel engine-governor ,decompression mechanism ,blow past mechanism.	Explain the role of the governor, decompression mechanism and blow past mechanism	Multimedia presentation ,questionnaire.	Activity log, chart preparation

## **ADDITIONAL INFORMATION**

### **ASSESSMENT ACTIVITIES**

- Class room test
- Assignment
- Flow chart
- Seminar
- Group discussion

### **PORTFOLIO**

4. Activity log, charts and seminar report on propulsion system used in ships.
5. Practical Activity log – indirect sea water cooling system
6. Practical Activity log –fuel system and lubrication system used in ships
7. Practical Activity log – types of propeller
8. Practical Activity log – types of starting system
9. Chart preparation on propeller nomenclature.
10. Chart preparation on stern tube assembly
11. Chart preparation on fuel injector.

### UNIT 3.4

## MARINE DIESEL ENGINES MAINTENANCE AND TROUBLE SHOOTING

Maintenance is the most critical job in ship. Maintenance includes daily, periodic, preventive and breakdown maintenances. In addition this unit goes in detail about fault diagnosis and rectification. The reasons and rectification methods for blue, black and white smoke, cavitation, engine temperature high/low, low mileage, detonation, compression pressure high and low, etc. are covered in detail. Maintenance procedures for decarburization, valve clearance adjustment, cylinder piston clearance, etc. are discussed. In addition a detailed study about crankcase explosion, oil mist detector and lubrication oil quality checking are also discussed in this unit

<b>UNIT NO. 3.4 MARINE DIESEL ENGINES MAINTENANCE AND TROUBLE SHOOTING</b>			
<b>PERIODS 80</b>			
<b>Ideas / concepts / skills</b>	<b>Learning outcomes</b>	<b>Suggested activities</b>	<b>Assessment</b>
Daily maintenance	Explain daily maintenance works in ships and boats.	General discussion, presentation, on hand experience(watch all temperature and pressure gauges, all oil levels, cooling water temp, engine vibration, bilge tank level)	Activity log, assignment
Periodic maintenance	Explain periodic maintenance works in ships and boats.	General discussion, presentation, on hand experience ( 50 hrs, 100 hrs,250 hrs, 500 hrs, 1000hrs etc in boats)	Activity log, assignment
Preventive maintenance	Explain preventive maintenance works in ships and boats.	General discussion, presentation, on hand experience( Decarburization using blow past valve in ship and decarburization in boats)	Activity log, assignment
Break down maintenance	Explain what is break down maintenance	General discussion, presentation on common break down causes like crank case explosion, propeller blade breakage, Rudder struck etc	Activity log, assignment

Fault diagnosis and rectification – Propeller efficiency low	Diagnosis and rectify low propeller efficiency.	Demonstration, General discussion on Diagnosis and rectify low propeller efficiency.	Activity log and practical activity log.
Smoke colour –Blue, White and Black	Understand the causes of blue, white and black smokes	Demonstration, general discussion and hands on experience of the causes of blue, white and black smokes	Activity log and practical activity log.
Cavitations in propeller	Explains the cavitations in propeller and its remedy	Demonstration, class room interaction, multimedia presentation cavitations in propeller due to bubbles formation near propeller (un even loading) and remedy proper loading or ballasting.	activity log, practical log
Engine temperature high	Rectifies the faults related high engine temperature	Multimedia presentation and interaction about the reasons for high engine temperature and its rectification.	class room activity log, practical log
Low mileage	Explain the reasons and rectification of low mileage	Multimedia presentation and interaction about the reasons for high engine temperature and its rectification.	class room activity log, practical log
Detonation inside the engine	Diagnosis and Rectifies the Detonation inside the engine due to decarburization, un burnt diesel sediments in the combustion chamber	Multimedia presentation and general discussion about the Detonation inside the engine due to decarburization, un burnt diesel sediments in the combustion chamber.	class room activity log, practical log
Decarburization	Gets skill on engine decarburization	Demonstration, Multimedia presentation, Hands on experience on decarburization	Practical activity log

Valve Clearance adjustment	Gets skill of engine Valve Clearance adjustment	Demonstration, Multimedia presentation, Hands on experience on engine Valve Clearance adjustment	Practical activity log
Cylinder piston clearance	Gets skill of engine Cylinder piston clearance checking	Demonstration, Multimedia presentation, Hands on experience on engine Cylinder piston clearance checking by using feeler gauge	Practical activity log
Compression pressure checking low/ high	Gets skill of engine Compression pressure checking low/ high	Demonstration, Multimedia presentation, Hands on experience on engine Compression pressure checking low/ high	Practical activity log
Crank case explosion	Explains the engine Crank case explosion and its remedy	Multimedia presentation and general discussion about the engine Crank case explosion and its remedy	Activity log
Oil mist detection	Explains the engine Oil mist detection and its rectification	Multimedia presentation and general discussion about the Oil mist detection and its rectification	Activity log
Engine oil quality checking – Visual, Viscosity, water, microbial degradation	Gets skill of Engine oil quality checking – Visual, Viscosity, water, microbial degradation	Demonstration, Multimedia presentation, Hands on experience on Engine oil quality checking – Visual, Viscosity, water, microbial degradation	class room activity log, practical log

## **ADDITIONAL INFORMATION**

### **ASSESMENT ACTIVITIES**

Class room test  
Assignment  
Flow chart  
Seminar



Group discussion

**PORTFOLIO**

- Activity log, charts and seminar report on types of maintenance and its importance
- charts and seminar report on oil mist detector
- Practical Activity log – decarburization
- Practical Activity log – valve clearance adjustment
- Chart preparation– daily maintenance
- Chart preparation- lube oil quality checking

**UNIT 3.5**

**GAUGES AND METERS**

The unit on gauges and meters is small but vital. The need and applications of different gauges and meters are discussed under this title. The devices like temperature gauge, pressure gauge, tachometer, inclinometer, ammeter, flow meter, gauge glass, hour meter are detailed.

<b>UNIT NO. 3.5</b>		<b>GAUGES AND</b>	<b>PRERIODS 40</b>
<b>METERS</b>			
<b>Ideas / concepts / skills</b>	<b>Learning outcomes</b>	<b>Suggested activities</b>	<b>Assessment</b>

Different gauges used in marine engines – Pressure gauge, temperature gauge, gauge glass	Explains the need, functions and constructions of Pressure gauge, temperature gauge, gauge glass	Demonstration, general discussion, Multimedia presentation, Hands on experience on the need, functions and constructions of Pressure gauge, temperature gauge, gauge glass	Activity log, Practical activity log, chart preparation
Different gauges and meters used in marine engines – tachometer, Ammeter, flow meter, pyrometer, Inclinator , hour meter	Explains the need, functions Tachometer ,Ammeter, flow meter, pyrometer, Inclinator , hour meter	Demonstration, general discussion, Multimedia presentation Tachometer ,Ammeter, flow meter, pyrometer, Inclinator , hour meter	Activity log, chart preparation

### **ADDITIONAL INFORMATION**

### **ASSESSMENT ACTIVITIES**

- 3) Class room test
- 4) Assignment
- 5) Flow chart
- 6) Seminar
- 7) Group discussion

### **PORTFOLIO**

- ❖ Activity log, charts and seminar report on bourdon tube pressure gauge
- ❖ charts and seminar report on different types of gauges
- ❖ Practical Activity log – Bourdon pressure gauge

## **UNIT 3.6**

## VESSEL AND VESSEL TERMINOLOGY

This unit deals with the terms used in maritime industry. A few terms from the glossary which are used most frequently are introduced here. A detailed explanation on navigation lights, ballasting and de ballasting, pipe line colour code and engine room layout are discussed in detail.

<b>UNIT NO. 3.6 PRERIODS 20</b>		<b>VESSEL AND VESSEL TERMINOLOGY</b>	
<b>Ideas / concepts / skills</b>	<b>Learning outcomes</b>	<b>Suggested activities</b>	<b>Assessment</b>
Vessel terminology	Familiar with the technical terms used in the vessels such as ahead, astern, bridge, gang way, stern, stem, starboard, port, ballast	Demonstration, general discussion, Multimedia presentation the technical terms used in the vessels such as ahead, astern, bridge, gang way, stern, stem, starboard, port, ballast	Activity log, chart preparation
Engine room lay out	Familiar with the Engine room lay out	Demonstration, general discussion, Multimedia presentation the Engine room lay out	Activity log, chart preparation
Colour lights and code used in ships	Identify the colour lights used in ship navigation and pipe line colour codes	Demonstration, Multimedia presentation, general discussion position of colour light such as star board (green), port (red), stem and stern (white) for navigation purpose and pipe line colour code compressed air line (white), sea water line (green), lube oil line (yellow), fuel line	Activity log, chart preparation

		(brown), waste water (black) and fresh water (blue)	
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## **ADDITIONAL INFORMATION**

### **ASSESSMENT ACTIVITIES**

- 8) Class room test
- 9) Assignment
- 10) Flow chart
- 11) Seminar
- 12) Group discussion

### **PORTFOLIO**

- ❖ Activity log and seminar report on vessel terminology
- ❖ charts and seminar report on navigation lights used in ships
- ❖ Chart preparation on engine room layout

### **EXTENDED ACTIVITIES**

### **LIST OF PRACTICALS**

- Identify and categorize the SI & C I engines parts.

- Dismantling and assembling of boat diesel engine and Identification of parts such as exhaust valve, piston rod, cross head, minimum 4 piston rings only, separate fuel injection pump for each cylinder, no transfer port, air induction by turbo charger, direct drive, two set of fuel cams for reversing the engine rotation.
- Dismantling and assembling of fuel injection pump.
- Dismantling and assembling of fuel injector
- Assembling of piston rings in the piston
- Hands on experience on injector servicing
- Hands on experience on injection pump servicing
- Hands on experience on manual starting systems
- Dismantling and assembling of Bendix starting system
- Heat exchanger servicing
- Dismantling and assembling of turbo charger
- Dismantling and assembling of fishing boat transmission system epi – cyclic
  - Dismantling and assembling of fishing boat transmission system differential.
  - Dismantling and assembling of fishing boat transmission system reverse and reduction.
- On hand experience of lube oil changing.
- On hand experience of Decarburization in boats.
- Hands on experience on engine Valve Clearance adjustment.
- Hands on experience on engine Cylinder piston clearance checking by using feeler gauge
- Calibration of piston and piston rings
- Hands on experience on engine Compression pressure checking low/ high
- Hands on experience on Engine oil quality checking – Water Content test, pH Test, Viscosity Test, Spot test, Flash point test, Water Crackle test
- Dismantling and assembling of bourden tube Pressure gauge.

**OVER VIEW OF THE MODULE 4**  
**MARINE EQUIPMENT SERVICING,**  
**WELDING AND NON DESTRUCTIVE TESTING**

The final module is named as marine equipment servicing, welding and non destructive test. The condition of an engine is assessed by reading on different meters. In this module the learner is familiarized with each and every meter and gauges found in most of the marine vessels. He is also introduced to deck equipments, navigation aids, auxiliary machines and life saving equipments. He is also skilled to service deck equipments like winches, centrifugal pump, reciprocating pumps, compressors etc. Welding and NDT in this module empowers the learner to explore job opportunities in corresponding area.

**OVER VIEW OF THE UNIT 4.1**  
**MARINE AUXILIARY MACHINES**

All machinery excluding main engine in a ships engine room comes under the topic marine auxiliary machinery. This includes pumps, compressor, A.C. Generator, etc. The study of pumps comprises of the working and operation of centrifugal pump, reciprocating pump, gear pump, hand pump. The need of a compressor onboard ship and types of compressor used are explained in detail. The role of AC generator and its working is also covered. In addition different types of power take off and batteries

onboard are also discussed.

<b>UNIT NO. 4.1 MARINE AUXILIARY MACHINES</b>			<b>PERIODS</b>
<b>Ideas / concepts / skills</b>	<b>Learning outcomes</b>	<b>Suggested activities</b>	<b>Assessment</b>
Auxiliary Machines- Pumps	Able to Service Centrifugal pump, reciprocating pump, Gear pump and Hand Pump, and able to explain its working.	Demonstration and Hands on experience of Centrifugal pump, Reciprocating pump, Gear pump and Hand Pump.	Practical Activity log, Chart preparation
Auxiliary Machines- Compressor	Able to Service Reciprocating compressor (Single stage and Multistage), Centrifugal compressor and able to explain its working.	Demonstration, Hands on experience and Multimedia presentation of Reciprocating compressor (Single stage and Multistage) and Centrifugal compressor.	Practical Activity log, Chart preparation
Auxiliary Machines- Electrical Generator	Explain working and identify parts of Single phase AC and DC generator.	Demonstration and Multimedia presentation of Single phase AC and DC generator.	Assignment , Activity log
Auxiliary Machines- Power take off	Categories Power take off such as Mechanical, Electrical and Hydraulic	Demonstration, Multimedia presentation and General discussion- block diagram preparation of Mechanical, Electrical	Assignment , Activity log, chart preparation

**ADDITIONAL INFORMATION****ASSESSMENT ACTIVITIES**

- 13) Class room test
- 14) Assignment
- 15) Flow chart
- 16) Seminar
- 17) Group discussion

**PORTFOLIO**

- ❖ Activity log and seminar report on AC generator
- ❖ charts and seminar report on centrifugal pump
- ❖ Chart preparation reciprocating pump
- ❖ Practical Activity log- centrifugal pump
- ❖ Practical Activity log- hand pump
- ❖ Chart preparation on different types of power take off

**OVER VIEW OF THE UNIT 4.2****DECK EQUIPMENTS AND FISHING ACCESSORIES**

Fishing accessories and deck equipment covers the machinery which are used exclusively for fishing purposes. These machinery includes mechanical trawl winch, line hauler, power block, gurdy, gallows, pulleys etc.

<b>UNIT NO. 4.2 DECK EQUIPMENTS AND FISHING ACCESSORIES</b>
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<b>PRERIODS 40</b>
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<b>Ideas / concepts / skills</b>	<b>Learning outcomes</b>	<b>Suggested activities</b>	<b>Assessment</b>
Deck Equipments and fishing Accessories- Mechanical Trawl winch	Servicing of Mechanical Trawl winch	Demonstration, Multimedia presentation and General discussion- Mechanical Trawl winch	Assignment , Activity log, chart preparation
Deck Equipments and fishing Accessories- Line Hauler, Power block (open and closed) and Net drum	Familiarization with Line Hauler, Power block (open and closed) and Net drum	Description and explanation of Line Hauler, Power block (open and closed) and Net drum	Quiz and Viva
Fishing Accessories- Gallows, Mast and Derrick and pulleys	Familiarization with Gallows, Mast and Derrick and pulleys	Description and explanation of Gallows, Mast and Derrick and pulleys.	Assignment.

## **ADDITIONAL INFORMATION**

### **ASSESMENT ACTIVITIES**

- 18) Class room test
- 19) Assignment
- 20) Flow chart
- 21) Seminar
- 22) Group discussion**

## PORTFOLIO

- ❖ Activity log and seminar report on winches
- ❖ charts and seminar report on fishing accessories
- ❖ Practical Activity log- winch
- ❖ **Chart preparation on deck equipments**

### OVER VIEW OF THE UNIT 4.3

#### NAVIGATION AIDS

Besides engine side, the deck department plays an equal role in navigation as well as manoeuvring. This is accomplished by a lot of navigation equipment, which assists the officer for a safe and efficient journey. The unit covers a detailed study and use of automatic identification system (AIS), SONAR, RADAR, etc.

<b>UNIT NO. 4.3</b>		<b>PRERIODS 40</b>	
<b>Ideas / concepts / skills</b>	<b>Learning outcomes</b>	<b>Suggested activities</b>	<b>Assessment</b>
Navigation aids	Familiarisation with GPS, Gyroscope, AIS, VHF Radio, RADAR, Ultra sonic devices ( Fadho meter, SONAR, Fish finder), Magnetic compass and Gyro compass	Demonstration, multi media presentation , general discussion with GPS, Gyroscope, AIS, VHF Radio, RADAR, Ultra sonic devices ( Fadho meter, SONAR, Fish finder), Magnetic compass and Gyro compass	Activity log

## ADDITIONAL INFORMATION

### ASSESSMENT ACTIVITIES

- 23) Class room test
- 24) Assignment
- 25) Flow chart
- 26) Seminar
- 27) Group discussion

### PORTFOLIO

- ❖ Seminar report on AIS
- ❖ charts and seminar report on navigation aids
- ❖ seminar on different types of compasses

## OVER VIEW OF THE UNIT 4.4 LIFE SAVING EQUIPMENTS

Onboard ship, the most importance is given for the safety of the crew. Lifesaving appliances are aids or appliances required in an emergency. Lifesaving appliances such as life boat, life raft, life buoy, life jacket are discussed in detail.

UNIT NO. 4.4 EQUIPMENTS		LIFE SAVING	PRERIODS 40
Ideas / concepts / skills	Learning outcomes	Suggested activities	Assessment
Life saving Equipments	Familiarization with Life saving Equipments such as Life raft, Life bouy, Life Jacket and Life Boat	Explanation and Multimedia presentation of as Life raft, Life bouy, Life Jacket and Life Boat	Assignment and Identification test

## **DETAILING OF THE CONCEPTS**

### **4.4.1 LIFE SAVING EQUIPMENTS**

#### **4.4.1.1 Life raft**

A life raft is a small inflatable boat carried for emergency evacuation in the event of a disaster aboard a ship. Inflatable life rafts may be equipped with auto-inflation (carbon dioxide or nitrogen) canisters or mechanical pumps. A quick release and pressure release mechanism is fitted on ships so that the canister or pump automatically inflates the life raft, and the life raft breaks free of the sinking vessel. Commercial aircraft are also required to carry auto-inflating life rafts in case of an emergency water landing; offshore oil platforms also have life rafts.

#### **4.4.1.2 Lifebuoy**

A lifebuoy is a life saving buoy designed to be thrown to a person in the water, to provide buoyancy and prevent drowning. Some modern lifebuoys are fitted with one or more seawater-activated lights, to aid rescue at night.

The lifebuoy is usually ring-or horseshoe-shaped and has a connecting line allowing the casualty to be pulled to the rescuer in a boat. They are carried by ships and are also located beside bodies of water that have the depth or potential to drown someone.

#### **4.4.1.3 Life jacket**

A life jacket is a piece of equipment designed to assist a wearer to keep afloat in water. The wearer may be either conscious or unconscious. Life jackets are available in different sizes to accommodate variations in body weight. Designs differ depending on wearing convenience and level of protection..

#### **4.4.1.4 Lifeboat**

Generally each merchant ship has one lifeboat fitted on the port side and one on the starboard side, so that a lifeboat is always available even if the ship is listing to one side. Ship-launched lifeboats are lowered from davits on a ship's deck, and are hard to sink in normal circumstances. The cover serves as protection from sun, wind and rain, can be used to collect rainwater, and is normally made of a reflective or fluorescent material that is highly visible. Lifeboats have oars, flares and mirrors for signaling, first aid supplies, and food and water for several days. Some lifeboats are more capably equipped to permit self-rescue, with supplies such as a radio, an engine and sail, heater, navigational equipment, solar water stills, rainwater catchments and fishing equipment.

## **DETAILING OF PRACTICALS**

- **Identification of Life raft, Life bouy, Life Jacket and Life Boat.**

Life raft, Life bouy, Life Jacket and Life Boat are identified during the OJT or Field visit in a marine vessel.

## **ADDITIONAL INFORMATION**

### **ASSESMENT ACTIVITIES**

28) Class room test

29) Assignment

30) Flow chart

31) Seminar

32) Group discussion

### **PORTFOLIO**

❖ charts and seminar report on life saving appliances

## **OVER VIEW OF THE UNIT 4.5**

### **WELDING AND WELDING DEFECTS**

Riveting of metal plates was widely used in construction of ships. The introduction of welding brought drastic change in construction of ship. New welding technologies ensured highly water tight joints and more strength. The different types of welding methods such as plastic welding (Resistance, Gas, Thermit and Forging) and Fusion welding (Arc, Gas and Thermit). The topics Under water welding and its two types such as Wet (Metal Arc)and Dry( Flux cored arc), different types of arc Welding Methods- Metal Arc, MIG, TIG and Submerged arc welding, Gas Welding (Oxy-Acetylene) etc. are discussed in detail. The welding defects such as undercut, porosity, slag inclusion, spatter and arc strike which may occur while doing welding are covered.

<b>UNIT No. 4.5 WELDING AND WELDING DEFECTS</b>	<b>PRERIODS 40</b>
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<b>Ideas / concepts / skills</b>	<b>Learning outcomes</b>	<b>Suggested activities</b>	<b>Assessment</b>
Welding Methods- different types of welding	Differentiates between different types of welding methods such as Plastic welding (Resistance, Gas, Thermit and Forging) and Fusion welding (Arc, Gas and Thermit)	Explanation and Multimedia presentation of different types of welding methods such as Plastic welding (Resistance, Gas, Thermit and Forging) and Fusion welding (Arc, Gas and Thermit)	Assignment and Chart Preparation
Welding Methods- Gas Welding (Oxy-Acetylene)	Explain Welding Methods-Gas Welding (Oxy-Acetylene)	Explanation and Multimedia presentation of Gas Welding (Oxy-Acetylene)	Assignment and Chart Preparation
Different types of Arc welding	Explain different types of arc Welding Methods- Metal Arc, MIG, TIG and Submerged arc welding	Explanation and Multimedia presentation of arc Welding Methods- Metal Arc, MIG, TIG and Submerged arc welding	Assignment and quiz
Hands on Experience on Metal arc Welding	Acquire Skill to do Metal arc Welding	Hands on experience on Metal arc Welding	Practical Activity Log.
Under water welding and its two types such as Wet (Metal Arc)and Dry ( Flux cored arc)	Explains Under water welding and its two types such as Wet (Metal Arc)and Dry( Flux cored arc)	Demonstration and general discussion on Under water welding and its two types such as Wet (Metal Arc)and Dry(Wet cored arc)	Activity log

Welding defects	Explains the welding defects such as undercut, porosity, slag inclusion, spatter and arc strike	Multimedia presentation, demonstration, general discussion about undercut, porosity, slag inclusion, spatter and arc strike	Activity log
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## ADDITIONAL INFORMATION

### ASSESSMENT ACTIVITIES

- Assignment
- Flow chart
- Seminar
- Group discussion

### PORTFOLIO

- Chart preparation and seminar on different types of arc welding processes
- Practical Activity log on vertical welding in butt joint
- Practical Activity log on preparation of 'v' groove in work piece
- Chart preparation and seminar on different weld defects

## OVER VIEW OF THE UNIT 4.6

### NON DESTRUCTIVE TESTING

As a part of inspection and certification a lot of tests are done on weld joints. These tests include destructive and non-destructive tests. The different types of non-destructive testing such as visual inspection, liquid penetration test, magnetic particle test, radiographic test and ultrasonic test are explained in detail in this unit.

<b>UNIT NO. 4.6 NON DESTRUCTIVE TESTING</b>			<b>PRERIODS 40</b>
<b>Ideas / concepts / skills</b>	<b>Learning outcomes</b>	<b>Suggested activities</b>	<b>Assessment</b>

Types of weld test	Explains welding test like destructive and non destructive	General discussion on welding test like destructive and non destructive	Activity log
Different types of non destructive testing	Explains the different types of non destructive testing such as visual inspection, liquid penetration test, magnetic particle test, radiographic test and ultra sonic test	General discussion, multimedia presentation and demonstration of non destructive testing such as visual inspection, liquid penetration test, magnetic particle test, radiographic test and ultra sonic test	Activity log, Practical Activity Log.
Visual Inspection test and liquid penetration test	Acquire skill to do Visual Inspection test and liquid penetration test	Demonstration, hands on experience on Visual Inspection test and liquid penetration test	Practical activity log

## **ADDITIONAL INFORMATION**

### **ASSESMENT ACTIVITIES**

- Assignment
- Flow chart
- Seminar
- Group discussion

### **PORTFOLIO**

- Chart preparation and seminar on non destructive tests
- Practical Activity log on Penetrant Testing

### **EXTENDED ACTIVITIES**

### **LIST OF PRACTICALS**



- Dismantling and assembling of Centrifugal pump.
- Dismantling and assembling of Reciprocating pump.
- Dismantling and assembling of Gear pump.
- Dismantling and assembling of Hand Pump.
- Dismantling and assembling of Reciprocating compressor (Single stage and Multistage).
- Dismantling and assembling of Centrifugal compressor.
- Dismantling and assembling of Mechanical Trawl winch.
- Identification of navigation aids commonly used in vessels GPS, Gyroscope, AIS, VHF Radio, RADAR, Ultra sonic devices (Fadho meter, SONAR, Fish finder), Magnetic compass and Gyro compass.
- Identification of Life raft, Life bouy, Life Jacket and Life Boat.
  
- **Hands on experience on Shielded Metal Arc Welding (SMAW).**
- Identification of welding defects such as undercut, porosity, spatter, arc strike, excessive penetration, cracking, blow holes
- Hands on experience on Visual Inspection test.
- Hands on experience on liquid penetration test.
- Hands on experience on magnetic particle test
- Hands on experience on radiographic film inspection.
- Hands on experience on ultra sonic test.

### **ON-THE-JOB TRAINING**

During the course of study, on the job training (OJT) is arranged to

improve the skill and efficiency of the learner. This education system motivates the attitude towards self –employment through Production Cum Service Training

Centers. (PSTC)