

## ABOUT THE COURSE

The course "Marine technology" helps one to open the door to a wonderful career that has endless opportunities. The technical knowledge and hands on experience helps the students to begin work as entry level technicians in boat yards and marine vessels. Through the course, students gain hands on experience in Marine engine mechanism, diagnosis and repairs of inboard and outboard engines and marine refrigeration. He will also be proficient in workshop safety, basic workshop drawing, workshop practices, deck and engine room equipments, marine refrigeration and modern navigational equipments.

Kerala shares 10% of the total coastal length of the country. Besides this, Kerala has a highly networked water transportation system, a good numbers of harbors, boats, ships and cargo carriers. Kerala is one of the leading states which exports sea foods.

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 vast majority of the population as well as sustaining the economy with the foreign exchange earned from the export of various fisheries products. The vibrancy of the sector can be visualized by the 11-fold increase that India achieved in fish production in just six decades.

Among the maritime status of India, Kerala 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 rectify 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 after completion, he gets a skill certificate in 'Marine Diesel Engine Servicing'.

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

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;

- Deck Cadets
- Diploma in Marine Electrical and Electronic Engineering
- Diploma in Marine Engineer Conversion Course (GEC)
- Diploma in Merchant Navy
- Diploma in Nautical Science
- General Purpose Rating (GP Rating)
- Marine diesel mechanic
- Global Maritime Distress and Safety System (GMDSS)

The prominent institutes one can join further studies are;

- CIFNET
- Indian Institute of Maritime Studies
- 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 etc

## JOB ROLES

<b>Govt./Semi Govt. Sector</b>	<b>Private Sector</b>	<b>Self Employment</b>
<ul style="list-style-type: none"> <li>• VHSE laboratory technical assistant</li> <li>• Boat mechanic in water transportation department</li> <li>• Engine mechanic in KSINC</li> <li>• Workshop technician in KSRTC</li> <li>• Out Board Motor technician in Matsyafed</li> <li>• In Board Motor technician Matsyafed</li> <li>• Diesel mechanic in Govt. workshops</li> <li>• Refrigeration technician in ships/boats</li> <li>• Refrigeration technician in dairies</li> <li>• Refrigeration technician sea food processing plants</li> <li>• Refrigeration technician in ice plants</li> </ul>	<ul style="list-style-type: none"> <li>• In Board Motor technician</li> <li>• Out Board Motor technician</li> <li>• Refrigeration technician in ice plants</li> <li>• Refrigeration technician in boats and ships</li> <li>• Refrigeration technician in dairies</li> <li>• Refrigeration technician in fish processing plants.</li> <li>• Diesel engine mechanic</li> <li>• Battery technician</li> </ul>	<ul style="list-style-type: none"> <li>• Out Board motor service centre</li> <li>• Refrigeration servicing</li> <li>• In Board Motor service provider</li> <li>• Battery service center</li> <li>• Diesel engine workshop</li> </ul>

## SUBJECT APPROACH

### Introduction

Vocational education, a dream of Mahatma Gandhi, was realized by the central government to address the problem of massive unemployment among the youth in our country. Among the different vocational courses, fisheries courses have great relevance. Being a country with a vast coastline of about 8000 Km, fishing and allied industries play an important role, in providing employment to a vast 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, Kerala holds a remarkable position in fisheries sector.

In our modern life mechanization gives us a better way to cope with different situations. So in the fishing industry also traditional crafts are charged to mechanized crafts. That means we are using marine engines in our vessels. Thus we are able to do fishing efficiently and with less effort. But for the proper operation of marine engines one must know it and do its maintenance properly. "Marine Technology" enables a leaner to develop skills in different sectors of marine engineering.

### Aims

- To develop skill to do maintenance, repair, servicing, diagnose and fault finding in different IBM and OBM Engines
- To impart knowledge and training on various marine engines and maintenance techniques
- To create and develop confidence and skills for initiatives in self employment in fisheries sector.

### EDUCATIONAL APPROACH

The study conducted by UNESCO and SCERT on the various defects of teacher centered education has evolved a new idea of student centered, skill centered and activity oriented educational approach. According to this approach the learning activities should pave way for the construction of knowledge.

Selecting the learning activities one should take into account the nature, mental ability and skills of students. This approach should explore activities like problem solving, skill developing and self studying. It is important that the new educational approach should create opportunities for Individual learning, co-learning and group learning. For this we can adopt different strategies and techniques.

### **Discovery learning**

The teacher has to create an atmosphere that encourages the learner to discover ideas and facts of his own. For example the teacher can assign the students to identify and classify different marine engine parts. This gives an opportunity for the learner to observe the different marine engine parts.

### **Co-operative learning**

In this method the learners learn by helping each other. The negotiations among peers take place here. For example, if we want to take an awareness among the students about different starting methods, the students can be divided into different groups and a group discussion on the topic can be conducted. The ideas evolved from the discussion can be consolidated and presented in the class by one person from each group.

### **Collaborative learning**

The two important aspects of this method of learning are sharing of ideas and negotiation among the learners. Suppose we want to deal with different filters used in engine, here also they can be divided into groups and the teacher can ask them to collect different types of filters and their working and uses. Their observation can be consolidated and presented in the class.

### **Socio- cultural related learning**

This method of learning pertains to social and cultural aspects of the society. For example, to study the problems of OBM handling, conduct an informal interview with the fishermen to understand the problems, find out solutions and prepare a report.

### **ICT possibilities**

Vocational education is practical oriented, even though time will be a factor for learning process. Hence the curriculum objectives can be achieved by making use of new technologies like ICT enabled education. Making use of multimedia, CDs are helpful in transaction processes inside the classroom as the learner understands more from what he sees than hear.

### **Learning situations**

Marine engine workshops, OBM workshops, Marine refrigeration plants are the most suitable areas for skill development. Students can make use of the hands on experience and knowledge of industrial experts, which are more effective than the classroom situation for the learning process.

## Resources

The 590 Km of Kerala coastline provides good marine fish resources, water transports and an established marine engineering industry. Other than the school level infrastructure and human resources, vocational education requires more practical experience from the industry.

## OJT/Field visit

More than the classroom activities OJT/Field visits provide the needed practical exposure for the students in an applied field like marine engines. In Kerala all the VHSE schools which offer Marine Technology courses have industrial linkages and they are situated near coastal areas. The students can utilize the facilities of institutions like FSI, MATSYAFED, KSINC, CIFNET etc.

## Inclusiveness

Gifted students will avail extra knowledge and skill which will help them for their higher studies. These extra knowledge and skill may be given through class room interactions, practical works and during OJT. IED students will get top most care from teachers for their skill development, practical works and during their OJT also. This may be done through repeated explanations and through repeated skill development processes.

## SYLLABUS

### Module I: MARINE WORKSHOP PRACTICE

#### 1.1 OPERATIONAL SAFETY AND PRECAUTIONS.

Introduction-Basic safety - Need for safety in Marine workshop.

Safety or general precautions to be observed in the floor shop

Study of personal protective equipments used in marine plant

#### 1.2 BASIC WORKSHOP DRAWING.

Fundamentals of workshop drawing (lettering, numbering, dimensions)

Projection of points - Projection straight line -Projection plane

Orthographic projection objects Isometric and sectional views of solids.

#### 1.3 MARINE FITTING WORKSHOP

Measuring Tools - Steel rule, try square, vernier calipers, micrometer (inside & outside), transfer calipers ( inside & outside), feeler gauge.

Marking tools - V block, surface plate, scribe, dot , prick centre and hole punch.

Cutting tools -Theory regarding files, nomenclature, types. Care and handling of file and methods of filing Hack saw -Nomenclature of hack saw, types of hack saw frame ( fixed frame and adjustable frame), types blades. Hack saw cutting practice ( MS rod) Chisel, types of chisel - its uses.

Striking tools- Nomenclature, different types and its uses - handling.

Holding devices - bench and pipe vice -Other holding devices - combination plier, nose plier, cutting plier and circlip plier- handling, V cutting square cutting on MS flat as per drawing.

General purpose tools- screw driver, spanner- double end open mouth and ring, tubular socket or box Combination, adjustable spanners and handling. Thread cutting tools - Taps and dies.

Special purpose tools- Piston ring compressor and extractor, torque wrench, pipe wrench, bearing extractor or puller, magneto puller.

#### 1.4 INTRODUCTION OF MARINE ENGINES

Introduction - Marine engines

Thermodynamics system - Definitions of thermodynamic system, open closed and isolated Thermodynamic properties - Definition of thermodynamic properties (Intensive and extensive) - temperature, pressure, volume, entropy, heat, density, work, energy, enthalpy

Thermodynamic process - isobaric, isochoric, isothermal, adiabatic and polytropic.

Thermodynamic cycle - Otto, Diesel cycle

IC engines - Fundamentals of IC engine- heat engine classification - external combustion, internal combustion engine-based on ignition, stroke and number of cylinder. IC engine terminology - TDC, BDC, Stroke length, Swept volume, Clearance volume, Total cylinder volume, Compression ratio, engine power- IHP,BHP,FHP, and Mechanical efficiency.

## Module 2: OUT BOARD MOTOR SERVICING

### 2.1 SPARK IGNITION ENGINE

SI engine description - working of 2 stroke SI engines, working of 4 stroke SI engines. SI engine parts - cylinder block- cylinder head- Piston- connecting rod-crank shaft - crank case-oil sump- piston pin -cam shaft- valves- flywheel - Timing gear Classification of SI engines - Differentiates between 2 stroke and 4 stroke engine parts

### 2.2 OUT BOARD MOTOR

Out Board Motor - General description -its external parts

OBM installation

OBM fuel system - functions - parts(carburetor, fuel tank, fuel lines, fuel pump, reed valve and hand squeeze pump) - its working - Carburetor and fuel pump servicing

OBM ignition system - function - parts (Stator coils, rotor, CDI unit, ignition coils, ignition switch and spark plug ) - its working

OBM cooling system - function - parts (strainer, cooling water pipe lines, and pump) -its working

OBM lubrication system -Petrol system - 4 stroke OBM pump lubrication system - function - parts (oil filter, strainer, oil lines and pumps) - its working - overhauling of lube oil pumps- lube oil changing

OBM transmission system - function - parts (bevel gears, dog clutch, clutch rod, gear shifter, push rod, transmission shaft) - its working- gear oil changing - Overhauling of OBM transmission system

### 2.4 OUT BOARD MOTOR MAINTENANCE

OBM Maintenance - Need for OBM maintenance

Type of maintenance - Daily, periodical, breakdown

OBM Overhauling -skill for decarburization, measure cylinder wear and its rectification (cylinder reboring), connecting rod bend checking, crankshaft run out measurement, Compression Pressure Checking & valve lapping.

## 2.5 OUT BOARD MOTOR FAULT DIAGNOSIS AND RECTIFICATION

Related to engine starting 1.Failure of the starter 2.Failure of ignition system 3. Failure of the fuel system 4. Engine struck due to (a. piston pin circlip, jumps out, b. cooling system failure, c. lubrication system failure and d. main bearing seizure)

Engine starts but stops suddenly a. Fuel system failure b. Ignition system failure

Engine starts but irregular idling speed a. CDI unit failure b. faulty carburetor c. valve clearance not set correctly/ valve leakage for 4stroke engines only

Engine starting but does not achieve speed - the causes and remedies of a. fuel system failure b. Ignition system failure

Troubles related to cooling system - Engine over heating a. cooling pump not working b. strainer block c. cooling water passage block or leakage

Problems related to combustion a. Black smoke b. White smoke c. Blue smoke ( 4 stroke engines only) c. Low mileage d. Knocking

Related to transmission system - a. gear shifting hard b. gear shifting not possible c. Humming noise

## LEARNING OUTCOMES OF THE COURSE

After the completion of first two modules of the course the learner will be able to;

- 1.1.1. List the importance of safety in marine filed.
- 1.1.2. List the different aspects and importance of safety precautions in the floor shop.
- 1.1.3. Identify the personal protective equipments and write its use.
- 1.2.1. Draw the dimensions, letters and numbers on a drawing sheet by using mini drafter.
- 1.2.2. Create a drawing sheet of projections of points.
- 1.2.3. Create drawing sheets of projections of straight lines in different aspects (line parallel to both HP and VP, line inclined to HP and parallel VP, line inclined to VP and parallel to HP, line inclined to both HP and VP.).
- 1.2.4. Create drawing sheets of projections of planes in different conditions (plane parallel to both HP and VP, plane inclined to HP and parallel VP, plane inclined to VP and parallel to HP, plane inclined to both HP and VP)
- 1.2.5. Make drawing sheets of isometric and sectional views of solids.
- 1.3.1. Identify and handle the various measuring tools, handle, measure and taking dimensions using the Steel rule, try square, vernier calipers, micrometer (inside & outside), transfer calipers (inside & outside), feeler gauge and tabulate dimensions.
- 1.3.2. Mark using V block, surface plate, punch and scriber on work piece.
- 1.3.3. Identify the parts of files and classify the files.
- 1.3.4. Make models by applying the different filing methods (straight, cross & draw filing) and care the files.
- 1.3.5. List and explain the parts of hack saw and different hack saw frames.
- 1.3.6. Get hands on experience of using hack saw.
- 1.3.7. Differentiate the chisels, find chisel angles and apply chisels on work pieces.
- 1.3.8. Identify the parts of hammer, classify it and describe the working of hammers.

- 1.3.9. Identify the parts bench vice and pipe vice and its handling.
- 1.3.10. Identify other holding devices such as nose plier, cutting plier, circlip plier, combination plier and describe its use.
- 1.3.11. Categorize various general purpose tools such as screw driver, spanners (double end open mouth, double end ring, tubular, socket or box, combination and adjustable spanners) and handle these tools.
- 1.3.12. Identify the parts of tap and dies and make threads on work pieces.
- 1.3.13. Classify and handle the special purpose tools such as piston ring compressor, piston ring extractor, torque wrench, pipe wrench, bearing puller / extractor and magneto puller.
- 1.4.1. Discuss various marine crafts and engines.
- 1.4.2. Explain thermodynamic systems and its types.
- 1.4.3. Write thermodynamic properties.
- 1.4.4. Categorise different thermodynamic process- isobaric, isochoric, isothermal, adiabatic and polytropic.
- 1.4.5. Describe thermodynamic cycles behind the working of internal combustion (IC) engines.
- 1.4.6. Classify different types of IC engines.
- 1.4.7. Write the engine terminology and skill to calculate the engine associated volumes (cylinder, clearance, total etc) and compression ratio.
- 1.4.8. Describe and classify the IHP, BHP, FHP and mechanical efficiency.
- 2.1.1. Explain working of 2 - stroke SI engines.
- 2.1.2. Explain working of 4 stroke SI engines.
- 2.1.3. Identify SI engine parts such as cylinder- cylinder block- cylinder head- Piston-connecting rod-crank shaft - crank case- oil sump- piston pin -Cam shaft- valves- flywheel - Timing gears.
- 2.1.4. Differentiate 2 stroke and 4 stroke engine parts.
- 2.2.1. Explain OBM and identify its external parts.
- 2.2.2. Get hands on experience with OBM installation.
- 2.2.3. Identify and explain OBM fuel system parts such as carburetor, fuel tank, fuel lines, fuel pump, reed valve and hand squeeze pump.
- 2.2.4. Get hands on experience on carburetor servicing and fuel pump servicing.
- 2.2.5. Identify ignition system and its parts (Stator coils, rotor, CDI unit, ignition coils, ignition switch and spark plug).

- 2.2.6. Describe OBM cooling system, identify cooling system parts such as strainer, cooling water pipe lines, and pump.
- 2.2.7. Explain petroil lube system.
- 2.2.8. Describe working of 4 stroke OBM pump lube system, identify various parts of system.
- 2.2.9. Get hands on experience on lube oil changing and lube pumpover hauling.
- 2.2.10. Explain transmission system and identify its parts.
- 2.2.11. Get hands on experience on overhauling transmission system and gear oil changing.
- 2.3.1. Explain the importance of OBM maintenance.
- 2.3.2. Take different types of maintenance works (daily, scheduled, preventive and breakdown) works on OBM.
- 2.3.3. Get skill of engine overhauling, decarbonization, measure cylinderwear and its rectification (cylinder reboring), connecting rod bendchecking, crankshaft runout measurement, Compression Pressure Checking & valve lapping.
- 2.4.1. Rectify the faults related to starting because of starter failure.
- 2.4.2. Diagnose the fault related to starting due to failure of ignition system and rectify it.
- 2.4.3. Rectify the faults related to starting due to failure of fuel system.
- 2.4.4. Diagnose the faults related to starting engine struck due to (a. piston pin circlip, jumps out, b. cooling system failure, c. lubrication system failure and d. main bearing seizure) and rectify it.
- 2.4.5. Identify the faults related to fuel and ignition systems and rectify it.
- 2.4.6. Rectify faults related to irregular idling speed.
- 2.4.7. Rectify faults related to engine speed.
- 2.4.8. Identify complaints related to cooling systems and rectify it.
- 2.4.9. Diagnose causes of excessive smoke as a. black, white and blue smoke (4 stroke only) and rectify.
- 2.4.10. Get skill of dismantle and rectify the transmission system troubles as a. gear shifting hard and b. gear shifting not possible.

## SCHEME OF WORK

### Module I :MARINE WORKSHOP PRACTICE

Sl. No	Month	Name of Units	Periods
1	June	Introduction-Basic safety - Need for safety in Marine workshop, Safety or general precautions to be observed in the floor shop, Study of personal protective equipments used in marine plant	5
2	June	Fundamentals of workshop drawing (lettering, numbering , dimensions )	10
3	June	Projection of Points, Projection of straight line.	40
4	July	Projection of planes,Orthographic projection objects Isometric and sectional views of solids	50
5	July/August	Measuring Tools, Marking Tools	15
6	August/ September	Cutting Tools, Striking tools, Holding devices	55
7	September	Other holding devices, General purpose tools.	55
8	September/ October	Special purpose tools	55
9	October	Introduction - Marine engines	55
		<b>Total Periods</b>	<b>340</b>

## SCHEME OF WORK

### Module II :OUT BOARD MOTOR SERVICING

Sl. No	Month	Name of Units	Periods
1	November	SI engine description - working of 2 stroke SI engines, working of 4 stroke SI engines. SI engine parts - cylinder block-cylinder head- Piston-connecting rod - crank shaft - crank case-oil sump- piston pin -cam shaft- valves-flywheel - Timing gear Classification of SI engines - Difference between 2 stroke and 4 stroke engine parts	50
2	November/ December	Out Board Motor - General description - its external parts OBM installation OBM fuel system - functions - parts(carburetor, fuel tank, fuel lines, fuel pump, reed valve and hand squeeze pump) - its working - Carburetor and fuel pump servicing	25
3	December	OBM ignition system - function - parts (Stator coils, rotor, CDI unit, ignition coils, ignition switch and spark plug) - its working OBM cooling system - function - parts (strainer, cooling water pipe lines, and pump) - its working OBM lubrication system - Petroil 4 stroke OBM pump lube system - function - parts (oil filter, strainer, oil lines and pumps) - its working-overhauling of lube oil pumps - lube oil changing OBM transmission system - function - parts (bevel gears, dog clutch, clutch rod, gear shifter, push rod, transmission shaft) - its working-Overhauling of OBM transmission system	65

4	January	OBM Maintenance - Need for OBM maintenance Type of maintenance - Daily, periodical, breakdown OBM Overhauling -skill for decarburization, measure cylinder wear and its rectification (cylinder reboring)	68
5	February	Connecting rod bend checking, crankshaft run out measurement, Compression Pressure Checking & valve lapping.	32
6	February	Related to engine starting 1. Failure of the starter 2. Failure of ignition system 3. Failure of the fuel system 4. Engine struck due to (a. piston pin circlip, jumps out, b. cooling system failure, c. lubrication system failure and d. main bearing seizure) Engine starts but stops suddenly a. Fuel system failure b. Ignition system failure Engine starts but irregular idling speed a. CDI unit failure b. faulty carburetor c. valve clearance not set correctly/ valve leakage for 4stroke engines only	36
7	March	Engine starting but does not achieve speed - the causes and remedies of a. fuel system failure b. Ignition system failure Troubles related to cooling system - Engine over heating a. cooling pump not working b. strainer block c. cooling water passage block or leakage Problems related to combustion a. Black smoke b. White smoke c. Blue smoke ( 4 stroke engines only) c. Low mileage d. Knocking Related to transmission system - a. gear shifting hard b. gear shifting not possible c. Humming noise	64
<b>Total Periods</b>			<b>340</b>

## COURSE STRUCTURE

This course will consist of 4 modules such as :-

MODULE 1	MARINE WORKSHOP PRACTICE
MODULE 2	OUT BOARD MOTOR SERVICING
MODULE 3	MARINE DIESEL ENGINE SERVICING
MODULE 4	MARINE VESSEL EQUIPMENT SERVICING

## CLASSROOM ACTIVITIES

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

## PRACTICAL ACTIVITIES

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

## ON THE JOB TRAINING

Even though a school has a very well equipped work shop, it is necessary for each student to get familiarized with the latest trends and technologies in the field.

OJT provides latest skills in the field, also provides training with highly skilled technicians on latest machinery, that makes new work culture.

OJT for Marine Technology students can be provided with central govt. institutes like CIFNET and FSI. It can also be done with state govt. institutes like MATSYAFED, KSINC and KSWTC.

OJT can be done in private institutes like marine engine workshops, OBM service center, harbors and refrigeration plants.

Each student must undergo an OJT programme of one month, during which he will get a hands on experience on maintenance of OBM, IBM and refrigeration system. The student also practises general workshop activities. This imparts confidence and latest technological skills to every student. The one month OJT programme can be done for a period of two weeks per year.

## CERTIFICATION OF SKILLS

Skill certificate in

- **MARINE WORKSHOP PRACTICE**
- **OUT BOARD MOTOR SERVICING**
- **MARINE DIESEL ENGINE SERVICING**
- **MARINE VESSEL EQUIPMENT SERVICING**

## OVER VIEW OF THE MODULE I

### Module 1 MARINE WORKSHOP PRACTICE

This module enables the learner to get familiar with general workshop safety rules, equipments, and precautions taken before and after the workshop floor as well as engine room. Learner gets hands on experience on various marine work shop tools, its handling and care. They will be able to draw and read workshop drawing. Introduction to marine engines deal with basics of IC engines and its thermodynamics.

#### List of Expected skills

1. Work safety in workshops
2. Draw and read basic workshop drawing.
3. Handling of workshop tools and its operations.
4. To make fitting model on MS flat.
5. Understand basics of marine Internal combustion engine.

### MODULE 1      MARINE WORKSHOP PRACTICE      Period 340

1.1	Operational safety and precautions	5
1.2	Basic workshop drawing	100
1.3	Marine fitting workshop	180
1.4	Introduction to Marine engines	55
	TOTAL PERIODS	340

MODULE : 1 MARINE WORKSHOP PRACTICE		UNIT NO. 1.1 OPERATIONAL SAFETY AND PRECAUTIONS (5 periods)	
Ideas/Concepts/Skill	Learning Outcomes	Suggested Activities	Assessment
<p>Introduction- basic safety - Need for safety in Marine workshop.</p> <p>Safety or general precautions to be observed in the floor shop - Identification of safety equipments and devices- protection apron - fire extinguisher- gloves-goggle</p> <p>Study of personal protective equipments used in marine plant</p>	<p>1.1.1 List the importance of safety in marine field.</p> <p>1.1.2 List the different aspects and importance of safety precautions in the floor shop.</p> <p>1.1.3 Identify the personal protective equipments and write its use.</p>	<p>General discussion about safety needs and multimedia demonstration of safety needs</p> <p>Group discussion for safety precautions and demonstration of safety equipments and devices- protection apron - fire extinguisher- gloves-goggle. Make charts and posters about safety in the plant.</p> <p>General discussion about personal protective equipments used in marine workshop. Demonstration of various safety equipments, multimedia presentation, visit to the nearest marine workshop, prepare the photo album of these products</p>	<p>Activity log.</p> <p>Activity log, chart and poster showing safety.</p> <p>Study notes , photo album preparation , visit report</p>

MODULE : 1 MARINE WORKSHOP PRACTICE		UNIT NO. 1.2		BASIC WORKSHOP DRAWING (100 periods)	
Ideas/Concepts/Skill	Learning Outcomes	Suggested Activities	Assessment		
<p>Fundamentals of workshop drawing (lettering, numbering, dimensions)</p> <p>Projection of points - Projection of points in four quadrants</p> <p>Projection straight line (line parallel to both HP and VP, line inclined to HP and parallel VP, line inclined to VP and parallel to HP, in inclined to both HP and VP.)</p>	<p>1.2.1 Draw the dimensions, letters and numbers by using drafter in a drawing sheet by using mini drafter.</p> <p>1.2.2 Create a drawing sheet of projections of points.</p> <p>1.2.3 Create drawing sheets of projections of straight lines in different aspects (line parallel to both HP and VP, line inclined to HP and parallel VP, line inclined to VP and parallel to HP, line inclined to both HP and VP.)</p>	<p>General discussion about how to prepare an engineering drawing sheet. Demonstration of lettering, numbering and dimensioning in the drawing sheet. General discussion and demonstration about the orthographic projections of points. General discussion and Preparing of drawing having projection of straight line (line parallel to both HP and VP, line inclined to HP and parallel VP, line inclined to VP and parallel to HP, line inclined to both HP and VP.</p>	<p>Activity log, Prepared drawing sheet.</p> <p>Activity log, prepared drawing sheet with ortho graphic projections of points.</p> <p>Activity log, prepared drawing sheet with ortho graphic projections of straight lines.</p>		
<p>Projection plane (plane parallel to both HP and VP, plane inclined to HP and parallel VP, plane inclined to VP and parallel to HP, plane inclined to both HP and VP)</p> <p>Orthographic projection objects Isometric and sectional views of solids.</p>	<p>1.2.4 Create drawing sheets of projections of planes in different conditions (plane parallel to both HP and VP, plane inclined to HP and parallel VP, plane inclined to HP, plane inclined to both HP and VP)</p> <p>1.2.5 Make drawing sheets of isometric and sectional views of solids.</p>	<p>General discussion and Preparing of drawing having projection of plane(plane parallel to both HP and VP, plane inclined to HP and parallel VP, plane inclined to VP and parallel to HP, plane inclined to both HP and VP.)</p> <p>General discussion and demonstration about the orthographic projections of isometric and sectional views, multimedia presentation.</p>	<p>Activity log, prepared drawing sheet with ortho graphic projections of planes.</p> <p>Activity log, prepared drawing sheet with ortho graphic projections of isometric, and sectional views.</p>		

MODULE : 1 MARINE WORKSHOP PRACTICE		UNIT NO. 1.3 MARINE FITTING WORKSHOP (180 periods)	
Ideas/Concepts/Skill	Learning Outcomes	Suggested Activities	Assessment
Measuring Tools - Steel rule, try square, vernier calipers, micrometer (inside & outside), transfer calipers (inside & outside), feeler gauge	1.3.1 Identify the various measuring tools ,handle , measure and taking dimensions using the Steel rule, try square, vernier calipers, micrometer (inside & outside), transfer calipers ( inside & outside), feeler gauge and tabulate dimensions.	Group discussion - Brief description regarding the tools such as Steel rule, try square, vernier caliper, micrometer (inside and outside), transfer caliper (inside and outside), chart preparations, multimedia presentation. Handling the tools and its demonstrations. Practical, chart preparations, multimedia presentation, interactive lecturing.	Activity log, evaluation of practical activity
Marking tools - V block, surface plate, scriber, dot , prick centre and hole punch	1.3.2 Mark using V block, surface plate, punch and scribe on work piece.	Group discussion - Brief description of marking tools such as scriber, dot, prick and centre punch. Handling the tools and its demonstrations. Practical, chart preparations, multimedia presentation, interactive lecturing.	Activity log, evaluation of practical activity
Cutting tools -Theory regarding files, nomenclature, types.	1.3.3 Identify the parts of files and classify the files.	chart preparations, multimedia presentation, interactive lecturing. Demonstration of file, types. Multimedia projection. Charts	Activity log, evaluation of practical activity
Care and handling of file and methods of filing	1.3.4 Make models by applying the different filing methods (straight, cross & draw filing) and care the files.	Demonstration of nomenclature ,type, care and handling of file and methods of filing, workshop practice for the filing methods, care and maintenance	Activity log, evaluation of practical activity
Hack saw -Nomenclature of hack saw, types of hack saw frame ( fixed frame and adjustable frame), types blades.	1.3.5 List and explain the parts of hack saw and different hack saw frames	Demonstration of hack saw, type, parts, blades. Group discussion, Cart preparation.	Activity log, evaluation of practical activity
Hack saw cutting practice ( MS rod)	1.3.6 Get hands on experience of using hack saw.	Demonstration of cutting in MS rod and flat.	Activity log, evaluation of practical activity

MODULE : 1 MARINE WORKSHOP PRACTICE		UNIT NO. 1.3 MARINE FITTING WORKSHOP (180 periods)	
Ideas/Concepts/Skill	Learning Outcomes	Suggested Activities	Assessment
chisel, types of chisel - its uses	1.3.7 Differentiate the chisels, find chisel angles and apply chisels on work pieces.	Brief description of chisel, type of chisel and its uses and Demonstration of different chisels, chisel angles,	Class room activity, practical activity log
striking tools Nomenclature, different types and its uses - handling	1.3.8 Identify the parts of hammer, classifies it and describe the working of hammers.	Demonstrate the hammer, its parts and method of hammering	Class room activity, practical activity log
Holding devices - bench and pipe vice	1.3.9 Identify the parts of bench vice and pipe vice and its handling. - its care and maintenance.	General discussion about bench vice, pipe vice and demonstrate parts, handling, care and maintenance.	Class room activity, practical activity log
Other holding devices -combination plier, nose plier, cutting plier and circlip plier- handling	1.3.10 Identify other holding devices such as nose plier, cutting plier, circlip plier, combination plier and describe its use.	Group discussion on nose plier, cutting plier, circlip plier, combination plier - its uses and its handling.	Class room activity, practical activity log

**MODULE : 1 MARINE WORKSHOP PRACTICE UNIT NO. 1.3 MARINE FITTING WORKSHOP (180 periods)**

<b>Ideas/Concepts/Skill</b>	<b>Learning Outcomes</b>	<b>Suggested Activities</b>	<b>Assessment</b>
<p>General purpose tools- screw driver, spanner- double end open mouth and ring, tubular socket or box combination,</p>	<p>1.3.11 Categorize various general purpose tools such as screw driver, spanners (double end open mouth, double end ring, tubular, socket or box, combination and adjustable spanners) and handle these tools.</p>	<p>Demonstration of various general purpose tools such as screw driver, spanner- double end open mouth and ring, tubular, socket or box combination, adjustable spanners. class room interaction, and work shop practice, multimedia presentation</p>	<p>Class room activity, practical activity log</p>
<p>Thread cutting tools - Taps and dies</p>	<p>1.3.12 Identify the parts of tap and dies and make threads on work pieces.</p>	<p>General discussion about taps and dies and demonstrate its functioning</p>	<p>Class room activity, practical activity log</p>
<p>Special purpose tools- Piston ring compressor and extractor, torque wrench, pipe wrench, bearing extractor or puller, magneto puller.</p>	<p>1.3.13 Classify and handle the special purpose tools such as piston ring compressor, piston ring extractor, torque wrench, pipe wrench, bearing puller / extractor and magneto puller.</p>	<p>Class room interaction about the special purpose tools such as piston ring compressor and extractor, torque wrench , pipe wrench, bearing extractor or puller, magneto puller, demonstrate and work shop practice, multimedia presentation</p>	<p>Class room activity, practical activity log</p>

MODULE : 1 MARINE WORKSHOP PRACTICE		UNIT NO. 1.4 INTRODUCTION OF MARINE ENGINES (55periods)	
Ideas/Concepts/Skill	Learning Outcomes	Suggested Activities	Assessment
Introduction - Marine engines	1.4.1 Discuss various marine crafts and engines.	Group discussion about the various types of marine engine in the world. Multimedia projection	Activity log
Thermodynamics system - Definitions of thermodynamic system, open closed and isolated	1.4.2 Explain thermodynamic system and its different types.	General discussion about definitions of thermodynamic system and its example - ( open, closed and isolated), Assignment, multimedia presentation,	Activity log, assignment
Thermodynamic properties Definition of thermodynamic properties (Intensive and extensive) - temperature, pressure, volume, entropy, heat, density, work, energy, enthalpy	1.4.3 Write thermodynamic properties.	Class room interaction about Definition of thermodynamic properties (Intensive and extensive) - temperature, pressure, volume, entropy, heat, density, work, energy, enthalpy.	Activity log
Thermodynamic process isobaric, isochoric, isothermal, adiabatic and polytropic.	1.4.4 Categorise different thermodynamic process- isobaric, isochoric, isothermal, adiabatic and polytropic.	General discussion - different thermodynamic process- isobaric, isochoric, isothermal, adiabatic and polytropic. Class room interaction, chart preparation.	Activity log and chart
Thermodynamic cycle - Otto, Diesel cycle	1.4.5 Describe thermodynamic cycles behind the working of internal combustion (IC) engines.	Basic idea about different thermodynamic systems for the working of petrol and diesel engines through class room interaction, chart preparation of cycles, seminar.	Activity log charts and seminar report.

MODULE : 1 MARINE WORKSHOP PRACTICE UNIT NO. 1.4 INTRODUCTION OF MARINE ENGINES (55periods)			
Ideas/Concepts/Skill	Learning Outcomes	Suggested Activities	Assessment
IC engines - Fundamentals of IC engine- heat engine classification -external combustion, internal combustion engine-based on ignition, stroke and number of cylinder.	1.4.6 Classify different types of IC engines.	Demonstration of different types of IC engines and class room interaction, multimedia presentation, chart preparation	Activity log, practical log, charts
IC engine terminology - TDC, BDC, stroke length, Swept volume, clearance volume, total cylinder volume, compression ratio, engine power-IHP,BHP,FHP, and mechanical efficiency	1.4.7 Write the engine terminology and skill to calculate the engine associated volumes (cylinder, clearance, total etc) and compression ratio.  1.4.8 Describe and classify the IHP, BHP, FHP and mechanical efficiency.	Demonstration of basic engine terminology- TDC, BDC, stroke length, Swept volume, clearance volume, total cylinder volume calculation of cylinder volumes, compression ratio and general discussion on its efficiencies. multimedia presentation, practical experiment for the engine measurement	Activity log, practical log, charts

## LIST OF PRACTICAL ACTIVITIES

### MODULE 1

- 1 Demonstration of safety needs
- 2 Demonstration of safety equipments and devices- protection apron - fire extinguisher- gloves-goggle
- 3 Identification of personal protective equipments
- 4 Drawing of letters, numbers and dimensions
- 5 Drawing of different projections of points,
- 6 Preparing of drawing having projection of straight line(line parallel to both HP and VP, line inclined to HP and parallel VP, line inclined to VP and parallel to HP, line inclined to both HP and VP
- 7 Preparing of drawing having projection of plane ( plane parallel to both HP and VP, plane inclined to HP and parallel VP, plane inclined to VP and parallel to HP, . plane inclined to both HP and VP
- 8 The practical experiment of measuring dimensions for the given specimen using Steel rule, try square, vernier calipers, micrometer (inside & outside), transfer calipers ( inside & outside), feeler gauge
- 9 The practical experiment for the marking on a work piece with the tools such as scribe, dot, prick and centre punch
- 10 Demonstration of nomenclature , type, care and handling of file and methods of filing, workshop practice for the filing methods , care and maintenance
- 11 Demonstration of hack saw, different types of hack saw frames and blades and cutting practice with MS rod
- 12 Demonstration of different types chisels and cutting practice
- 13 Demonstration of different types of hammers
- 14 Demonstration of bench vice pipe vice, nose pliers, cutting pliers , circlip pliers, combination pliers and its working
15. Make a V - cut and Square cut on a given MS flat as per the drawing
- 16 Demonstration of various general purpose tools such as screw driver, spanner- double end open mouth and ring, tubular, socket or box combination, adjustable spanners.
- 17 Demonstration and practice of special purpose tools such as piston ring compressor and extractor, torque wrench , pipe wrench, bearing extractor or puller, magneto puller

- 18 Demonstration of different types of IC engines.
- 19 Demonstration of basic engine terminology- TDC, BDC, stroke length, Swept volume, clearance volume, total cylinder volume calculation of cylinder volumes, compression ratio.

## OVER VIEW OF THE MODULE II

### Module 2 Out Board Motor Servicing

This module will help the learner to acquire a thorough knowledge on SI engine, its working cycles and its parts. He will get an introduction of Out Board Motor (OBM) and its advantages using in the small fishing crafts and speed boats. Learners get hands on experience on installation of OBM. The learner is enabled to repair, do maintenance, do service and rectify faults of OBM. He can also do installation of OBM in boats.

#### List of Expected skills

1. Identifies SI engine parts (2stroke and 4 stroke).
2. Describes working of 2 stroke and 4 stroke SI engines.
3. Gets hands on experience in OBM maintenance.
4. Fault diagnosis, rectification, engine overhauling and repairing of OBM.
5. Hands on experience on OBM installation.

### MODULE 2      OUT BOARD MOTOR SERVICING      Period 340

2.1	Spark Ignition Engine	50
2.2	Out Board Motor	90
2.3	Out Board Motor maintenance	100
2.4	Out Board Motor fault diagnosis and rectification	100
	<b>TOTAL PERIODS</b>	<b>340</b>

MODULE : 2 OUT BOARD MOTOR SERVICING		UNIT NO. 2.1 SPARK IGNITION ENGINE (50 periods)	
Ideas/Concepts/Skill	Learning Outcomes	Suggested Activities	Assessment
SI engine description - working of 2 - stroke SI engines.	2.1.1 Explain working of 2 - stroke SI engines.	Demonstration of SI engine working using engine cut model, Multimedia presentation	Activity log, Practical activity log
working of 4 - stroke SI engines.	2.1.2 Explain working of 4 - stroke SI engines.	Demonstration of SI engine working using engine cut model, Multimedia presentation	Activity log, Practical activity log
SI engine parts cylinder- cylinder block- cylinder head- Piston-connecting rod- crank shaft - crank case-oil sump- piston pin -Cam shaft- valves- flywheel - Timing gears	2.1.3 Identify SI engine parts such as cylinder- cylinder block- cylinder head- Piston- connecting rod-crank shaft - crank case-oil sump- piston pin -Cam shaft- valves- flywheel - Timing gears	Demonstration of SI engine parts such as cylinder- cylinder block- cylinder head- Piston-connecting rod-crank shaft - crank case-oil sump- piston pin -Cam shaft- valves- flywheel - Timing gears and conduct a group discussion, chart preparation	Activity log, Practical activity log, chart
Classification of SI engines	2.1.4 Differentiate between 2 stroke and 4 stroke engine parts.	Identification of 2 stroke and 4 stroke engine parts, categorize the 2 stroke and 4stroke engine parts.	Practical activity log.

MODULE : 2 OUT BOARD MOTOR SERVICING		UNIT NO. 2.2 OUT BOARD MOTOR (90 periods)	
Ideas/Concepts/Skill	Learning Outcomes	Suggested Activities	Assessment
Out Board Motor - General description - its external parts	2.2.1 Explain OBM and identify its external parts.	Demonstration and general discussion of OBM, its parts. Multimedia presentation.	Activity log, chart
OBM installation	2.2.2 Get hands on experience with OBM installation.	Students get hands on experience with Installing OBM on stand with transom clamps by adjusting height and tilt angle OJT, Field visit	Practical activity log, activity log , OJT report, Field visit report
OBM fuel system - functions - parts(carburetor, fuel tank, fuel lines, fuel pump, reed valve and hand squeeze pump) - its working	2.2.3 Identify and explain OBM fuel system parts such as carburetor, fuel tank, fuel lines, fuel pump, reed valve and hand squeeze pump and its working.	Identification and discussion on OBM fuel system parts such as carburetor, fuel tank, fuel lines, fuel pump, reed valve and hand squeeze pump and its working. construct flow chart about fuel system, multimedia presentation	flow chart in activity log , Practical activity log
Carburetor and fuel pump servicing	2.2.4 Get hands on experience on carburetor servicing and fuel pump servicing.	Demonstration on carburetor servicing and fuel pump servicing, OJT, Field visit	Practical activity log OJT report, Field visit report
OBM ignition system - function - parts(Stator coils, rotor, CDI unit, ignition coils, ignition switch and spark plug) - its working	2.2.5 Identify and explain ignition system and its parts (Stator coils, rotor, CDI unit, ignition coils, pulsar coil, ignition switch and spark plug).	Diagram , flow chart, general discussion on ignition system and its parts (Stator coils, rotor, CDI unit, ignition coils, ignition switch and spark plug) and its demonstration, project	flow chart, activity log, project report
OBM cooling system - function - parts (strainer, cooling water pipe lines, and pump)- its working	2.2.6 Describe OBM cooling system, identification of cooling system parts such as strainer, cooling water pipe lines, and pump.	General discussion and demonstration of OBM cooling system parts identification such as strainer, cooling water pipe lines, pump etc.	Practical activity log, activity log,

MODULE : 2 OUT BOARD MOTOR SERVICING UNIT NO. 2.2 OUT BOARD MOTOR (90 periods)			
Ideas/Concepts/Skill	Learning Outcomes	Suggested Activities	Assessment
OBM lubrication system - petroil	2.2.6 Explain petroil lube system	General discussion petroil lube system and its demonstration	Activity log
4 stroke OBM pump lube system - function - parts (oil filter, strainer, oil lines and pumps)- its working-overhauling of lube oil pumps	2.2.7 Describe working of 4 stroke OBM pump lube system, identify various parts of system.	Demonstration lube oil filter, strainer, oil lines and pumps and overhauling of lube oil pumps, multimedia presentation , seminar, chart preparation OJT, Field visit	Seminar report, activity log, chart, practical log, field visit report, OJT report
lube oil changing	2.2.8. Get hands on experience on lube oil changing and lube pump overhauling	Demonstration and general discussion of OBM, its parts. Multimedia presentation. And also demonstrate pump overhauling. OJT, Field visit	Practical activity log, activity log, OJT report, Field visit report
OBM transmission system - function - parts(bevel gears, dog clutch, clutch rod, gear shifter, push rod, transmission shaft )- its working	2.2.9 Explain transmission system and identifies its parts.	Identification of transmission system parts as bevel gears, dog clutch, clutch rod, gear shifter, push rod, gear lube oil and transmission shaft through demonstration and general discussion	Practical activity log, activity log,
Overhauling of OBM transmission system	2.2.10 Get hands on experience on overhauling of OBM transmission system	Demonstration on overhauling of OBM transmission system. OJT, Field visit	Practical activity log, activity log,OJT report, Field visit report

MODULE : 2 OUT BOARD MOTOR SERVICING UNIT NO. 2.3 OUT BOARD MOTOR MAINTENANCE (100 periods)			
Ideas/Concepts/Skill	Learning Outcomes	Suggested Activities	Assessment
OBM Maintenance - Need for OBM maintenance	2.3.1 Explain the importance of OBM maintenance.	General discussion need for OBM maintenance	Activity log
Type of maintenance - daily, periodical, breakdown	2.3.2 Take different types of maintenance works (daily, scheduled, preventive and breakdown) works on OBM.	Multimedia demonstration of daily, periodical, breakdown maintenances. Maintenance chart preparation and hands on experience. OJT, Field visit	Activity log, chart, worksheet, Practical activity log ,OJT report, Field visit report
OBM Overhauling -skill for decarburization, measure cylinder wear and its rectification (cylinder reboring), connecting rod bend checking, crankshaft run out measurement, Compression Pressure Checking & valve lapping.	2.3.3 Get skill of engine overhauling, decarburization, measure cylinder wear and its rectification (cylinder reboring), connecting rod bend checking, crankshaft run out measurement, Compression Pressure Checking & valve lapping.	General discussion and demonstration of engine overhauling, decarburization, measure cylinder wear and its rectification (cylinder reboring), connecting rod bend checking, crankshaft run out measurement, Compression Pressure Checking & valve lapping. OJT, Field visit	Activity logs , practical activity log . OJT report, Field visit report

<b>MODULE : 2 OUT BOARD MOTOR SERVICING UNIT NO. 2.4 OUT BOARD MOTOR FAULT DIAGNOSIS AND RECTIFICATION (100 periods)</b>			
<b>Ideas/Concepts/Skill</b>	<b>Learning Outcomes</b>	<b>Suggested Activities</b>	<b>Assessment</b>
<p>Related to engine starting</p> <p>1. Failure of the starter</p> <p>2. Failure of ignition system</p> <p>3. Failure of the fuel system</p> <p>4. Engine struck due to (a. piston pin circlip, jumps out, b. cooling system failure, c. lubrication system failure and d. main bearing seizure)</p>	<p>2.4.1 Rectify the faults related to starting because of starter failure.</p> <p>2.4.2 Diagnose the fault related to starting due to failure of ignition system and rectify it.</p> <p>2.4.3 Rectify the faults related to starting due to failure of fuel system.</p> <p>2.4.4 Diagnose the faults related to starting engine struck due to (a. piston pin circlip, jumps out, b. cooling system failure, c. lubrication system failure and d. main bearing seizure) and rectify it.</p>	<p>On hand rectification practice of false fault starter troubles in the workshop, OJT. Group discussion</p> <p>On hand checking and rectification of spark plug , ignition coil, charging coil, CDI, and pulsar coil. OJT, Group discussion</p> <p>Checking and rectification of false fault in carburetor, fuel pump , fuel filter and fuel lines through demonstration and general discussion</p> <p>Demonstration of failed engines due to (a. piston pin circlip, jumps out, b. cooling system failure, c. lubrication system failure and d. main bearing seizure) and rectify it. OJT</p>	<p>Practical activity log, OJT report, Activity log</p>
<p>Engine starts but stops suddenly</p> <p>a. Fuel system failure</p> <p>b. Ignition system failure</p>	<p>2.4.5 Identify the faults related to fuel and ignition systems and rectifies it.</p>	<p>On hand practice in the workshop with false faults in fuel and ignition systems, OJT, Group discussion</p>	<p>Practical activity log, OJT report, Activity log</p>
<p>Engine starts but irregular idling speed</p> <p>a. CDI unit failure</p> <p>b. faulty carburetor</p> <p>c. valve clearance not set correctly/</p> <p>valve leakage for 4stroke engines only</p>	<p>2.4.6 Rectify faults related to irregular idling speed.</p>	<p>Checking and rectification of CDI unit faults demonstration and Carburetor overhauling and rectification troubles and vale lapping and clearance setting in on hand practice. OJT</p>	<p>Practical activity log, OJT report, Activity log</p>

<b>MODULE : 2 OUT BOARD MOTOR SERVICING UNIT NO. 2.4 OUT BOARD MOTOR FAULT DIAGNOSIS AND RECTIFICATION (100 periods)</b>			
<b>Ideas/Concepts/Skill</b>	<b>Learning Outcomes</b>	<b>Suggested Activities</b>	<b>Assessment</b>
Engine starting but does not achieve speed - the causes and remedies of a. fuel system failure b. Ignition system failure	2.4.7 Rectify faults related to engine speed.	On hand practice in the workshop, checking and correcting the components in workshop with false faults	Practical activity log, OJT report, Activity log
Troubles related to cooling system - Engine over heating a. cooling pump not working b. strainer block c. cooling water passage block or leakage	2.4.8 Identify complaints related to cooling systems and rectify it.	On hand practice in the workshop, checking and correcting the components in workshop with false fault. OJT	Practical activity log, OJT report, Activity log
Problems related to combustion a. Black smoke b. White smoke c. Blue smoke( 4 stroke engines only) c. Low mileage d. Knocking	2.4.9 Diagnose causes of excessive smoke as a. black, white and blue smoke (4 stroke only) and rectify.	On hand practice in the workshop, checking and correcting the components in workshop with false fault.OJT	Practical activity log, OJT report, Activity log
Related to transmission system - a. gear shifting hard b. gear shifting not possible c. Humming noise	2.4.10 Get skill of dismantle and rectifies the transmission system troubles as a. gear shifting hard and b. gear	On hand practice in the workshop, checking and correcting the components in workshop with false fault.OJT	Practical activity log, OJT report, Activity log

## LIST OF PRACTICAL ACTIVITIES

### MODULE 2

- 1 Demonstration of IC engine working using Engine cut model
- 2 Differentiate between 2 stroke and 4 stroke engine parts
- 3 Identification of engine parts such as Cylinder-cylinder block-cylinder head- Piston-connecting rod-crank shaft - crank case- oil sump- piston pin - Cam shaft- valves- flywheel
- 4 Demonstration of OBM and its external parts
- 5 Installing OBM on stand with transom clamps by adjusting height and tilt angle
- 6 Identify and study of parts such as carburetor, fuel tank, fuel lines , fuel pump, reed valve and Carburetor overhauling
- 7 Identifications of ignition system parts magneto assembly, CDI unit, Ignition coil, pulsar coil', sparkplug
- 8 OBM cooling system parts identification such as strainer, cooling water pipe lines, pump etc.
- 9 Demonstration of petrol system
- 10 Identification lube oil filter, strainer, oil lines and pumps and overhauling of lube oil pumps
- 11 Familiarization with daily , periodical maintenance works
- 12 Engine overhauling decarburization cylinder wear (taper/ ovality) checking connecting rod bend checking crankshaft run out, Compression Pressure Checking and valve lapping.
- 13 Demonstration of starter assembly
- 14 Checking and rectification of spark plug , ignition coil, charging coil, CDI, and pulsar coil
- 15 Checking and rectification of carburetor, fuel pump , fuel filter and fuel lines
- 16 Demonstration of a failed engines due to
  - a. piston pin circlip jumps out
  - b. cooling system failure
  - c. lubrication system failure
  - d. main bearing seizure)
- 17 Demonstration of fuel system and ignition system
- 18 Checking and rectification of CDI unit
- 19 Carburetor overhauling and rectification
- 20 valve lapping

- 21 Trouble shooting of carburetor, fuel pump, fuel line, fuel filter
- 22 Trouble shooting of ignition coil, charging coil, pulsar coil, CDI and spark plug
  - a. cooling pump overhauling
  - b. strainer cleaning
  - c. cooling water passage inspection and cleaning
- 23 Identify the excessive smoke as a. Black smoke , b. White smoke, c. Blue smoke( 4 stroke engines only)
- 24 Dismantle and rectifying OBM transmission system faults related to
  - a. gear shifting hard
  - b. gear shifting not possible
  - c. Humming noise

## **DETAILED UNIT ANALYSIS OF UNIT 2.1**

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### **Overview**

Engine is the heart of a vehicle. Engine produces the energy which drives the vehicle forward. It is made possible by converting chemical energy into mechanical energy by igniting fuel. In spark ignition engine air fuel mixture is ignited by an electric spark. In this unit we have a detailed study on Spark ignition engines, their two categories such as 2 stroke and 4 stroke engine and their parts. The scope of this unit is to give a detailed basic idea about a spark ignition engine.

MODULE : 2 OUT BOARD MOTOR SERVICING UNIT NO. 2.1 SPARK IGNITION ENGINE (50 periods)			
Ideas/Concepts/Skill	Learning Outcomes	Suggested Activities	Assessment
SI engine description - working of 2 - stroke SI engines.	2.1.1 Explain working of 2 - stroke SI engines.	Demonstration of SI engine working using engine cut model, Multimedia presentation	Activity log, Practical activity log
working of 4 - stroke SI engines.	2.1.2 Explain working of 4 - stroke SI engines.	Demonstration of SI engine working using engine cut model, Multimedia presentation	Activity log, Practical activity log
Si engine parts cylinder-cylinder block-cylinder head- Piston-connecting rod-crank shaft - crank case-oil sump- piston pin -Cam shaft- valves- flywheel - Timing gears	2.1.3 Identify SI engine parts such as cylinder- cylinder block- cylinder head- Piston-connecting rod-crank shaft - crank case-oil sump- piston pin -Cam shaft- valves- flywheel - Timing gears	Demonstration of SI engine parts such as cylinder- cylinder block- cylinder head- Piston-connecting rod-crank shaft - crank case-oil sump- piston pin -Cam shaft- valves- flywheel - Timing gears and conducta group discussion, chart preparation	Activity log, Practical activity log, chart
Classification of SI engines	2.1.4 Differentiate between 2 stroke and 4 stroke engine parts.	Identification of 2stroke and 4 stroke engine parts, categorize the 2 stroke and 4stroke engine parts.	Practical activity log.

## Detailing of activities

### KEY ACTIVITIES : Demonstration

Using the 2 stroke SI engine cut model or multimedia projection, teacher demonstrate its working by rotating the flywheel. The learner can identifies what happens in upward and downward strokes. The teacher must give an opportunity to each student for hands on experience to rotate the engine. After the demonstration the students discuss suction, compression, power and exhaust process associated with the upward and downward strokes. Learner assesses the working of this engine and teacher can evaluate each student by asking questions and checking activity log.

Same method is adopted in 4 stroke engine working also.

### KEY ACTIVITY : Demonstration

During the dismantling of 2 stroke engine the teacher demonstrates all parts of engines and the learner is familiarized with engine parts and he can draw the figures on his activity log and also list out 2 SI stroke engine part on a chart table. Learner can self evaluate himself and teacher can also evaluate them with the help of their activity log. This method is carried out for 4 stroke SI engine parts' identification.

### KEY ACTIVITY : Identification

Teacher mixes 2 stroke and 4 stroke engines on a work table and asks students to categorize them and gives opportunity to justify their selection. The learner is able to list out the 2 stroke and 4 stroke engine parts and he gets hands on experience on categorization. The teacher can evaluate learner on his ability to separate the engines parts and his justification. Teacher asked each student to prepare a table chart. It is another tool for evaluation.

### REPOSITORY OF CE ITEMS

1. Process Assessment
  - General Discussion
  - Group Discussion
  - Assignment on Two Stroke and Four Stroke SI Engine
2. Unit Based Assessment
  - Conduct a Unit Test
3. Open Book Examination
  - Explain the principle behind four stroke SI engine cycle?
  - Explain principle behind two stroke SI engine cycle?
  - Prepare a comparison chart between two stroke and four stroke engines?

- Write the peculiarity of engine parts such as piston, fly wheel and cylinder in two stroke and four stroke engines?

#### 4. ICT Possibilities

- Videos of 4S and 2S engine cycles
- Videos of various engine parts.

### **PRACTICAL ASSESSMENT**

- Identification of engine parts, cylinder, piston, connecting rod, camshaft, valves, crank shaft, crankcase etc
- Identification of engine parts as 2S engine parts and 4S engine parts.
- Classifications of 2 stroke and 4 stroke engine parts.

### **TE QUESTIONS**

- 2.1 Why fins of 2S engine is bigger than that of 4S?
- 2.2 Where are ports found in an engine? Draw this engine part and suggest which engine (2S or 4S ) it belongs to?
- 2.3 Draw a comparison chart of 2S and 4S engines.
- 2.4 Write the peculiarity of engine parts found in 2S engines - piston, cylinder and flywheel.

## **LIST OF TOOLS, EQUIPMENTS AND MATERIALS**

### **MODULE I**

#### **Safety Equipments**

Apron, Gloves, Mask, Goggles, Fire extinguisher (Powder type), Safety shoe, Helmet

#### **Drawing Equipments**

Drawing Board, Mini drafter, Drawing sheet, pins

#### **Engine Models**

2 stroke and 4 stroke engine cut models

#### **Tools**

All general purpose tools

Special tools to dismantle engines

#### **Consumables**

MS Flat, Washing Soap, Cotton Waste

## **LIST OF TOOLS, EQUIPMENTS AND MATERIALS**

### **MODULE 2**

#### **Engines**

2 stroke single cylinder engine - 1 (old)

4 stroke single cylinder engine - 1 (old)

OBM 2 stroke - 2 nos (working)

OBM 4 stroke - 2 nos (working)

#### **Tools and Equipments**

Special tool kit for every model of engine

Multimeter - 4

Special tool kit for every model of engine

Spark plug tester - 1

Compression Pressure gauge - 2

Carburetor - 3

Vane pump impellor - 5

Fuel pump - 3

Spark plug - 3

#### **Consumables**

Petrol, cotton waste, Gear box oil, engine oil, grease

#### **REFERENCE BOOKS**

- 1) Automobile engineering volume I and II - Kirpal Singh
- 2) Internal Combustion Engines - Mathur & Sharma
- 3) Fishing craft and gear technology - Y.Sreekrishna & Latha Shenoy
- 4) The glimpses of Marine Engineering - C.Rethinadhas, CIFNET
- 5) Engineering Graphics - P I Varghese
- 6) Engineering Graphics - Anil Kumar
- 7) Workshop Technology Vol 1 - SK Hajra Choudhury
- 8) Out board engine - Joseph Manuel and K. S. Rana Prapathapan
- 9) Fishing craft and gear technology - Y.Sreekrishna & Latha Shenoy

#### **Web links**

- 1) Basics of Two stroke and Four stroke engines  
[en.wikipedia.org/wiki/Two-stroke\\_engine](http://en.wikipedia.org/wiki/Two-stroke_engine)  
[en.wikipedia.org/wiki/Four-stroke\\_engine](http://en.wikipedia.org/wiki/Four-stroke_engine)  
Youtube videos are available for OBM service