SYLLABUS FOR THE TRADE
OF

MARINE ENGINE FITTER

(SEMESTER PATTERN)

UNDER
CRAFTSMAN TRAINING SCHEME (CTS)

Designed in – 2013

By
Government of India
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
Directorate General of Employment & Training
Ministry of Labour & Employment
EN-Block, Sector-V, Salt Lake
Kolkata-700 091

List of members of Trade Committee meeting for the trade of "**MARINE ENGINE FITTER**" held on 26th February'2010 at I.T.I. Dollygaunge, Port Blair, Andaman & Nicobar Island.

SL NO	NAME & DESIGNATION S/SHRI	REPRESENTING ORGANIZATION	REMARKS
1	Madam S.K.P. Sodhi, Secretary	Labour Department, Port Blair, Andaman & Nicobar Administration	Chairman
2	Md. Mansoor, Principal	Govt. ITI, Dollygaunge, Port Blair	Member
3	Abhinoy Nandi, Dy. Director of Trg.	CSTARI, Kolkata	Member
4	P.P.Paul, Course In charge, Post Diploma Marine Engineering	Dr. B.R.Ambedkar Govt. Polytechnic, Port Blair	Member
5	T.S.Subraman, General Manager	Mak Logistics (P) Ltd., Port Blair	Member
6	C.S.Ashok, Managing Director	Inland Marine Works, Port Blair	Member
7	A.J.Paul, Instructor, Deck Cadet Course	Dr. B.R.Ambedkar Govt. Polytechnic, Port Blair	Member
8	C. Sanmughan, Master Mac Logistic	Mak Logistics (P) Ltd., Port Blair	Member
9	Commandant A.N.Jha, AHM	P M B	Member
10	Shajan Thomas, Course Co ordinator, Maritime Course	Dr. B.R.Ambedkar Govt. Polytechnic, Port Blair	Member
11	L. Senthil, Vocational Instructor	Govt. ITI, Dollygaunge, Port Blair	Member
12	CH. Venkateswar Rao, Vocational Instructor	Govt. ITI, Dollygaunge, Port Blair	Member
13	Jagga Rao (C/E), Faculty PDME	Dr. B.R.Ambedkar Govt. Polytechnic, Port Blair	Member
14	T. Narendranath, Vocational Instructor	Govt. ITI, Dollygaunge, Port Blair	Member
15	Shakeel Akhtar, Vocational Instructor	Govt. ITI, Dollygaunge, Port Blair	Member

List of members attended the Workshop to finalize the syllabi of existing CTS into Semester Pattern held from 6th to 10th May'2013 at CSTARI, Kolkata.

Sl. No.	Name & Designation	Organisation	Remarks
1.	R.N. Bandyopadhyaya, Director	CSTARI, Kolkata-91	Chairman
2.	K. L. Kuli, Joint Director of Training	CSTARI, Kolkata-91	Member
3.	K. Srinivasa Rao, Joint Director of Training	CSTARI, Kolkata-91	Member
4.	L.K. Muhkerjee, Deputy Director of Training	CSTARI, Kolkata-91	Member
5.	Ashoke Rarhi, Deputy Director of Training	ATI-EPI, Dehradun	Member
6.	N. Nath, Assistant Director of Training	CSTARI, Kolkata-91	Member
7.	S. Srinivasu, Assistant Director of Training	ATI-EPI, Hyderabad-13	Member
8.	Sharanappa, Assistant Director of Training	ATI-EPI, Hyderabad-13	Member
9.	Ramakrishne Gowda, Assistant Director of Training	FTI, Bangalore	Member
10.	Goutam Das Modak, Assistant Director of Trg./Principal	RVTI, Kolkata-91	Member
11.	Venketesh. Ch. , Principal	Govt. ITI, Dollygunj, Andaman & Nicobar Island	Member
12.	A.K. Ghate, Training Officer	ATI, Mumbai	Member
13.	V.B. Zumbre, Training Officer	ATI, Mumbai	Member
14.	P.M. Radhakrishna pillai, Training Officer	CTI, Chennai-32	Member
15.	A.Jayaraman, Training officer	CTI Chennai-32,	Member
16.	S. Bandyopadhyay, Training Officer	ATI, Kanpur	Member
17.	Suriya Kumari .K , Training Officer	RVTI, Kolkata-91	Member
18.	R.K. Bhattacharyya, Training Officer	RVTI, Trivandrum	Member
19.	Vijay Kumar, Training Officer	ATI, Ludhiana	Member
20.	Anil Kumar, Training Officer	ATI, Ludhiana	Member
21.	Sunil M.K. Training Officer	ATI, Kolkata	Member
22.	Devender, Training Officer	ATI, Kolkata	Member
23.	R. N. Manna, Training Officer	CSTARI, Kolkata-91	Member
24.	Mrs. S. Das, Training Officer	CSTARI, Kolkata-91	Member
25.	Jyoti Balwani, Training Officer	RVTI, Kolkata-91	Member
26.	Pragna H. Ravat, Training Officer	RVTI, Kolkata-91	Member
27.	Sarbojit Neogi, Vocational Instructor	RVTI, Kolkata-91	Member
28.	Nilotpal Saha, Vocational Instructor	I.T.I., Berhampore, Murshidabad, (W.B.)	Member
29.	Vijay Kumar, Data Entry Operator	RVTI, Kolkata-91	Member

GENERAL INFORMATION

1. Name of the Trade : MARINE ENGINE FITTER

2. N.C.O. Code No. :

3. Duration : 1 Year (2 Semesters)

4. Power norms : 3 KW

5. Space norms : a) Workshop: 5.25 sq. mt. per trainee.
b) Class room: 30 sq.meter.

6. Entry Qualification : Passed 10th class examination under 10+2 system of education with Science and Mathematics or its equivalent.

7. Unit size (No. of Student) : 16

8. Instructors Qualification :

(A) Degree in Marine / Mechanical Engineering from Recognized engg. College/university with one year experience in the relevant field OR
Diploma in Marine / Mechanical Engineering From recognized board of technical education with two years experience in the relevant field

OR

10th/Madhyamic pass + NTC/NAC in the Trade of "Marine Engine Fitter" with 3 years post qualification experience in the relevant field.

(B) Desirable qualification
: Preference will be given to a candidate with Craft Instructor Certificate.

Note: At least one Instructor must have Degree/Diploma in **Marine/ Mechanical** Engineering.

Syllabus for the Trade of "**MARINE ENGINE FITTER**" under C.T.S.

Duration: Six Month

First Semester **Code : MEF – Sem-I**

Week No	Trade Theory	Trade Practical	Engg. Drg.	Workshop Calculation & Science
1	2	3	4	5
1.	General introduction to the course-duration of the course and course content. Study of the syllabus general rules pertaining to the institute facilities- library working hours. **Occupational Safety & Health** Basic safety introduction, Personal protection:- Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution & personal safety message. Use of Fire extinguishers. Visit & observation of sections.	Familiarization with the institutes. Importance of the trade machinery used in the trade - types of work done by students in the institute shop of the institute.	Introduction to Engineering Drawing and Blue Print Reading. Free hand sketching of straight lines, rectangles, squares.	Simple workshop problems involving addition, subtraction, multiplication and division of whole numbers.
2.	Importance – Safety or general precautions to be observed in the shop floor. Types of fire, class of fire, fire extinguishers used for different types and class of fire, storing and handling of inflammable materials- Elementary First Aid. Study of personal protective equipments used in Marine plant. Environmental pollution, sources, causes, consequences and controls.	Description of safety equipment their use – safety rules to be observed in the repair shop. Accidents their causes. Fire extinguishers uses. Familiarization of the tools, machinery available in the repair shop. Their use and up keep importance of maintenance, cleanliness of workshop. Tools, jacks trays and hoses.	Free hand sketching of parallelogram, rhombus, polygons and circles.	Common fractions, additions, subtraction, multiplication and division of common fractions,
3.	Systems of measurement conversion of English into metric measurement and vice versa – marking media -. Chalk, Prussian Blue, Red lead and	Demonstration of the use of Fitter's Hand Tools, marking off with steel rules, calipers, scriber, dividers, dot & center punch, chipping in marked	Free hand sketching with dimensions and proportionate sketching of rectangles, square,	vulgar fractions, shop problems involving fractions.

	Tools used for marking e.g., steel rule, Try Square, etc.	lines in a given piece, sharpening of chisels, center punch and dot punches to a correct angles.	parallelogram, rhombus,	
4.	Types of hacksaw frames and blades - their selection and uses. Types of files and their uses. Care and maintenance of files. Types and sizes of drills - cutting angles and speeds of drills, calculation of tap drill sizes	Hack sawing filling to given dimensions – filling true and square practice different types of filling operation – making and drilling clear and blind holes. Sharpening of twist drill, safety precautions to be observed while using a drilling machine.	Free hand sketching with dimensions and proportionate sketching of circles, polygons.	Applied workshop problems involving fractions.
5.	Taps & dies description use of different types of taps and dies – use of 'V' threads precautions while using taps and dies – description and use of different types of scrapers, reamers and emery papers.	Tapping a clear and blind hole. selection of tap drill sizes. use of lubrication cutting threads on a bolt/ stud adjustment of two piece die reaming a hole/bush to suit the given pin/shaft scraping a given mechanical surface.	Reading of simple blue prints. Sketching of simple solids such as cubes, rectangular blocks, cylinders.	Properties of ferrous metals their uses. Cast iron, wrought iron, plain and high carbon steel, high speed steel and alloy steel.
6.	Study of construction of micrometer (outside & inside) and vernier caliper, vernier bevel protector. Calculation of least count for micrometer, venier caliper and vernier bevel protector. Calculation of errors & correct dimension for Micrometer. Use and care of measuring instruments. Use of combination sets.	Correct measurement techniques of micrometer, vernier caliper, vernier bevel protector. Measuring diameter of pistons, main journals, crank pins, king pin big end, main bearings, cylinder bores using micrometer and vernier calipers. Measuring of thickness, machined flat surface, bars valve angles, head locating centers of a round bar with center head.	- Do -	- Do -

ALLIED TRADE - SHEET METAL WORK

7.	Study of sheet metal workers hand tools their description and uses. Use of sheet and wire gauges. Descript- ion of simple soldering & brazing, Use of fluxes for common joints – types of sheet metal joints – their uses. Study of blow lamp and its uses	Simple marking of sheet metal and cutting. Joining of sheet metal, parts by soft soldering, bending and folding. Practice in silver soldering.	Free hand sketching of nuts – bolts – studs – with dimensions from samples.	- Do -
8.	Difference between pipe & tubes. Types of pipe fitting (in marine) its purposes. Study about connecting two pipe pieces, branching, changing in diameter, direction & stopping the end of pipes.	Practice in soldering, brazing, annealing, bending of pipes. Practice for nipples, union & other pipe joint.	Sketching of views of solid bodies such as square, rectangular blocks, hollow cylinders rings, cones.	Properties of non – ferrous metals and their uses. Copper, zinc, lead, tin, brass, aluminum, bronze, soldering metals.
9.	General description and construction of diesel engine – characteristics and classification working principles of 4 strokes cycle diesel and petrol engine. Comparisons between petrol and diesel engine.	Exercise involving use of wrenches, pliers, screw drivers, and pliers – cleaning and lubrication of engine parts, location and identification of engine components.	Freehand sketching of pliers, washers, bolts, nut with dimensions from samples.	Brief description of manufacturing process of non ferrous metals- copper, aluminum, zinc, tin.
10.	Two stroke cycle diesel engine types of scavenging uniflow and loop flow scavenge opposed copper piston engine differences between two stroke and four stroke cycle diesel engines.	Practice on unserviceable diesel engine, removing jammed nuts and broken studs reconditioning and damaged stud hole fitting over sized stud.	Free hand sketching of four strokes – two strokes cycles.	- Do -
11.	Engine details – cylinder materials – cylinder liners and their advantages, cylinder heads, description function, cares and maintenance – location combustion chamber in cylinder heads and also heater plugs and port and valve arrangements.	Selection of materials for gaskets and packing – use of locking devices lock nuts, cotters, split pin, circlips, lock rings location where they are used inspection and checking leakage of air, fuel oil and exhaust in the engine.	Explanation of simple orthographic projection in third angle projection.	F.P.S. & C.G.S. systems Metric weights and measurements, conversion factors.
12.	Combustion chambers – open and closed types, advantages and disadvantages compression ratio & compression pressures,	Practice on starting and stopping of diesel engines. Use of speed counter in determining the engine speed /rpm	Contd.	Shop problem on metric systems of weights and measurements.

	compression testing of cylinders and analysis of results & its importance.	of the engine. Checking of temperature and pressure of oil and cooling water , exhaust gas temperature etc.		
13.	Need of maintenance, check up in IC engines – preparation of maintenance schedule from charts of popular makes of engine	Maintenance schedule to check – daily, weekly, monthly for different types of engines. Writing procedure of inspection schedules – maintenance log book - details of maintenance work	View of simple hollow and solid bodies with dimensions	Meaning of tenacity, elasticity, malleability, brittleness, hardness, compressibility and ductility with example.
14.	Engine Valves & valves operation – mechanism – parts and function of each valve timing diagram, cam shaft and timing, gears – types of drives used in engines, chain tension and its importance, cylinder head and manifold construction and its function – water jackets passages.	Remove rocker arm assy. Manifolds, and cylinder head – removing valves and its parts – cleaning and decarburizing – checking valve seat and valve guide – reconditioning valve seats and refacing valves – lapping valves on its seat – testing leakage of valve seat for leakage inspection of cylinder head and manifold surfaces for lapping and cracks.	Free hand sketching of valves, valves springs, valve assy. With dimensions.	Effect of allowing elements on properties of cast iron & steel.
15.	Description and function of valve parts – maintenance material used – necessity of valve clearance prescribed by makers of engine – effect of incorrect clearance – common trouble and remedies reason for lapping of cylinder head.	Dismantle of rocker arm assembly – clean and check shaft – bushes, pork and rocker arm for wear and cracks and reassemble. Check valve springs, tappets push rods, tappet screws, and valve stem cap. Reassembling of valve parts in sequence refit cylinder head and manifold, rocker arm assy., adjusting of valve clearances, starting of engine after decarburizing.	Simple isometric view of object such as square, rectangle and cubes.	Square root of perfect square and whole number of square root of decimals.
16.	Piston and piston rings – function - types and material used recommended clearances for the rings and its necessity – precautions while fitting rings. Connecting rod – types	Removing piston & connecting rod from engine – examine – piston ring grooves for wear – examine piston for cracks & distortions, clean oil	Free hand sketching of piston gudgeon pins rings and connecting rod with dimensions	Shop problems involving square roots.

	function and material used – methods of fixing gudgeon pin on small end method of lubrication provided for small end bushes.	holes – measuring piston ring clearances– check connecting rod for bend and twist and cylinder bore for taper and ovality and gudgeon pin bushes for wear – check elongation of BE bearing bolts.	from samples	
17.	Crank shaft – construction and function material used – arrangements of crank pins and main journal – balancing method – flywheel – construction and its function and material used. Elementary knowledge of function of clutch and coupling units attached to flywheel.	Removing crank shaft and cam shaft from engine – checking crank shaft for bend & twist – checking oil retainer and thrust surfaces for wear - measure crank shaft journal for wear – checking flywheel and mounting flange – spigot, bearing – check vibration damper for defects – check cam shaft for bend and crack. Check crank shaft deflection.	Free hand sketching of crank shaft and flywheels with dimension from samples.	Ratio & proportions. Shop problem
18.	Description and function of cylinder block – material used for – cylinder & liners, effect of sea water with engine body, cylinder & liners. Construction of water jacket passage and wall thickness. Fixing of cylinder head and mountings. Fixing of accessories like oil pump, water pump, filters – oil flow passages and cleaning plugs.	Checking cylinder blocks surface – major cylinder bore for tapered and ovality – check main bearing for taper and ovality, clean oil gallery passage and oil pipe lines – check main bearing cap bolt holes. Check cam shaft bearing and tappet bolts. Descaling water passage and examine bursting disc, check cylinder head for warpping.	Free hand sketching of cylinder block and cylinder head	Mass – unit of mass force – absolute unit of force – weight of body, shop problems
19.	Engine bearing – classification and location – material used. Composition of bearing materials – shell bearing and their advantages – special bearing material for diesel engine application bearing failure and its causes – care and maintenance.	Fixing of crank shaft and bearing and engine entablature and checking and adjusting of clearances end play etc.	Free hand sketching of bearing with dimensions from sample.	Mass unit of mass, force, weight of body, shop problem.
20.	Friction – its meaning and importance methods to reduce friction in engines – use of lubricants – oil grease high detergent oil for diesel engine lubricants.	Overhauling of oil pump, oil filters, oil coolers, air cleaners and air filters. Adjusting of oil pressure relief valves – changing oil in the	Free hand sketching of oil filters oil pumps, oil coolers with dimensions from samples.	Example of useful and wasteful friction.

		sump, repairs to oil flow pipe line and unions.		
21.	Need for lubrication system for diesel engines – types used and layout of the system by pass & full flow arrangement – types of oil pumps, oil filters, oil coolers, common troubles – care and maintenance.	Reassemble all parts of engine in correct sequence and torque all bolts and nuts as per makers recommendations for engines.	Freehand sketching of examples of oil pumps, oil coolers with dimensions from samples.	Example of use and waste friction in engine applied problems.
22	Engine assembly procedure need for cleanliness and special tools and gauges used for engine assembling, practice – periods of decarburizing and overhauling engine in terms of hours of run or mileage – running in procedure of overhauled engines.	Reassemble all parts of engine in correct sequence and torque all bolts and nuts as per makers recommendations for engines. – Fit accessories & start and run the engine on stands	Freehand sketching of cylinder liners with dimensions from sample	Work, Unit of work engine power, Unit of power.
23	Cylinder liners – construction & purpose – material used and finish provided types of liners in use – methods used to fit the same in cylinder bore, advantages of wet and dry liners wear pattern & allowable wear cylinder wear and its causes.	Removing cylinder liners from cylinder block, practice in measuring and refitting new liners as per maker's recommendations, precautions while fitting new liners.	Freehand sketching of cylinder liners with dimensions from sample	Work, Unit of work engine power - Unit of power – shop problems.
24	Need for cooling an engine general description & types of air and water – cooling used in engine – layout of cooling system and function of parts like radiator – thermostat & need to maintain engine working temperature. Effect of sea water in marine engine cooling system. Prevention of corrosion of engine parts from sea water.	Removing radiator and water pump from engine, cleaning & reverse flushing. Radiator testing thermostat and refitting on engine – overhauling – water pump refitting – adjusting fan belt tension and connecting water pump with radiator with hoses & flushing cooling system of the engine.	Freehand sketching of water pump thermostatic valve & water jackets in the cylinder block.	Ratio & proportion
25	**Project Work / Industrial Visit (Optional)**			
26	**Examination**			

Syllabus for the Trade of "**MARINE ENGINEER FITTER**" under C.T.S.
Duration : Six Month

Second Semester **Code : MEF – Sem-II**

Week No	Trade Theory	Trade Practical	Engg. Drg.	Workshop Calculation & Science
1	Description & operation of Air compressor, turbo chargers and common troubles & maintenance. Description of different types of pumps (centrifugal, reciprocating, gear, screw, etc.)	Dismantling air compressor and turbo chargers – cleaning all parts – measuring wear – reassembling all parts and fitting them in the engine. Dismantling different types of pumps, checking and reassembling.	Free hand sketching of 4 stroke cycle, 2 stroke cycle valve timing diagram.	Different forms of heat energy mechanical and electrical
2	Basic refrigeration system in marine - operation and maintenance. Marine paints its specialty, types, Indian standards, recommended paints for inside and outside of ships/vessel. Anti-fouling, leaching, pigment operation for paints.	Basic procedure for gas charging, leak testing and general maintenance of marine engine refrigeration. Recommended procedure for application of paints to ship/vessel.	Freehand sketching of engine parts, fuel supply, ignition, lubrication and cooling system.	Different forms of Heat Energy mechanical and Electrical their conversation from one to another with examples.
3	Step by Step method of diagnosis of troubles in the lubrication and cooling system, reasons for engine overheating & remedies for the same. Crank case contamination and crank case ventilation, flow test rate recommended for radiator.	Troubleshooting in cooling and lubrication system/engine checking up and correcting oil and water leaks – changing defective packing and gaskets –testing functioning of thermostat	Views of solid & hollow bodies cut sections plane	Measuring of Horse power IHP, FHP and applied shop problem
4	Reasons for excessive exhaust smoke overheating, vibration missing & hunting noises and its reasons for development of noises in engine, methods of rectification for noises for smooth working of the engine.	Diagnosis of engine faults like main bearing – noises piston pin noise flywheel knock & valve noise and crank noises and diesel knock.	Views of hollow & solid bodies cut sections plane	Measuring of Horse power IHP, BHP, FHP and applied shop problem
5	Engine assembling practice for overhauling of engine - procedure, observations, precautions, alignments between spare parts, makers recommendation for setting of spare parts.	Diagnosis of engine faults like smoky, exhaust, over heating, heavy vibration, missing cylinders, exhaust noise, hunting characteristics of engine and erratic or irregular idling.	Practice on blue print reading	Effects of force on materials like bending twisting and shearing problems,

6	Starting methods used for starting diesel engines used for marine, brief description of each method – methods to eliminate starting difficulty in a diesel engine.	Diagnosis of reasons for starting difficulty in a diesel engine and rectifying the faults	Further practice on blue print reading	Torque - definition – example torque wrenches application problems involving torque values of engine.
7	Foundations for diesel engine in marine– details of foundation bolts & nuts its dimensions. Boxes to suit engine base – purpose of template need for aligning the engine on HD Bolts. Checking methods for alignment.	Practice in erecting overhauled engines on stands & foundations, preparation of templates of foundation holes of the engine base, preparation of holding down bolts and nuts and boxes for foundation, starting engine on foundation and observing vibrations.	Freehand sketching of engine mountings templates & fixing brackets & Stands	Shop problems on determination of volume & weight of simple bodies.
8 to 9	Fuel feed system in diesels - Air injection and airless injection systems their general description and layout importance of water separators, constructional details of water separators (centrifuges).	Cleaning fuel tanks, checking leaks in the fuel lines – soldering & repairing pipe lines and unions brazing nipples to high pressure line studying the fuel feed system in diesel engines draining of water separators (centrifuges).	Freehand sketching of water separators and fuel tanks with dimension from sample.	Menstruation of areas volumes & weight calculation solid bodies,
10 to 11	Fuel filters types & constructional details – reasons for using no. of filters sequence of replacement of filter elements – Importance of diesel fuel cleanliness – types of diesel fuel HSD & HFO – Description of oil fuel valves & their functions	Bleeding of air from the fuel lines servicing primary & secondary filters removing filters elements in pressure filters, overhauling of fuel valves.	Freehand sketching of fuel feed system and of filters.	Center of gravity of bodies stable & unstable Neutrals & equilibrium Examples & problems on center of gravity.
12 to 13	Constructional details of fuel injection pumps, feed pumps and governors - explanation of function and operation.	Dismantling an unserviceable fuel injection pump – feed pump governor studying the parts and reassemble general maintenance of fuel injection Pumps.	Freehand sketching of simple fuel injection pump with dimension from samples.	Simple levers with examples ie. Bell- crank lever & other used in engine- Advantage in using them Problems on lever.
14	Importance of fuel valve and pump timing and method of advancing and retarding and its effects on the firing.	Removing a fuel injection pump from an engine- refits the pump to the engine reset timing –fill adjust slow speed of the engine.	Lettering numbers & alphabets and freehand sketching of feed pump.	Heat and temperature. scales -Fahrenheit and Centigrade- their conversations.

				Temperature measuring devices used in the shop.
15 to 16	Power transmission system – types, belt pulley, chain, gear, coupling etc. Governors- pneumatic type- construction & operation – venturi unit and its purpose and action – precaution to be observed in attending to the governor- definition of rated speed – maximum speed –over run of governors- purpose of auxiliary venturi in the Governor – principle of idling damper.	Start engine adjust idling speed and damping device in pneumatic governor and venture control unit checking performance of engine with off load adjusting timings.	Freehand sketching of a pneumatic governor with dimensions from samples.	Definition -stress, strain and modulus of elasticity, ultimate strength, type of stresses, factor of safety. examples and problems.
17	Mechanical governors, Their construction, function and operation under different load and speed and maintenance – common troubles and remedies including hydraulic governors.	Start engine-adjusting idle speed of the engine fitted with mechanical and hydraulic governors, checking-high speed operation of the engine.	Freehand sketching of mechanical governor with dimensions from sample.	Definition -stress, strain and modulus of elasticity, ultimate strength, type of stresses, factor of safety. examples and problems.
18 to 19	Fuel injection Nozzles description and operation of each type spray angles and orifices and their characteristic- injector Tester- construction and function types of tests and their purpose. Effects of incorrect setting of nozzles on engine performance.	Checking performance for missing cylinder by isolating defective injectors – dismantle and replace defective parts and reassemble and refit back to the engine, importance of correct setting of pressure – while assembling the unit and also fitting on to the engine.	Freehand sketching of different types of nozzles (cut section) lettering practice.	Mechanical advantage velocity ratio and efficiency. example and problems.
20	Importance of periodical maintenance and upkeep of shop equipments. Preventive maintenance to avoid sudden and major failure. preparing maintenance charts for machineries and follow up.	Repairing of grease guns oil cans-oil spray gun & other shop floor equipment. Maintenance of drill press, pedestal grinder, valve reface and air compressor.	Freehand sketching of grease gun horses – oil gun and service accessories.	Determination mechanical advantage velocity ratio and efficiency screw jack wide pulley bully bumble wheel and inclined phasing.
21	Safe working practice while using work shop tools.	Repairing of injector tester, hoses, jacks and stands vacuum & compression gauges maintenance of washing pumps and hydraulic presses phasing and calibrating machine.	Practice on blue print reading.	working Principle of a simple machines.

22	BASIC ELECTRICAL WORK Simple electrical circuit series & parallel circuits - identification of alternating current and direct current meters - insulators and conductors - types of resistance – ohm's law and its application – common electrical terms and symbols-primary and secondary cells-lead acid battery description – construction – common troubles and remedy . Safe working practice while working on electrical systems.	Practice in joining wires & soldering - forming simple electrical circuits-measuring of current, voltage and resistance –cleaning and topping up of a lead acid battery –Testing battery with hydrometer, cell tester connecting battery to charger.	Freehand sketching of electrical symbols and drawing of simple electrical circuits.	Electricity and its effects static electricity, AC and DC difference.
23	Description of electrical circuits –ignition system and the components- purpose of induction coil, condenser, spark plugs-common troubles in ignition circuit and its remedy.	Studying electrical circuits in the engine assemble checking loose, open and short circuit in ignition circuits-cleaning and testing spark plugs-overhauling of distributor assemble-checking and setting ignition timing.	Freehand sketching of ignition circuit of a vehicle- sketching the circuit-line diagram of magneto ignition.	Magnets natural and artificial types-poles of magnets-magnetic fields.
24	Description of charging circuit- operation of dynamo and regulator Unit- Ignition warning lamp-troubles & remedy in charging system.	Removing dynamo from engine, dismantling, cleaning checking for defects, assembling and testing for monitoring action of dynamo & fitting to engine.	Freehand sketching of charging system.	Definition of ampere, volt & ohm- Units of ampere, volt, ohm, ohm's law.
	Description of starter motor circuit-constructional detail of starter motor, solenoid switches, common troubles and remedy in starter circuit.	Removing starter motor from the engine and overhauling the starter motor-testing of starter motor.	Starting starter motor circuit and solenoid switch circuit	Calculation based on ohm's law
25	**Revision**			
26	**Examination**			

MARINE ENGINE FITTER

TOOLS AND EQUIPMENTS FOR 16 TRAINEES + ONE

A. Trainees Kit – (As per the below table)

SL. No.	Name of the Items	Qty
1.	Hammer Ball peen 0.75 Kg	17 Nos.
2.	Chisel cold flat 19 mm X 200 mm	17 Nos.
3.	Steel rule 15 cm (English and Metric)	17 Nos.
4.	Screw driver 15 cm	17 Nos.
5.	Screw driver 30 cm 9mm Blade	17 Nos.
6.	Screw driver 20 cm 9mm Blade	17 Nos.
7.	Spanner D.E. set of 12 metric 8-32 mm	17 Nos.
8.	Pliers combination 15 cm	17 Nos.
9.	Centre Punch	17 Nos.
10.	Hand File Flat 200 mm (Second Cut)	17 Nos.
11.	Ring spanner set of 12 metric 8-32 mm	17 Nos.
12.	Steel tool box with locks and keys	17 Nos.
13.	Safety goggles	17 Nos.
14.	Safety Helmets	17 Nos.
15.	Hand Gloves (Leather)	17 Nos.

B. GENERAL Machinery Shop Outfit (As per the table)

SL.NO.	NAME & DESCRIPTIONOF MACHINES	QUANTITY
1.	Rule Steel 30cm	2
2.	Dividers Spring 15 cm	2
3.	Prick Punch 15 cm	4
4.	Chisel cross cut 9x3 mm	4
5.	Hammer ball Peen 0.5 Kg	4
6.	Hammer copper 1 Kg with blade	2
7.	Engineer square 15 cm blade	4
8.	Scriber 15 cm	4
9.	Scriber block universal	1
10.	Marking out tables 90 cm x 60 cm x 90 cm (high)	1
11.	Surface plate 60 x 60 cm blade	1
12.	Angle Plate	1
13.	Hacksaw frame	4
14.	V - block 75 x 38 mm pair with clamps	2
15.	Punch hollow set of 6	2 sets
16.	Number Punch set 3mm	1 set
17.	Letter Punch set 3 mm	1 set
18.	Hand vice 150 mm	2
19.	Screw driver, Electrician type 20cm size	2
20.	File, flat 35cm bustard	2
21.	File, flat 25 cm second cut	2
22.	File flat 20 cm smooth	2
23.	File flat safe edge 25 cm smooth	2
24.	File, triangular 15 cm second cut	2
25.	File, half round 40 cm second cut	2

26.	File round 30 cm, Second cut	2
27.	File square 20 cm second cut	2
28.	Screw Pitch Gauge (BSW,BSP,BSF and Metric)	1 Set Each
29.	Drill, Twist, metric 3mm to 12mm by 1mm parallel shank	1 set
30.	Taps and Dies complete set in box B.A. ,B.S.W. ,BSF American and metric	1 set
31.	H.S.S Hand reamer, adjustable 10.5 mm to 11.25 mm 11.25 mm to 12.75 mm 12.78mm to 14.25 mm and 14.25 to 15.75mm	1set
32.	Scraper, flat 25 cm handled	2
33.	Scraper half round 25cm	2
34.	Scraper triangular 25cm	2
35.	Micrometer outside 0 to 150mm	1 set
36.	Micrometer (Inside) 25mm to 150mm	1 set
37.	Vernier caliper set 25 or 20 cm inside outside Depth to read both inches and in mm	1
38.	Hammer planishing	2
39.	Setting hammer	2
40.	Mallet (Wooden)	2
41.	Trammel 30 cm	1
42.	Blow lamp 0.5 litre	2
43.	Soldering iron 120 watts	2
44.	Soldering iron, copper 225 gms (Fire heated)	2
45.	Pliers nose (round and straight)	2 each
46.	Snip straight	1
47.	Pot melting	2
48.	Poker	2
49.	Open Spanners, double ended set of 12 metric size 8 to 32	4 set
50.	Spanners, double off-set double set of 7 W/W from 3 mm to 13.5 mm	4 set
51.	Double open ended ignition spanner of B.A. 0x 1 to 8x9 set of 5 Spanner, Clyburn 15cm	1 set
52.	Adjustable Spanner 6inch, 12inch &18 inches	1 each
53.	Box spanner set upto 32 mm	1 set
54.	Spanners ring of set of 6 S.I.	1 set
55.	Spanner for sparking plug	1 set
56.	Pipe Ranches Stilson type 6,12, 18 inches	2 each
57.	Set of Allen Key 1 mm to 12 mm by 1mm	2 set
58.	Double open ended spanner American A/F size from 7.5 mm x 99 mm to 19 mm x 20.5 mm set of 6	1
59.	Torque Wrench	1
60.	Drill Drift 10mm x 150mm	2
61.	Grease Gun	2
62.	Oil Can 0.5 liter	2
63.	Chain block 1 ton capacity	1
64.	Tray cleaning 45 x 30 cm	1
65.	Drilling machine pillar type capacity upto 20mm dia with motor	1
66.	Valve Grinding Stick (consumable)	6

67.	Valve seat cutting tools complete with guide & pilot bar (all angle) in a box	1 set
68.	Extractor stud "ezy out" Type	1 set
69.	Compression gauge	1
70.	Oil Stone (consumable)	2
71.	Piston Ring Remover and compressing tool	1 set each
72.	Fire extinguisher CO_2, Mechanical Foam	1 each
73.	Fire buckets and stands	1
74.	Tachometer (counting type)	1
75.	Puller set 6 inch & 12 inch	1 set
76.	Lifting jack mechanical 3 ton	2 Nos.
77.	Injection testing set (Hand operated)	1
78.	Injection cleaning kit	2 sets
79.	Tube Expander with cutter (for copper tubes)s	1 Set

C. GENERAL MACHINARY

SL.NO.	NAME & DESCRIPTIONOF MACHINES	QUANTITY
1.	Bench Grinder with two 17.5 cm wheels	1
2.	Arbor press hand operated 2 ton capacity	1
3.	Diesel engine cut away model two show working parts for demonstration (One 2 stroke & one 4 stroke)	1
4.	Diesel engine 4 stroke Multi cylinder 4/6 vehicular type Indian Make contemporary model	1
5.	Petrol engine (Running condition, car type) Indian make	1
6.	Diesel engine (Running condition) Stationary type	1
7.	Petrol engine vertical (2 stroke)	1
8.	Portable Hand Blower Electrically Operated	1
9.	Battery charger	1
10.	Hydrometer (consumable tool)	1

D. WORKSHOP FURNITURE

SL.NO	NAMES & DESCRIPTION OF FURNITURE	QUANTITY
1.	Work bench 250x120x75 with four vices of 12.5 cm	4
2.	Locker with 8 drawers (standard size)	2
3.	Metal Rack 180x150x45cm	2
4.	Steel almirah / cupboard	1
5.	Black board and easel	1
6.	Instructor's Desk or table	1
7.	Chair	1