

**SYLLABUS OF SEMESTER SYSTEM  
FOR THE TRADE OF**

**“MECHANIC MACHINE TOOL MAINTENANCE”**

**SEMESTER PATTERN**

**Under**

**Craftsmen Training Scheme (CTS)  
(Two years/Four Semesters)**

**Revised in  
2014**

**By  
Government of India  
Ministry of Labour & Employment (DGE&T)**

## GENERAL INFORMATION

1. **Name of the Trade** : “MECHANIC MACHINE TOOL MAINTENANCE”
2. **N.C.O. Code No.** : 845.50
3. **Duration of Craftsmen Training** : Two years(Four semesters each of six months duration).
4. **Power norms** : 17 KW
5. **Space norms** : 192 Sq. Mt.
6. **Entry Qualification** : Passed class 10<sup>th</sup> Exam. Under 10+2 system of Education or its Equivalent.
7. **Trainees per unit** : 16 (Supernumeraries/Ex-Trainee allowed: 5)
- 8a. **Qualification for Instructors** : Degree in Mechanical Engineering from recognized university with one year post qualification experience in the relevant field
- OR
- Diploma in Mechanical Engineering from recognized Board of Technical Education with two years post qualification experience in the relevant field
- OR
- NTC/NAC in the Trade of “Mechanic Machine Tool Maintenance” with 3 years post qualification experience in the relevant field.
- 8b. **Desirable qualification** : Preference will be given to a candidate with Craft Instructor Certificate (CIC) in Mechanic Machine Tools Maintenance Trade.

**Note:**

- (i) Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications.
- (ii) Instructor qualification for WCS and E.D, as per the training manual.

**Distribution of training on Hourly basis:**

Total hours /week	Trade practical	Trade theory	Work shop Cal. &Sc.	Engg. Drawing	Employability skills	Extra curricular activity
40 Hours	25 Hours	6 Hours	2 Hours	3 Hours	2 Hours	2 Hours

# COURSE INFORMATION

## **1. Introduction:**

- This course is meant for the candidates who aspire to become professional Mechanic in Machine Tool Maintenance.

## **2. Terminal Competency/Deliverables:**

After successful completion of this course the trainee shall be able to perform the following skills with proper sequence.

1. The trainees can work in the industry as semi-skilled maintenance mechanic of machine.
2. The trainee can work in the field of fitting, maintenance of drilling, grinding, lathe, Shaper, Milling, welding machineries, general machine tool maintenance work observing safety precautions.
3. The trainees can work on Dismantle & assemble of various valves, test the accuracy of Machine tools.
4. Perform repair on machinery, dovetail slides and assemble with location dowel pins, stud and bolts.
5. Handle different type of Fire extinguishers

## **3. Employment opportunities:**

On successful completion of this course, the candidates shall be gainfully employed in the following industries:

1. Production & Manufacturing industries.
2. Structural Fabrication like bridges, Roof structures, Building & construction.
3. Automobile and allied industries
4. Service industries like road transportation and Railways.
5. Ship building and repair
6. Infrastructure and defence organizations
7. In public sector industries like BHEL, BEML, NTPC, HAL, BDL etc and private industries in India & abroad.
8. Self employment

## **4. Further learning pathways:**

- On successful completion of the course trainees can pursue Apprenticeship training in the reputed Industries / Organizations.
- On successful completion of the course trainees can opt for Diploma course (Lateral entry).
- On successful completion of the course trainees can opt for CITS course.

# SYLLABUS FOR THE TRADE OF MECHANIC MACHINE TOOL MAINTENANCE

## First Semester

**(Semester Code no. MMTM - 01)**

**Duration : Six Month**

Week No.	Trade Practical	Trade Theory
1.	<p>Importance of trade training, List of tools &amp; Machinery used in the trade. Health &amp; Safety: Introduction to safety equipments and their uses. Introduction of first aid, operation of Electrical mains.</p> <p><b>Occupational Safety &amp; Health</b> <b>Importance of housekeeping &amp; good shop floor practices.</b> Health, Safety and Environment guidelines, legislations &amp; regulations as applicable. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Basic safety introduction, Personal protective Equipments(PPE):- Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution &amp; personal safety message. Preventive measures for electrical accidents &amp; steps to be taken in such accidents. Use of Fire extinguishers.</p>	<p>Importance of safety and general precautions observed in the in the industry/shop floor. All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. <b>Soft Skills: its importance and Job area after completion of training.</b> Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept &amp; its application. Response to emergencies eg; power failure, fire, and system failure.</p>
2.	<p>Usage of First aid box and practice of Cardiopulmonary Resuscitation (CPR)</p> <p>Usage of - Fire extinguishers - Safety appliances- personal protective equipment (PPEs). Identification of Various tools &amp; Equipments in work shop</p>	<p>Accidents, major types and causes of accidents, accident prevention. Near-Miss, hazard identification. Unsafe acts and unsafe conditions. Introduction of first aid. Causes and types of fire, fire precautions, precautions against outbreak of fire, different type of fire extinguishers and their uses. Precautions while working at height. Gas safety. Electrical safety.</p>
3-4	<p>Marking practice: Marking - straight, parallel and curved lines with odd leg calipers, steel rule, dividers, Scriber. Cut metal pieces of different profiles &amp; sections by hack-sawing to accuracy of 0.5 mm.</p>	<p><b><u>Basic Fitting Skill</u></b> Classification, constructional and functional details of different type of vices (bench &amp; machine), Care of vices, hacksaw, its classification, saw setting, selection of hacksaw blades. Bench work safety- related hazards, risk</p>

		and precautions.
5.	Marking of flat job as per drawing and parallel filing practice within the accuracy of 0.5mm.	Classification, construction, material and functional details of Files. Specification of files & Filing technique. Marking media, Prussian blue, red lead, chalk and their special application and description
6-7	Filing- flat, square and steps surfaces to an accuracy of 0.4mm. (Measurement by caliper and steel rule).	Linear measurements & its units Classification, construction, materials and functional detail of following basic measuring and marking tools : - <ul style="list-style-type: none"> <li>• Steel Rule</li> <li>• Calipers(Inside &amp; outside),</li> <li>• Divider, Trammel</li> <li>• Try Square</li> <li>• Marking Punch</li> </ul> Measuring Instruments.
8	Checking and setting of Vernier calipers, vernier height gauge & vernier bevel protractor. Filing flat, square, steps and contour surfaces to an accuracy of 0.4 mm	Vernier calipers, vernier height gauge & vernier bevel protractor - principle, construction, calculation of least count and its use and care.
9	Checking and setting of micrometer. Filing flat, square and steps to an accuracy of 0.3mm (Measurement by Precision Instrument).	Precision Measuring Instruments: Concept of precision & accuracy Micrometer (outside, inside and depth) – working principle, construction, use & care, calculation of least count.
10	Transfer of dimensions from drawing to work pieces. Finding center of a round bar with the help of 'V' block and marking block. Filing flat, square, steps and contour surfaces to an accuracy of 0.2mm.	Classification, construction and functional detail of following marking devices- Surface plate, angle plate, marking block and V-Block.
11-12	Fixing of hammer handle. Chipping practice on flat surface, slots & oil grooves, and chamfer at different angle on MS plate. Scraping practice on flat & curved surfaces	Classification, construction, materials and functional detail of Chisels & Hammers. Chipping technique. Related hazards, risk and precautions while working. <b>Scrapers:</b> Introduction, Its types, material and use.
13 - 14	Truing of Pedestal grinding wheels. Grinding/Repair and maintenance of ordinary fitter's hand tools such as chisel, Screw driver, Scriber, Centre punches, dividers, trammel, scrapers and Hammer.	Pedestal grinder – Introduction, care & use. Procedure of wheel mounting & wheel dressing. Related hazards, risk and precautions.
15 - 16	Grinding practice of Drill. Use of drilling machine for drilling through & blind holes, counter boring and counter sinking on mild steel (MS) flat. Drilling on cylindrical surface. Reaming of drilled hole. Making internal & external thread by Taps & Dies. Prepare studs and nut.  Identification of various parts of Drilling	<b>Drilling machines:</b> Introduction to Drilling machines. Types of drilling machines like bench, pillar & radial drilling machines and their constructional details. Types of drilling operations, calculation of cutting speed, feed & drilling time. Related hazards, risk and precautions. Introduction to theory of metal cutting - cutting speeds, feeds etc. about tools and their geometry.

	machines.	Drill & Reamer- its classification, construction, materials and functional detail. Study of drill chuck, drill chuck key, drill sockets, sleeves – its construction, materials, its specifications and use. <b>Taps &amp; Dies:</b> Classification, construction, material and functional detail of Taps & Dies.
17 -- 18	Filing & fitting mating components by filing within an accuracy of $\pm 0.15$ mm & angular 30 minutes	Surface finish - importance, symbol, measuring techniques. Lapping & honing process. <b>Gauges:</b> Classification and uses of Sine bar, Slip gauge, Limit gauge, Feeler gauge, thread gauge, screw pitch gauge, taper gauge.
19	Fitting of mating components by filing and scrapping within an accuracy of $\pm 0.10$ mm & angular within 30 minutes	<b>Tolerances &amp; interchangeability</b> - Definition and its necessity, basic size, actual size, limits, deviation, Tolerance, allowance, clearance, interference, Fits-definition, types, description with sketches. Method of expressing Tolerance as per BIS, Hole and Shaft basis (BIS standard). Related calculation on Limit, Fit and Tolerance.
20	Practice on dovetail fitting mating components by filing and scrapping within an accuracy of $\pm 0.10$ mm & angular within 30 minutes for cylindrical surfaces.	<b>Fasteners:</b> Introduction to fasteners, screw threads, related terminology and specification. Keys- types & use, (parallel, sunk, tangential, gib head, woodruff, key ways.) Related hazards, risk and precautions, while working.
21 - 22	Preparation of flat surfaces and scraping practice on flat surface taking impression on face high spots using prussian blue sharpening by diamond dresser & wheel and lapping stone.	Types of nuts, bolts, studs, locking devices for nut, wrench and spanner, pliers, screw drivers, Circlip, split pin, washers, spring washer. Concept of torque & torque wrench. Different types of rivets and their applications. Identification of different fasteners & operating them by using proper hand tool
23-24	<b>Revision</b>	
25	<b>Examination</b>	

# SYLLABUS FOR THE TRADE OF MECHANIC MACHINE TOOL MAINTENANCE

Second Semester  
(Semester Code no. MMTM - 02)

Duration : Six Month

Week No.	Trade Practical	Trade Theory
01.	<p>Identification and study of various components of mechanical power transmission assembly System. Dismantling &amp; assembly of Shafts, couplings, keys, gears, bearings, belts, chain pulley, rope pulley.</p> <p>Related hazards, risk and precautions while working.</p>	<p><b><u>Maintenance Practice and Mechanical Assembly</u></b> Introduction to various maintenance practices such as preventive maintenance, predictive maintenance, breakdown maintenance &amp; reconditioning.</p> <p><b><u>Transmission of Power</u></b> Elements of mechanical power transmission, type of spindles and shafts (Universal spindle, Plain shaft, Hollow shaft, crank shaft, cam shaft). Positive and Non-positive drive, Friction drive, Gear drive, Belt drive, Chain drive and Rope drive.</p>
02 & 03	<p>Identification of various types of clutches, clutch arrangements in power transmission system (machine tools), maintenance of clutch mechanism in machine tool.</p> <p>Dismantling &amp; assembly of mechanical &amp; electromagnetic assembly.</p> <p>Related hazards, risk and precautions while working.</p> <p>Measuring shaft and coupling bore for finding out taper &amp; ovality to determine the type of fit.</p> <p>Find out the size of key for a given set of shaft &amp; bore. Key making, mounting of coupling on shaft with key.</p> <p>Application of fits on assembly of key, hub &amp; shaft.</p> <p>Identification of different types of Brakes &amp; Functioning of Braking mechanism in machine tools. Inspection of components of Brakes &amp; braking mechanism.</p>	<p><b>Clutches</b> Function of Clutches, its types and use in power transmission system. Function of mechanical &amp; electromagnetic system in clutch mechanism.</p> <p><b>Couplings:</b> Concept of coupling and its type viz. Rigid coupling- Muff coupling, Flange coupling, Flexible coupling, Pin-bush coupling, Chain coupling, Gear coupling, Spider coupling, Tyre coupling, Grid coupling, Oldham-coupling, Fluid coupling, Universal coupling and their specific applications.</p> <p><b>Brakes &amp; Braking Mechanism :</b> Types &amp; Functions. Inspection of brakes for safe &amp; effective working.</p>
04	<p>Installing drive belts, Measuring and adjusting the belt tension.</p> <p>Related hazards, risk and precautions while working.</p>	<p><b>Belts-</b> Belt types (Flat and V) and specifications. Pulleys used for belt drive. Installation, Alignment of belts. Problems related to belts(Creep and slip) Belt maintenance. Sheave alignment, Chain drive- Roller chain, Silent chain, alignment of sprockets, and maintenance of chain drive.</p>

<p>05 &amp; 06</p>	<p>Identification of various types of bearings. Checking dimensions of solid bush bearing, split bush bearing, journal and housing comparing of fits with its mating components as per BIS. Checking split bush bearing for proper contact on journal and housing by impression testing. Mounting of split bush bearing with proper clearance, measuring clearance with the help of lead wires. Identification of various types of bearing and bearing mounting arrangements in machine tools. Tackles used for mounting and dismounting of bearing. Inspection and mounting of ball bearing on shaft with proper fit by i) Impact sleeve ii) Hydraulic or iii) Mechanical Press Mounting of ball &amp; roller bearing in gear box housing. Dismounting of rolling contact bearing by using i) Hydraulic puller ii) Hydraulic press and iii) Mechanical pullers. Inspection of bearing for its smooth rolling, allowable-side play, noises. Practice of Mounting and dismounting of bearings. Practice of Dismantling &amp; assembly of simple m/c parts &amp; units like cross slide, compound slide &amp; tailstock of lathe.</p>	<p><b>Bearing:</b> Description and function of bearing, its types - Solid Bush, Split Bush, Collar, Pivot and Plummer Block Bearing. Mounting of bearings, measurement and adjustment of clearances in bearings. Types of bearing fitting on shaft and hubs. Type of Roller contact bearings- Ball bearings- single row &amp; double row, Deep groove ball bearing, Angular contact, Self aligning and Thrust bearing. Roller bearing- Cylindrical, Needle roller, Taper roller, Spherical roller, self aligning and Spherical roller thrust bearing. Use of ISO bearing designation code to generate market survey and purchase. Checking and adjustment of bearing clearance. Methods of Mounting and dismounting of roller contact bearing, taper roller bearing and angular contact ball bearing. (Back-to-back, Face-to-face, tandem) Mounting-dismounting and adjustment of Taper bore bearings with adopter and withdrawal sleeve. Handling and storage of bearings. Related hazards, risk and precautions.</p>
<p>07.</p>	<p>Identification of various types of Gears &amp; Gear boxes. Inspection of various aspects of Gears &amp; Gear boxes such as PCD checking by Cylindrical Pin, Checking of gear tooth thickness, clearance, concentricity &amp; wear etc. Gear meshing: Checking of backlash and root clearances with Feeler Gauge, Dial Test Indicator and Lead Wire.</p>	<p><b>Gear:</b> Type, description and function of gears- Spur, Helical, Spiral, Bevel, Straight and Spiral bevel, Worm gears, Rack and pinion. Gear Terminology. Gear train- simple, compound, reverted and epicyclic. Types of Gear box Gear meshing: Checking of backlash and root clearances with Feeler Gauge, Dial Test Indicator and lead wire. Impression testing of gear mesh with Prussian blue. Running maintenance Related hazards, risk and precautions</p>
<p>08</p>	<p>Practice on oil removing &amp; filling from gear box. Inspection of the drained oil for contaminants &amp; wear debris with focus on visual inspection. Overhauling procedure of gear box (Pre cleaning, dismantling, cleaning, inspection, repair/ replacement, assembly).of speed &amp; feed gearboxes of lathe &amp; milling m/c</p>	<p>-do-</p>



	Preparation of inspection sheet/ report. Preparation of action plan.	
09 & 10.	<p>Identification of various types of lubrication systems and their components.</p> <p>Working on centralized lubrication system, various lubrication fittings (on models).</p> <p>Cleaning procedure of oil filters, lubricating line.</p> <p>Identification &amp; fitting of different type of seals and oil rings.</p> <p>Preparation &amp; fitting gasket for different joint surfaces.</p> <p>Identification of elements for pressure switch, temperature gauge, level indicator and relief valve and their assembly procedure.</p> <p>Simple preventive and breakdown maintenance of Lubrication systems of Lathe, Drilling and Grinding machines.</p> <p>Lubrication pipe / tube and connectors fixing - Practice</p>	<p>Lubrication and its importance, lubricating systems</p> <p>Concept of lubrication</p> <p>Types and properties of Oil and Grease.</p> <p>Methods of oil lubrication-</p> <p>Once through and centralized lubrication system.</p> <p>Methods of grease lubrication system- grease guns, centralized lubrication system.</p> <p>Warning &amp; protective devices used in centralized lubrication system (Pressure switch, temperature gauge, level indicator and relief valve.)</p> <p>Lubrication fittings. Storage and handling, Contamination control,</p> <p>Leakage prevention- Shaft seals, sealing devices and "O" rings.</p>
11	<p>Preparation of coolants.</p> <p>Identification of various parts of cooling systems.</p> <p>Preventive &amp; breakdown maintenance of coolant systems</p>	<p>Cutting Fluids and Coolants.</p> <p>Essential parts of a basic cooling system used in the cutting of metals.</p> <p>Various types of coolants, its properties and uses , cooling system type-soluble oils- soaps, sudsparaffin, soda water etc.</p> <p>Effect of cutting fluids in metal cutting.</p> <p>Difference between coolant and lubricants.</p>
12	Demonstration for location & excavation for foundation bolts, method employed for installation & erection of precision & heavy duty machines.	<p><b>MACHINE FOUNDATION</b></p> <p>Purpose &amp; methods employed for installation &amp; erection of precision &amp; heavy duty machines.</p> <p>Location &amp; excavation for foundation. Different types of foundations – foundation bolts, structural, reinforced, wooden, isolated foundations.</p>
13	Leveling of a machine – Practice on models	<p><b>Leveling</b></p> <p>Definition and importance of leveling.</p> <p>Types of levels- Spirit level, Water level, Dumpy level, Method of leveling.</p> <p>Preparation of packing and shim.</p>
14	<p>Shaft alignment, Pre-check: coupling fit, eccentricity, perpendicularity, with feeler, dial gauge and corrections methods.</p> <p>Checking misalignment with the help of Taper gauge, Feeler gauge and Dial test indicator for</p> <p>i) Rim and Face readings on stationary machine (SM)</p> <p>ii) Rim and Face reading on machine to be seamed (MTBS)</p> <p>Checking and correcting alignment with straight edge and thread:</p> <p>V-pulley and sprocket.</p> <p>Geometrical Alignment and accuracy of Machine as per the test chart of machine tool builder.</p> <p>Locating static unbalance in a rotor, finding the correction weight.</p>	<p><b>Alignment:</b></p> <p>Definition and importance of alignment, Types of misalignment, Planes of misalignment, Shaft vs. coupling alignment, Actions to be taken before alignment, Concept of axial float, Concept of Indicator sag, Dial Test Indicator, Methods of alignment - Rim and Face readings on Stationary Machine, Rim and Face reading on machine to be seamed.</p> <p>Geometrical Alignment of Machine.</p> <p><b>Balancing</b></p> <p>Understanding importance of balancing and reasons of unbalance.</p> <p>Type of unbalance.</p> <p>Method of static balancing and its correction</p> <p>-Adding and removing mass</p>

	Checking & adjusting radial & axial play of spindles & eliminating play of slide units.	-Mass centering.
15 & 16	Safety precautions in dismantling & assembly of Drilling machines. Dismantling and assembly of various parts such as Motors, Spindle & Spindle head, Gear box and Arm.	Maintenance and Repairs of Various types of drilling machines.
17 & 18	Practice of Lathe tool grinding, tool setting. Lathe operations – plain turning, facing, step turning, undercut, chamfering, grooving, drilling, boring, counter boring, fillet radius within the accuracy of $\pm 0.1\text{mm}$ and its checking of square ness, diameter, length, chamfer, fillets radius using micrometer, vernier caliper and gauges. Practice on regular maintenance of a machine tool. Practice of different taper turning methods on lathe. Practice screw thread cutting - whit worth/metric (Internal & external).	<b><u>Machine Tool Operation &amp; Maintenance</u></b> <b>Lathe Machine</b> Introduction to lathe machines parts, constructional details and Different simple lathe operations – parallel/straight turning, step turning, grooving, radius forming, drilling and boring, counter boring. Calculation of cutting speed, feed and turning time. Lathe accessories and attachments. Chuck – its types, face plates, lathe dogs, lathe centers - its types, and lathe steady. Related hazards, risk and precautions. Regular maintenance of a machine tool. Nomenclature of cutting tool. Lathe cutting tools geometry. Recommended cutting tool materials for lathe operations. Different taper turning methods and its calculations. Definition of screw thread, types, forms and its applications. Calculation of gear train for screw thread cutting on lathe. Change gear and its calculation.
19 & 20	Dismantling & Assembly of various parts & sub assemblies of lathe such as head stock, apron, saddle, tool post, tail stock etc Checking & accuracy of lathe after assembly. Practice of preventive maintenance on machines and Demo with case studies on breakdown maintenance & Trouble shooting	Breakdown maintenance and preventive maintenance of a lathe.
21 & 22	Holding the job on shaping machine vice, setting of length of ram stroke. Making square block and “V” block. Dismantling & assembly of parts of a shaper machine, Inspection & accuracy of shaper after assembly Simple preventive and breakdown maintenance of Shaping m/c	<b>Shaper:</b> Introduction to Shaper machine parts & constructional details, its function and operations. Quick return mechanism of shaper. Calculation of cutting Speed, feed & depth of cut.
23-24	<b>Implant training / Project work (work in a team)</b>	
25	<b>Revision</b>	
26	<b>Examination</b>	

# SYLLABUS FOR THE TRADE OF MECHANIC MACHINE TOOL MAINTENANCE

## Third Semester

(Semester Code no. MMTM - 03)

Duration : Six Month

Week No.	Trade Practical	Trade Theory
01 & 02.	<p><b><u>Arc Welding</u></b> Setting up of an arc welding machine before start welding considering material thickness, diameter of electrode etc. Edge preparation for arc welding. Practice for straight horizontal and vertical position – Lap, Butt &amp; Tee joint. Practice on pipe joint.</p>	<p><b><u>Welding &amp; Gas Cutting</u></b> <b><u>Arc Welding</u></b> Introduction to arc welding process viz Fusion, Non-fusion &amp; Pressure, its classifications, accessories and its safety. Metal Joining Methods &amp; its advantages, Welding types, Common tools used in welding. Basic Electricity as applied to Welding Arc Length &amp; its effects Arc Welding Machines: - advantages &amp; disadvantages of AC &amp; DC Arc Welding Machine. Safety Precautions: Related to Arc welding m/c &amp; accessories. Manual Metal Arc Welding Electrodes: - Sizes &amp; Coding. Edge Preparation: - Necessity of edge preparation. Nomenclature of butt &amp; fillet welding. Welding Symbols &amp; Weld defects.</p>
03	<p><b><u>Gas Welding</u></b> Setting up of a gas welding set. Setting of different types of flames with gas welding &amp; adjustment of flame. Making straight beads with and without filler rod. Making square lap joint, butt joint &amp; Tee joint using plates / sheets of up to 3 mm thickness. Setting up of flames for gas cutting of different material thickness.</p>	<p><b><u>Gas Welding</u></b> Introduction to gas welding process, its classifications, accessories and its safety. Principle of gas cutting. Systems of Oxy-Acetylene Welding- Flashback &amp; backfire Types of Oxy-Acetylene flames: - Gases used in welding &amp; Gas flame combination. Filler Rods for Gas Welding. Safety in gas cutting process. Description about types of welding joints. Knowledge about flux, filler rod material.</p>
04	<p>Identification and familiarisation of various types of hydraulic elements such as pumps, valves, actuators and oil filters. Overhauling of valves</p>	<p><b><u>Hydraulics &amp; Pneumatics</u></b> Basic principles of Hydraulics - Advantages &amp; limitation of hydraulic system, hydrostatic transmission, Pascal's law, Brahma's press, pressure Temperature &amp; flow, speed of an actuator. Control valves: Different type of control valves used in hydraulic System. Function of pressure control valve, directional control valve, check valve, flow control valve.</p>

05 & 06.	Overhauling of <ul style="list-style-type: none"> <li>- Hydraulic pumps</li> <li>- Hydraulic actuators.</li> </ul>	Function and construction of gear pump, vane pump and piston pump, cylinder & hydraulic motor.
7.	Simulation of hydraulic circuits. <ul style="list-style-type: none"> <li>- Simple hydraulic circuits.</li> </ul> <p><b>Hydraulic</b> circuit reading practice &amp; constructing hydraulic circuits for single &amp; double acting cylinders, meter in, meter out circuit, pressure control circuits &amp; regenerating circuit.</p>	Auxiliary & fluid conditioner: Reservoir, filter, strainer, pressure gauge, pipe & pipe fitting, accumulator, seals & packing Simple hydraulic circuits : <ul style="list-style-type: none"> <li>- Hydraulic symbols</li> <li>- Study of different hyd. Circuits</li> </ul> Related hazards, risk and precautions.
8.	Practice on constructing hydraulic circuits.	Electro hydraulic circuit, Electrical components <ul style="list-style-type: none"> <li>- Switches</li> <li>- Solenoid</li> <li>- Relay</li> </ul>
9.	Identification of various types of pneumatic elements such as: control valves, actuators, filter, pressure regulator and lubricator.	Basic principle of pneumatic system. Advantages & limitation. Air preparation. Constructional & functional details of pneumatic cylinder, motor, control valves and FRL unit.
10	Overhauling of pneumatic cylinders. Practice on construction of Pneumatic circuit. Practice on construction of two-hand safety pneumatic circuit.	Introduction to Pneumatic actuators Pneumatic Symbols Pneumatic circuit Electrical control components <ul style="list-style-type: none"> <li>- Switches</li> <li>- Solenoid</li> <li>- Relay</li> </ul>
11	Cutting & Threading of pipe. Fitting of pipes as per sketch.	<b><u>Pipe Fitting and Valves</u></b> Types of pipe, tubes and different fittings. Tools used in pipe work.
12	Bending of pipes as per drawing. Making pipe joint (flaring and ferrule).	Pipe bending and jointing methods. Different types of expansions joints and their applications.
13 & 14	Use of different type of valve like: Gate, Globe, butterfly, Diaphragm. Direction control valve, pressure relief valve, non return valve, flow control valve. Assembly and disassembly of valves. Making and replacement of gaskets.	Pipe colour code. Safety precautions to be observed while working at pipeline. Constructional detail of different type of valve & their uses like: Gate, Globe, butterfly, Diaphragm.
15.	Setting of milling cutters, machine vice (job holding device), cutting speed, feed, setting of table movement. Preparation of rectangular block by milling with in an accuracy of $\pm 0.2$ mm. Step milling (external) operation within the accuracy of $\pm 0.2$ mm. T slot milling	<b>Milling:</b> Introduction to milling machine, parts & constructional details, types. Safety precaution followed during milling operation. Milling machine attachments. Different types of milling cutters and its materials. Nomenclature of milling cutters.
16	Angular milling (external) & Dovetail	Milling cutter holding devices, work holding

	milling & calculating roller reading. Concave and convex radius milling. Corner rounding milling	devices, Milling machine operations, Up milling and Down milling. Calculation of cutting speed, feed, machining time for milling machine. Indexing methods and its calculations.
17 & 18	Dismantling & Assembly of various parts & sub assemblies of milling machine such as head stock, gear box, lead screw, table, etc Checking & accuracy of milling machine after assembly. Practice of preventive maintenance on milling machines and Demo with case studies on breakdown maintenance & Trouble shooting	Breakdown maintenance and preventive maintenance of a lathe.
19	Procedure for holding of job, setting of machine – stroke length. Practice of wheel balancing. Grinding of parallel and perpendicular surfaces with in the accuracy of $\pm 0.02$ mm, using magnetic chucks and C-clamp. Grinding angular surfaces within an accuracy of $\pm 0.02$ minutes using universal vice. Setting of machine for cylindrical grinding for internal & external surfaces. Setting of machine for Grinding taper holes on cylindrical grinding machine	<b>Grinding:</b> Grinding machine – introduction, parts & constructional details, types – surface grinding and cylindrical grinding machines. Safety precaution followed while working on grinding machines. Grinding wheels – abrasives, bond and bonding process, grit, grade, and structure of grinding wheels and its marking system. Procedure for mounting of grinding wheels, balancing of grinding wheels, dressing and truing of grinding wheels, glazing and loading in grinding wheel.
20 & 21	Dismantling & Assembly of various parts & sub assemblies of grinding machine such as grinding head, ,lead screw, table, hydraulic cylinder etc Checking & accuracy of grinding machine after assembly. Practice of preventive maintenance on grinding machines and Demo with case studies on breakdown maintenance & Trouble shooting	Preventive and breakdown maintenance of grinding machine.
22-23	<b>Implant training / Project work (work in a team)</b>	
24-25	<b>Revision</b>	
26	<b>Examination</b>	

**SYLLABUS FOR THE TRADE OF  
MECHANIC MACHINE TOOL MAINTENANCE  
Fourth Semester  
(Semester Code no. MMTM - 04)  
Duration : Six Month**

Week No.	Trade Practical	Trade Theory
01.	<p>Electrical: Safety precautions to be observed while working in electrical shop. Identification of electrical accessories. Making simple wiring circuits and measurement of current and voltage.</p>	<p>Basic Electricals Safety in electrical shop Measurement of current, voltage, resistance and power. Use of multimeters. Basic principles of DC generators and motors, Alternators and AC motors and transformers. Various types of switches, circuit breakers, fuses, lamps, proximity switches, relays and contactor in electrical circuits.</p>
02.	<p>Testing of power supply (AC &amp; DC) Demonstration of use of test lamp and megger. Connections of DC/AC motors and its speed control - demonstration only.</p>	<p>Passive circuit elements – resistors, capacitors and inductors. Its identification and testing. Colour code. Ohm's law and its applications. Energy sources. Series and parallel connections.</p>
03.	<p>Identification of passive and active electronic components. Observation of waveforms in a power supply using oscilloscope. Verification of logic gate operations.</p>	<p><b>BASIC ELECTRONICS</b> Introduction to electronics and its industrial applications. Introduction to digital electronics – numbers system and logic gates.</p>
04	<p>Scope of industrial electronics with reference to its application in machine tools operation. Identification of basic components - such as Resistor capacitors Inductors.etc,from their out look.Types specifications and general applications of these components Testing &amp; measurement of their values using multimeter,use of Resistance colour codes.solddering and desoldering of component on</p>	<p>Study of electronic circuit – macro level with block diagram.</p>

	<p>printed circuit boards (<b>PCB</b>) precautions to be taken while soldering on PCB.</p>	
05.	<p>Study of rectifiers available in different package –lead identification &amp; testing by multimeter. Study of rectifier circuits –half wave full wave &amp; bridge rectifiers.</p> <p>Study of solid state devices such as diodes transistors, SCRS &amp; ICS available in different packages, type &amp; application. Identification leads &amp; testing by multimeter.</p> <p>Assembly of simple battery eliminator circuit using bridge rectifier &amp; filter capacitor.</p> <p>Measurement of input &amp; output voltages.</p>	Study of PLC - macro level
06.	<p>Instrumentation</p> <p>Demonstration on various measuring devices</p> <p>Demonstration of PLC</p> <p>Trouble shooting of mechanical elements with case studies.</p>	<p>Introduction to industrial process control system and equipment - sensors, transmitters and final control elements.</p> <p>Measurement of displacement, pressure, temperature, flow, level and speed. Application of encoders.</p> <p>Programmable logic controller (PLC) – General concept of working, Relay Logic Control vs. PLC, Block diagram, applications.</p>
07 & 08	<p>Safety precautions in use &amp; maintenance of hydraulic presses.</p> <p>Dis-assembly of hydraulic power pack from press unit.</p> <p>Removal, replacing / refitting of hydraulic pipes, ferrules, O rings, etc.</p> <p>Dismantling of hydraulic cylinder, piston, seals, reassembly, pipe reconnection, air bleeding &amp; testing / working of power press.</p>	Study & working of a hydraulic press along with its components. Breakdown & preventive maintenance of a hydraulic press. Safety in use of and maintenance of hydraulic presses.
09. & 10	<p>Practical Demo on CNC lathe / machining centre operation, its essential parts. Functioning of each part. Multi-media demo.</p> <p>Industrial visit to CNC based Workshop/factory. CNC part program simulation practice.</p>	Introduction to CNC lathe and machining center, constructional details, Mechanical, electrical and Electronic elements of CNC machine, CNC Part program. study of hydraulic diagram, hydraulics valves etc.
11 & 12.	<p>Identification of various types of centrifugal pumps, their parts.</p> <p>Overhauling of pump.</p> <p>Priming of pump,</p> <p>Fitting gland packing.</p> <p>Starting and stopping of pumps.</p> <p>Trouble shooting in pump operation.</p> <p>Preventive and schedule maintenance</p>	<p><b>Centrifugal Pump, Fan, Blower and Compressor:-</b></p> <p><b>Pump</b></p> <p>Function of pump.</p> <p>Types and working principle of centrifugal pump.</p> <p>Constructional detail of pump</p> <p>Starting and stopping</p>

	of pumps.	Pump performance and characteristics. Capitation & aeration Preventive & schedule maintenance of pumps. Gland packing changing procedure. Concept of Mechanical seal Trouble shooting in pump.
13. & 14	Identification of various types of fans, Blowers, their parts. Dismantling, cleaning and assembly of parts. Identification of various types of compressors, their parts. Starting and stopping of compressors Cleaning and changing of filters Preventive & schedule maintenance of Blower & Compressor	<b>Fan &amp; Blowers:</b> Types and working principle Constructional detail of Fans & Blowers. Starting and stopping of Fans and Blowers Different parts of Fans & Blowers Concept of surge. Preventive & scheduled maintenance. <b>Compressors:</b> Compression theory, Types of compressors Constructional detail of compressors, working mechanism Different parts and their function. Loading unloading system Concept of air dryer. Preventive & schedule maintenance.
15.	Practice of different type of knots & hitches used in material handling Raving sets of pulley block. Splicing of manila rope. Inspection of wire rope/steel rope/belts.	Rigging Knowledge of different tools & tackles used in rigging. Construction and capacity of wire rope/steel rope/belts. Application of knots and hitches. Care and maintenance of all types of ropes.
16	Use of mechanical & hydraulic jack, rope puller, chain puller, chain block, winch. Inspection of tools and tackles Loading, unloading and shifting of common and uncommon shapes of material. Hand signal used in rigging.	Different type of jacks, chain block and pull lift. Knowledge of different types of scaffolding. Material movement by using different rigging tools and techniques. Safety appliances & precautions in rigging. Maintenance of tools and tackles.
17 & 18	Demonstration on Belt conveyor system, Vibratory screen & feeder. Demonstration & practice on flat belt jointing	Bulk Material Handling (Conveyor belt, Vibratory screen, Feeders) Principle & mode of material handling. Various components used in belt conveyor system & their functions. (Pulleys, idlers, scrapers, skirts, belt, take up unit system and safety devices). Vibratory screen- working mechanism. Feeders- types, working mechanism. Maintenance practice- Pulley lagging, belt sway control belt joining methods.
19	Revision of Dismantle, inspect and do minor repairs and assemble machine tools such as drill, shaper, lathe and power saw machines.	Breakdown Maintenance, Preventive Maintenance, Predictive Maintenance & Concepts of TPM, OEE.(without calculations) Difference between breakdown and preventive



	Practice of dismantling & assembly of feed units of lathe, milling, grinding etc.	maintenance – Its importance in productivity, types. Normal procedure followed for maintenance of machine tools on the shop floor.
20	Practice on accuracy testing of machine tools. Logging checklist for machine tools.	Accuracy testing of machine tools. Various maintenance practices. Concepts & Measurement of machine performance : MTBF, MTTR. (without calculations)
21	Preparing inspection check-list, taking measurement with the help of industrial thermometer and temperature gun. Use of vibration meter to take measurement. Fault finding practice & attending breakdowns of equipment available in workshop.	Inspection & Condition Monitoring. Maintenance strategy – Reactive, Preventive, Predictive and proactive Importance of inspection. Type / methods of equipment inspection. Shutdown inspection, Inspection of running equipment and inspection of spare parts. Commonly used gadgets for inspection. Concept of inspection check-list. Importance of condition monitoring. Various techniques used for condition monitoring. (vibration, temperature, sound and lubricant condition)
22-23	<b>Implant training</b> / Project work (work in a team)	
24-25	<b>Revision</b>	
26	<b>Examination</b>	

# **LIST OF TOOLS & EQUIPMENTS**

## **TRADE: MECHANIC MACHINE TOOL MAINTENANCE**

### **A1. TRAINEES TOOL KIT**

<b>Sl. No.</b>	<b>Name of tools and equipments</b>	<b>Quantity</b>
1.	Steel Rule 15 cm both side Graduated in Metric & English.	21nos.
2.	Center punch 100 mm	21nos.
3.	File flat 2 <sup>nd</sup> cut 250 mm	21nos.
4.	File flat bastard 350 mm	21nos.
5.	File flat smooth 200 mm	21nos.

### **A2. TRAINEE TOOL KIT (ONE FOR GROUP OF 5 TRAINEES)**

<b>Sl. No.</b>	<b>Name of tools and equipments</b>	<b>Quantity</b>
1.	Hermaphrodite Caliper 150 mm	4 nos.
2.	Try Square 150 mm	4 nos.
3.	Hack Saw frame adjustable 250-300 mm with blades.	4 nos.
4.	Hammer ball peen 400 gm with handle.	4 nos.
5.	Cold Chisel 20 x200 mm	4 nos.
6.	Cross Chisel 10x150 mm	4 nos.
7.	Half Round Chisel 10x150 mm	4 nos.
8.	Diamond point Chisel 10x150 mm	4 nos.
9.	File Half round 2 <sup>nd</sup> cut 250 mm	4 nos.
10.	File triangular smooth 200 mm	4 nos.
11.	File round smooth 200 mm	4 nos.
12.	File square smooth 200 mm	4 nos.
13.	Round nose pliers 200 mm	4 nos.
14.	Combination pliers 200 mm	4 nos.
15.	Scraper A 250 mm (Bearing)	4 nos.
16.	Scraper B 250 mm (Triangular)	4 nos.
17.	Scraper D 250 mm (Half Round)	4 nos.
18.	Spindle blade screw driver 100 mm	4 nos.
19.	Allen keys 2 to 16 mm (Hexagonal)	4 nos.
20.	Card file	4 nos.

## B. TOOLS AND EQUIPMENT FOR MAINTENANCE SHOP

Sl. No.	Name of tools and equipments	Quantity
1	Tap and die set M6, M8, M10, M12, M16, M20 & M25 with necessary tap wrench and die holder.	1 each
2	Spanner socket set of 25 pieces (10 to 25, 27, 30, 32, mm = 18 pcs and assorted = 7 nos.)	1no.
3	Hammer soft (faced 30 mm dia.) plastic tipped.	As required
4	Pipe wrench 450	As required
5	Chain pipe wrench 650	As required
6	Telescopic gauges 13 mm to 300 mm.	As required
7	Tap Extractor	1 no.
8	Linear Actuator (Differential and non-differential)	1 each
9	Cut section model of Pneumatic vales	1 no.
10	Vibrometer	As required
11	Flow Detector	1 no.
12	Magnetic crack detector	1 no.
13	Engineers Stethoscope	As required
14	Stud Extractor	1 no.
15	Tool picker collate type	As required
16	Tool picker magnetic type	As required
17	Magnifying Glass 75 mm	1 no.
18	Pin spanner set	1set
19	Hand keyway breacher	As required
20	C.I. Surface plate 400 x 400 mm with stand and cover	As required
21	Head lamp	1 no.
22	Bearing and gear tester	As required
23	Master test bars (Different sizes)	1 no.
24	Spirit Level 150 mm, accuracy 0.02 mm / 1000 mm	2 nos.
25	3 Cells Torch	2 nos,
26	Gasket Hollow punches 5, 6, 8, 10, 12, 19, 25 mm dia.	1 each
27	Bar type Torque Wrench	1 no
28	Cam lock type Screw Driver	1 no
29	Flaring tools	2 no
30	Tube Expander up to 62 mm	2 set
31	Circlip Pliers (inside, outside and straight)	1 each
32	Sledge hammer 5 Kgs.	1 no
33	Viscometer	1 no.
34	Vernier height gauge 300 mm	1 no.
35	Maintenance tool kit trolley of 1200 x 800 x1200 mm (L x W x H)	As required
36	Steel lockers for 20 trainees	2 nos.
37	Steel cupboard 180 cm x 60 cm x 45 cm	6 nos.
38	Workbench 240 cm x 120 cm x 75 cm (Each bench fitted with 4 vices)	5 nos.
39	Bench Vice with 100 mm jaw	20 nos.
40	Letter punch 5 mm set	1 set
41	Number punch 5mm set	1 set
42	Deep cutting hacksaw frame 300 mm	1 no.
43	Bearing puller	1 no

### C. PRECISION INSTRUMENTS:

Sl. No.	Name of tools and equipments	Quantity
1	Vernier Bevel protractor with 150 mm blade	1 no.
2	Vernier caliper 200 mm with Inside and depth measurements	2 nos.
3	Dial vernier caliper 200 mm, with 0.02 mm least count	1 no.
4	Optical Bevel protractor	1 no.
5	Outside micrometer 0 to 25mm	1 no.
6	Outside micrometer 25 to 50 mm	1 no.
7	Outside micrometer 50 to 75 mm	1 no.
8	Combination set with 300 mm blade centre head, square head and protector head.	1 no.
9	Sine bar 200 mm	1 no.
10	Slip Gauge Box (workshop grade) - 87 pieces per set	1 no.
11	Inside micrometer 50 mm to 200mm, 0.01 mm least count with six extension rod.	1 no.
12	Gear tooth Micrometer ( metric )	1 no.
13	Bevel gauge 200	1 no.
14	Dial test indicator – Plunger type-Range 0-10 mm , Graduation 0.01 mm & 0.001mm Reading 0-10 with revolution counter ( complete with clamping devices and magnetic stand )	1 set
15	Dial test indicator – Puppitast type-Range 0-10 mm , Graduation 0.01 mm & 0.001 mm. Reading 0-10 with revolution counter ( complete with clamping devices and magnetic stand )	1 set
16	Feeler gauge	1 no.
17	Radius gauge 1 to 25 mm radius	1 no.
18	Screw pitch gauge for metric, standard & fine pitches. BSP & BSW pitches ( 0.25 to 6 mm )	1 no.
19	Center gauge 55° x 47½°	1 no.
20	Center gauge 60°	1 no.
21	Plug gauge Morse taper No.1, 2, 3, 4,	1 set
22	Ring gauge Morse taper No.1, 2, 3, 4,	1 set
23	Ring gauge Ø20mm (Go and No Go )	1 no.
24	Limit plug gauges Ø20mm	1 no.
25	Wire gauges	1 no.
26	Bore gauge with dial indicator (1 mm range, 0-0.01 mm graduation)-Range of bore gauge 18-150 mm)	1 no.
27	Straight edge 485 mm to 1445 mm	1 set
28	Bearing fitting tool	1 set
29	Multimeter	2 Nos.
30	Tong tester	1 No.
31	Megger	1 No.
32	Wire stripper cum cutter	1 No.
33	Crimping Tool	1 No.

**D. LATHE TOOLS:**

Sl. No.	Name of tools	Quantity
1	Reduction sleeve and extension socket.	As required
2	Centre drills 3, 4 and 5 mm (Consumable)	2 nos. each
3	Revolving centre with arbor	As required
4	Knurling tool with holder (straight, cross, diamond )	1 each
5	Dog carrier	As required
6	Oil can pressure feed	As required
7	Tool holder (straight) to suit 6 & 8 mm sq. bit size	As required
8	H.S.S. tool bits 6 mm, 8 mm sq. x100 mm length (consumable)	As required

**E. MILLING MACHINE TOOLS:**

Sl. No.	Name of tools	Quantity
1	Cylindrical milling cutter $\text{Ø} 63 \times 70 \times \text{Ø} 27$ mm	1 no.
2	Side and face cutter $\text{Ø} 80 \times 10 \times \text{Ø} 27$ mm	1 no
3	Slitting Saw cutter $\text{Ø} 100 \times 6 \times \text{Ø} 27$ mm	1 no.
4	Slitting Saw cutter $\text{Ø} 75 \times 3 \times \text{Ø} 27$ mm	1 no.
5	'T' slot cutter with parallel shank- $\text{Ø} 17.5 \times 8$ mm width x dia. of shank 8 mm	1 no.
6	Woodruff key seating cutters A 13.5x3, A16x4	1 each
7	Parallel shank end mill $\text{Ø} 5$ mm, $\text{Ø} 6$ mm, $\text{Ø} 8$ mm, $\text{Ø} 10$ mm and $\text{Ø} 12$ mm	1 each
8	Disc type form milling cutter (involute form -1.5 & 2 module, $20^\circ$ pressure angle)	As required
9	Scribing block universal 300mm	As required
10	V-Block-Aprox 65x65x80 mm with clamping capacity of 50 mm with clamps	1 set each
11	D.E spanners 3-4 , 6-8, 10-12, 13-14, 15-16, 18-19, 20-22, 24-26 ( 8 spanners)	1 set
12	Angle plate-adjustable 250x250x300 mm	1 no.
13	Twist Drill Parallel Shank $\text{Ø} 4$ mm to $\text{Ø} 12$ mm in steps of 0.5 mm	1 each
14	Grinding wheel dresser (diamond dresser) with holder 1.5 carat diamond	2 nos.
15	C – clamp- 50 mm & 75 mm	1 each
16	Hand reamer 6 to 16 mm in steps of 1 mm	1 each
17	Machine reamer 6 to 16 in steps of 1 mm	1 each

**F. GENERAL MACHINERIES:**

<b>Sl. No.</b>	<b>Name of tools and equipments</b>	<b>Quantity</b>
1.	SS and SC centre lathe (all geared) with minimum specification as: Centre height 150 mm and centre distance 1000 mm along with 3 & 4 jaw chucks, auto feed system, safety guard, taper turning attachment, motorized coolant system, lighting arrangement & standard accessories.	2 nos.
2.	Universal Milling machine with minimum specification as:  Table Length x width 1200 x 300 mm having motorized up & down movement along with auto feed arrangement and with following attachments such as:  a. Vertical head b. Slotting attachment c. Rack cutting attachment d. Rotary table e. Dividing head f. Adaptors, arbors and collects etc. for holding straight shank drills and cutters from 3 mm to 25 mm.	1no
3.	Surface grinding machine wheel dia 180 mm (or near) reciprocating table, longitudinal table traverse 200mm (or near) full motorized supplied with magnetic chuck 250 X120mm and necessary accessories.	1no
4.	Pillar Drill machine type 20mm capacity.	1no
5.	Double ended Pedestal Grinder with 178 mm wheels(one fine and one rough)-motorized with twist drill grinding attachment	1no
6.	Flexible Hand Grinder 100 mm dia – light duty	1no
7.	Portable Drilling machine 6 mm capacity.	1no
8.	Shaping Machine 450 mm stroke (motorized) with all attachments	1no
9.	Pipe bending machine	1no
10	Hydraulic trainer with necessary elements for different machine circuit with all types of transparent valves and pressure gauge, reservoir etc.	1 set
11	Pneumatic trainer with necessary elements for demonstration different machine circuit with all types of valves, pressure gauge and compressor etc.	1 set

**G. OLD MACHINES FOR JOB WORK (REPAIR & RECONDITIONING):**

<b>Sl. No.</b>	<b>Name of tools and equipments</b>	<b>Quantity</b>
1.	Old Centre lathe	1no
2.	Old Milling Machine (Universal)	1no
3.	Old Grinding Machine (Universal)	1no
4.	Old Shaping Machine	1no
5.	Old Gear Box (any type)	1no
6.	Revolving Centre	1no
7	Old hydraulic power pack with hydraulic cylinder	1 no
8	Old hydraulic power press	1 no
9	Old Gear pump	1 no.
10	Old Vane pump fixed and variable delivery	1each
11	Old Piston pump ( Radial & Axial)	1each

## H. WELDING WORK:

(If welding trade is available in the institute may be used-otherwise to be provided as per list given below)

### 1. GAS WELDING -

Sl. No.	Name of tools and equipments	Quantity
1.	Oxy-acetylene welding Cylinder Trolley	1 no.
2.	Welding hose P.V.C. flexible internal dia. 6 mm (Blue and red)	5m
3.	Hose coupling Nipples	2 nos.
4.	Hose Protractor	2 nos.
5.	Double stage Pressure regulator for Oxygen and Acetylene	1no. each
6.	High Pressure blow pipe with tips	1 no.
7.	Gas cutting torch with cutting tips	1 no
8.	Welding gloves pair (Leather)	1 pair
9.	Goggles (4A) for Gas. Welding	4 nos.
10.	Spark lighter	2 nos.
11.	Spindle key	1 no.
12.	Gas Welding table with fire bricks.	1 no.

### 2. ARC WELDING -

(If welding trade is available in the institute may be used-otherwise to be provided as per list given below)

Sl. No.	Name of tools and equipments	Quantity
1.	Welding Machine DC or AC, (Single phase / 3 phase), 150 – 300 Amps capacity with all accessories	1 no.

## I. ERECTION TOOLS :

Sl. No.	Name of tools and equipments	Quantity
1.	Foundation bolts (different types)	1each.
2.	Plumb bob	1 no.
3.	Square Box Wrenches	1 no
4.	Square T Wrenches	1 no
5.	Engineers square 700 mm	1 no
6.	Threaded Fastener B Type	1 no
7.	Threaded Fastener C Type	1 no
8.	Threaded Fastener F Type	1 no
9.	Hoisting Equipment: chain pulley, steel slings, rope, belt, tackles	1 set

## LIST OF TRADE COMMITTEE MEMBERS

Sl. No.	Name & Designation Sh/Mr/Ms.	Organization	Mentor Council Designation
<b>Members of Sector Mentor council</b>			
1.	A. D. Shahane, Vice-President, (Corporate Trg.)	Larsen & Turbo Ltd., Mumbai:400001	Chairman
2.	Dr. P.K.Jain, Professor	IIT, Roorkee, Roorkee-247667, Uttarakhand	Member
3.	N. Ramakrishnan, Professor	IIT Gandhinagar, Gujarat-382424	Member
4.	Dr. P.V.Rao, Professor	IIT Delhi, New Delhi-110016	Member
5.	Dr. Debdas Roy, Asstt. Professor	NIFFT, Hatia, Ranchi-834003, Jharkhand	Member
6.	Dr. Anil Kumar Singh, Professor	NIFFT, Hatia, Ranchi-834003, Jharkhand	Member
7.	Dr. P.P.Bandyopadhyay Professor	IIT Kharagpur, Kharagpur- 721302, West Bengal	Member
8.	Dr. P.K.Ray, Professor	IIT Kharagpur, Kharagpur- 721302, West Bengal	Member
9.	S. S. Maity, MD	Central Tool Room & Training Centre (CTTC), Bhubaneswar	Member
10.	Dr. Ramesh Babu N, Professor	IIT Madras, Chennai	Member
11.	R.K. Sridharan, Manager/HRDC	Bharat Heavy Electricals Ltd, Ranipet, Tamil Nadu	Member
12.	N. Krishna Murthy Principal Scientific Officer	CQA(Heavy Vehicles), DGQA, Chennai, Tamil Nadu	Member
13.	Sunil Khodke Training Manager	Bobst India Pvt. Ltd., Pune	Member
14.	Ajay Dhuri	TATA Motors, Pune	Member
15.	Uday Apte	TATA Motors, Pune	Member
16.	H B Jagadeesh, Sr. Manager	HMT, Bengaluru	Member
17.	K Venugopal Director & COO	NTTF, Peenya, Bengaluru	Member
18.	B.A.Damahe, Principal L&T Institute of Technology	L&T Institute of Technology, Mumbai	Member
19.	Lakshmanan. R Senior Manager	BOSCH Ltd., Bengaluru	Member
20.	R C Agnihotri Principal	Indo- Swiss Training Centre Chandigarh, 160030	Member
<b>Mentor</b>			
21.	Sunil Kumar Gupta (Director)	DGET HQ, New Delhi.	Mentor
<b>Members of Core Group</b>			
22.	N. Nath. (ADT)	CSTARI, Kolkata	Co-ordinator
23.	H.Charles (TO)	NIMI, Chennai.	Member
24.	Sukhdev Singh (JDT)	ATI Kanpur	Team Leader
25.	Ravi Pandey (V.I)	ATI Kanpur	Member



26.	A.K. Nasakar (T.O)	ATI Kolkata	Member
27.	Samir Sarkar (T.O)	ATI Kolkata	Member
28.	J. Ram Eswara Rao (T.O)	RDAT Hyderabad	Member
29.	T.G. Kadam (T.O)	ATI Mumbai	Member
30.	K. Mahendar (DDT)	ATI Chennai	Member
31.	Shrikant S Sonnavane (T.O)	ATI Mumbai	Member
32.	K. Nagasrinivas (DDT)	ATI Hyderabad	Member
33.	G.N. Eswarappa (DDT)	FTI Bangalore	Member
34.	G. Govindan, Sr. Draughtsman	ATI Chennai	Member
35.	M.N.Renukaradhya, Dy.Director/Principal Grade I.,	Govt. ITI, Tumkur Road, Banglore, Karnataka	Member
36.	B.V.Venkatesh Reddy. JTO	Govt. ITI, Tumkur Road, Banglore, Karnataka	Member
37.	N.M.Kajale, Principal,	Govt. ITI Velhe, Distt: Pune, Maharashtra	Member
38.	Subrata Polley, Instructor	ITI Howrah Homes, West Bengal	Member
39.	VINOD KUMAR.R Sr.Instructor	Govt.ITI Dhanuvachapuram Trivendrum, Dist., Kerala	Member
40.	M. Anbalagan, B.E., Assistant Training Officer	Govt. ITI Coimbatore, Tamil Nadu	Member
41.	K. Lakshmi Narayanan, T.O.	DET, Tamil Nadu	Member
<b>Other industry representatives</b>			
42.	Venugopal Parvatikar	Skill Sonics, Bangalore	Member
43.	Venkata Dasari	Skill Sonics, Bangalore	Member
44.	Srihari, D	CADEM Tech. Pvt. Ltd., Bengaluru	Member
45.	Dasarathi.G.V.	CADEM Tech. Pvt. Ltd., Bengaluru	Member
46.	L.R.S.Mani	Ohm Shakti Industries, Bengaluru	Member