

**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 10th Exam. Under 10+2 system of Education or its Equivalent.
7. **Trainees per unit** : 20
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).

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.

9. **For Employability Skills:-** One contract/part time / guest faculty for Generic module
i) MBA/ BBA with two years experience **OR** Graduate in Sociology / Social Welfare / Economics with Two years experience **OR** Graduate / Diploma with Two years experience and trained in Employability Skills from DGET institutes
AND
Must have studied English / Communication Skills and Basic Computer at 12th / Diploma level and above
OR
Existing Social Study Instructors duly trained in Employability Skills from DGET institutes

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 & Machinery used in the trade. Health & Safety: Introduction to safety equipments and their uses. Introduction of first aid, operation of Electrical mains.</p> <p>Occupational Safety & Health Importance of housekeeping & good shop floor practices. Health, Safety and Environment guidelines, legislations & 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 & personal safety message. Preventive measures for electrical accidents & 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. Soft Skills: its importance and Job area after completion of training. Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept & 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 & 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 & sections by hack-sawing to accuracy of 0.5 mm.</p>	<p><u>Basic Fitting Skill</u> Classification, constructional and functional details of different type of vices (bench & machine), Care of vices, hacksaw, its classification, saw setting, selection of hacksaw blades. Bench work safety- related hazards, risk and precautions.</p>

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"> • Steel Rule • Calipers(Inside & outside), • Divider, Trammel • Try Square • Marking Punch 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. Scrapers: 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	Drilling machines: 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.

	<p>& Dies. Prepare studs and nut.</p> <p>Identification of various parts of Drilling machines.</p>	<p>Related hazards, risk and precautions. Introduction to theory of metal cutting - cutting speeds, feeds etc. about tools and their geometry. 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. Taps & Dies: Classification, construction, material and functional detail of Taps & Dies.</p>
17 -- 18	<p>Filing & fitting mating components by filing within an accuracy of ± 0.15 mm & angular 30 minutes</p>	<p>Surface finish - importance, symbol, measuring techniques. Lapping & honing process. Gauges: Classification and uses of Sine bar, Slip gauge, Limit gauge, Feeler gauge, thread gauge, screw pitch gauge, taper gauge.</p>
19	<p>Fitting of mating components by filing and scrapping within an accuracy of ± 0.10 mm & angular within 30 minutes</p>	<p>Tolerances & interchangeability - 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.</p>
20	<p>Practice on dovetail fitting mating components by filing and scrapping within an accuracy of ± 0.10 mm & angular within 30 minutes for cylindrical surfaces.</p>	<p>Fasteners: 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.</p>
21 - 22	<p>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.</p>	<p>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</p>

23-24	Revision
25	Examination

SYLLABUS FOR WORKSHOP SCIENCE AND CALCULATION
SEMESTER-I

Week No	Workshop Science and Calculation
1	- Introduction to Iron and Steel. Differences in Iron & steel.
2	- Introduction to Property and uses of C.I. and wrought Iron. - Iron and steel properties and uses.
3	- Properties and uses of plain carbon steel and alloy steel.
4	- Properties and uses of non ferrous metals and alloys. - Fraction and decimal -conversion fraction decimal and vice-versa.
5	- Properties and uses of copper, zinc, lead, tin, aluminum.
6-7	- Composition, properties and uses of brass, bronze, solder, bearing material, timber, rubber etc.
8	- System of units, British, metric and SI units for length, area, volume capacity, weight, time, angle, their conversions. - Effect of alloying elements in the properties of C.I. & steel.
9	- Unit of temperature for & related problems. Standard & absolute temp.
10-11	- Mass, volume, density, weight, sp. Gravity & specific weight. S.I. M.K.S. and F.P.S. units of force, weight etc. their conversion to related problems.
12	- Inertia, rest and motion, velocity and acceleration.
13	- Types of forces, its units and Weight calculation.
14	- Revision & Test - Power and roots Factor, Power base exponents number. Multiplication and division of power and root of a number. Square root of number and problems.
15	- Heat & temperature, thermometric scales, their conversions.
16-17	- Work energy and power, their units and applied problems.
18-19	- Percentage, changing percentage to decimal and fraction and vice versa. Applied problems.
20	- Problem on percentage related to trade.
21	- Different types of loads, stress, strain, modulus of elasticity. Ultimate strength, different types of stress, factor of safety, examples.
22	- Ratio & proportion- Ratio, finding forms ratio proportions, direct proportion and indirect proportion. Application of ratio and proportion & related problems.
23-25	Revision
26	Examination

SYLLABUS FOR ENGINEERING DRAWING
SEMESTER-I

Week No	Engineering Drawing
1-2	- Engineering Drawing-- introduction to Engg. Drawing and its importance.
3	- Use of drawing instruments –Drawing of straight, inclined and curved lines.
4	- Exercise on linear and angular measurements.
5	- Types of lines their meaning & application as per BIS SP: 46-2003.
6-7	- Simple conventional symbols for material and parts as per BIS SP: 46-2003. - Geometrical construction of rectangles, square, circles.
8	- Geometrical construction of polygon and ellipse, parabola & hyperbola.
9	- Geometrical construction of involutes, oval, and helix.
10-11	- Free hand sketching of straight lines, rectangles, circles, square, polygons, ellipse.
12	- Standard printing style for letters and numbers as per BIS : SP: 46-2003 using stencils
13	- Free hand sketching of simple geometrical solids, cube, cone, prism, cylinder, sphere, pyramids.
14	- Scales- Types & its use.
15	- Revision & Test - Construction of diagonal scale.
16	- Simple dimensioning technique, size and location, dimensions of parts, holes angles, taper, screw etc. as per BIS SP: 46-2003.
17	- Transferring measurements for linear, angular, circular dimensions from the given object to the related free hand sketches using different measuring instruments.
18-19	- Pictorial drawings, isometric drawings of simple geometrical solids.
20	- Oblique/orthographic projection of simple geometrical solids.
21	- Orthographic drawings: Application of both the first angle and third angle. Isometric drawing of simple machined & casting blocks.
22	- Free hand sketches of trade related hand tools and measuring tools.
23-25	Revision
26	Examination

SYLLABUS FOR EMPLOYABILITY SKILLS

SEMESTER-I

1. I.T. Literacy	
Hours of Instruction : 20 Hrs.	Marks Allotted : 20
Computer	- Introduction, Computer and its applications, Hardware and peripherals, Switching on and shutting down of computer.
WINDOWS	- Basics of Operating System, WINDOWS, The user interface of Windows OS, Customizing Windows Operating System, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc, Use of Common applications.
MS office	- Basic operations of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creation and Editing of Text, Formatting the Text, Printing document, Insertion & creation of Tables. - Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets
INTERNET	- Basic of Computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks), Applications of Internet : Browsing, Searching, Emailing, Social Networking
WEB Browser	- Meaning of World Wide Web (WWW), Search Engines with examples, Web Browsing, Accessing the Internet using Web Browser, Downloading Web Pages, Printing Web Pages - Information Security and antivirus tools Do's and Don'ts in Information Security, Awareness of IT – ACT, Importance of information security and IT act, types of cyber crimes.
2. English Literacy	
Hours of Instruction: 15 Hrs.	Marks Allotted : 15
Pronunciation	- Phonetics and pronouncing simple words.
Listening	- Interpreting conversation and discussions related to everyday life, Responding to spoken instructions in order to carry out requests and commands.
Speaking	- Asking and answering simple questions in English to describe people, things, situations and events.
Reading	- Reading and interpreting simple sentences, forms, hoardings, sign boards and notices.
Writing	- Writing sentences with simple words, reply to everyday office correspondence, - Writing CV & simple application forms.
3. Communication skill	
Hours of Instruction: 15 Hrs.	Marks Allotted : 15
Communication Skills	- Definition, Effective communication, Verbal communication, Use of right words, Non verbal communication, Body Languages.
Motivation	- Self awareness, Goal setting, Career planning, Values and Ethics
Time management	- Managing time effectively through planning
Facing Interviews	- Appearance and behaviour in an interview, Do's and don'ts
Behavioral Skills	- Attitude, Problem Solving, Thinking Skills, Confidence building

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 & assembly of Shafts, couplings, keys, gears, bearings, belts, chain pulley, rope pulley.</p> <p>Related hazards, risk and precautions while working.</p>	<p><u>Maintenance Practice and Mechanical Assembly</u> Introduction to various maintenance practices such as preventive maintenance, predictive maintenance, breakdown maintenance & reconditioning.</p> <p><u>Transmission of Power</u> 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 & assembly of mechanical & electromagnetic assembly.</p> <p>Related hazards, risk and precautions while working.</p> <p>Measuring shaft and coupling bore for finding out taper & ovality to determine the type of fit.</p> <p>Find out the size of key for a given set of shaft & bore. Key making, mounting of coupling on shaft with key.</p> <p>Application of fits on assembly of key, hub & shaft.</p> <p>Identification of different types of Brakes & Functioning of Braking mechanism in machine tools. Inspection of components of Brakes & braking mechanism.</p>	<p><u>Clutches</u> Function of Clutches, its types and use in power transmission system. Function of mechanical & electromagnetic system in clutch mechanism.</p> <p><u>Couplings:</u> 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><u>Brakes & Braking Mechanism : Types & Functions.</u> Inspection of brakes for safe & 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><u>Belts-</u> 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>
05 & 06	<p>Identification of various types of bearings.</p> <p>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</p>	<p><u>Bearing:</u> Description and function of bearing, its types - Solid Bush, Split Bush, Collar, Pivot and Plummer Block Bearing. Mounting of bearings, measurement and adjustment</p>

	<p>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 & 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 & assembly of simple m/c parts & units like cross slide, compound slide & tailstock of lathe.</p>	<p>of clearances in bearings. Types of bearing fitting on shaft and hubs. Type of Roller contact bearings- Ball bearings- single row & 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>
07.	<p>Identification of various types of Gears & Gear boxes. Inspection of various aspects of Gears & Gear boxes such as PCD checking by Cylindrical Pin, Checking of gear tooth thickness, clearance, concentricity & wear etc. Gear meshing: Checking of backlash and root clearances with Feeler Gauge, Dial Test Indicator and Lead Wire.</p>	<p>Gear: 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>
08	<p>Practice on oil removing & filling from gear box. Inspection of the drained oil for contaminants & wear debris with focus on visual inspection. Overhauling procedure of gear box (Pre cleaning, dismantling, cleaning, inspection, repair/ replacement, assembly).of speed & feed gearboxes of lathe & milling m/c Preparation of inspection sheet/ report. Preparation of action plan.</p>	-do-

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

	<p>builder. Locating static unbalance in a rotor, finding the correction weight. Checking & adjusting radial & axial play of spindles & eliminating play of slide units.</p>	<p>Type of unbalance. Method of static balancing and its correction -Adding and removing mass -Mass centering.</p>
15 & 16	<p>Safety precautions in dismantling & assembly of Drilling machines. Dismantling and assembly of various parts such as Motors, Spindle & Spindle head, Gear box and Arm.</p>	<p>Maintenance and Repairs of Various types of drilling machines.</p>
17 & 18	<p>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 ± 0.1mm 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).</p>	<p><u>Machine Tool Operation & Maintenance</u> <u>Lathe Machine</u> 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.</p>
19 & 20	<p>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</p>	<p>Breakdown maintenance and preventive maintenance of a lathe.</p>
21 & 22	<p>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</p>	<p>Shaper: Introduction to Shaper machine parts & constructional details, its function and operations. Quick return mechanism of shaper. Calculation of cutting Speed, feed & depth of cut.</p>
23-24	Implant training / Project work (work in a team)	

25	Revision
26	Examination

SYLLABUS FOR WORKSHOP SCIENCE AND CALCULATION
SEMESTER-II

Week No	Workshop Science and Calculation
1-2	- Simple machines-principle, velocity ratio, mechanical advantage, efficiency, related problems.
3	- Algebraic symbols, fundamental algebra operations, sign and symbols used in algebra, coefficient terms, and unlike terms.
4	- Algebraic addition, subtraction, multiplication and division.
5	- Simple machines like winch pulley and compounding axle etc.
6-7	- Calculation of tap hole sizes for internal threads and blank size for cutting external threads.
8	- Factors and equations: Algebraic formula and solving simple equations.
9	- Factors and different types of factorization (LCM, HCF).
10	- Equations: simple simultaneous equation.
11	- Simple simultaneous equation.
12	- Application, construction and solution of problems by equation.
13-14	- Atmospheric pressure, pressure gauge, gauge pressure and absolute pressure and their units.
15	- Simple problems on multiplication, division, power and root using calculator.
16	- Power and exponent. Laws of exponent.
17	- Relation between specific gravity and density simple experimental determination.
18	- Geometry: Fundamental geometrical definition- angles and properties of angles, triangles, and properties of triangles.
19-20	- Pythagoras theorem, properties of similar triangles. - Revision.
21	- Definition and units of torque. Pythagoras theorem, properties of similar triangles. - Revision.
22-23	Implant training / Project work (work in a team)
24-25	Revision
26	Examination

SYLLABUS FOR ENGINEERING DRAWING
SEMESTER-II

Week No	Engineering Drawing
1	- Simple sketches of trade related hand tools & measuring instruments
2	- Introduction to Orthographic Views and its advantages.
3-4	- Orthographic drawings, application of both the first angle and third angle. Method of representing the drawings for simple and complex machine parts, exercises with dimensions.
5	- Standard method of sectioning as per BIS: SP: 46-2003. Exercises for different sectional views on the given orthographic drawing of machine part, castings etc. - Orthographic drawings in first angle projection.
6	- Orthographic drawings in the first angle projection.
7-9	- Orthographic drawings in the third angle projection
10-11	- Standard method of sectioning as per BIS. SP: 46-2003. Exercises for different sectional views on the given orthographic drawing of machine parts, casting etc.
12-14	- Conversion of isometric, oblique drawings to orthographic drawings and vice-versa. Related problems such as 'V' block oriented by various machining operations etc.
15	- Method of representing the drawings for simple and complex machine blocks given for exercises with dimensions.
16	- Reading of production drawing including machining symbol, GD&T.
17-18	- Surface development of simple geometrical solids like cube, rectangular block, cone, pyramid, cylinder, prism etc.
19-20	- Interpretation of solids and conventional application of intersectional curves on drawing. - Solution of NCVT test paper (preliminary) Revision.
21	- Sketches for bolts, nuts, screws and other screwed members.
22-23	Implant training / Project work (work in a team)
24-25	Revision
26	Examination

SYLLABUS FOR EMPLOYABILITY SKILLS
SEMESTER-II

1. Entrepreneurship skill	
Hours of Instruction : 10 Hrs.	
Marks Allotted : 10	
Business & Consumer	Types of business in different trades and the importance of skill, Understanding the consumer, market through consumer behavior, market survey, Methods of Marketing, publicity and advertisement
Self Employment	Need and scope for self-employment, Qualities of a good Entrepreneur (values attitude, motive, etc.), SWOT and Risk Analysis
Govt Institutions	Role of various Schemes and Institutes for self-employment i.e. DIC, SIDBI, MSME, NSIC, Financial institutions and banks.
Initiation Formalities	Project Formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment Procedure - Loan Procurement - Agencies - banking Process
2.Environment Education	
Hours of Instruction : 10 Hrs.	
Marks Allotted : 10	
Ecosystem	Introduction to Environment, Relationship between Society and Environment, Ecosystem and Factors responsible for destruction.
Pollution	Pollution and pollutants including liquid, gaseous, solid and hazardous waste.
Energy Conservation	Conservation of Energy, re-use and recycle.
Global warming	Global warming, climate change and Ozone layer depletion.
Ground water	Hydrological cycle, ground and surface water and treatment of water.
Environment	Right attitude towards environment, Maintenance of in-house environment.
3.Occupational Safety, Health & Environment	
Hours of Instruction : 10 Hrs.	
Marks Allotted : 10	
Safety & Health	Introduction to Occupational Safety and Health and its importance at workplace
Occupational Hazards	Occupational health, Occupational hygiene, Occupational Diseases/ Disorders & its prevention
Accident & safety	Accident prevention techniques- control of accidents and safety measures
First Aid	Care of injured & Sick at the workplaces, First-aid & Transportation of sick person
Basic Provisions	Idea of basic provisions of safety, health, welfare under legislation of India
4.Labour Welfare Legislation	
Hours of Instruction : 10 Hrs.	
Marks Allotted : 10	
Welfare Acts	Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's Compensation Act
5.Quality Tools	
Hours of Instruction : 10 Hrs.	
Marks Allotted : 10	
Quality Consciousness	Meaning of quality, Quality Characteristic
Quality Circles	Definition, Advantage of small group activity, objectives of Quality Circle, Roles and Functions of Quality Circles in organisation, Operation of Quality Circle, Approaches to Starting Quality Circles, Steps for Continuation Quality Circles

Quality Management System	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.
House Keeping	Purpose of Housekeeping, Practice of good Housekeeping.5S Principles of Housekeeping: SEIRI – Segregation, SEITON – Arrangement, SEISO – Cleaning, SEIKETSU – maintenance of Standards, SHITSUKE – Discipline

Third Semester
(Semester Code no. MMTM - 03)
Duration : Six Month

Week No.	Trade Practical	Trade Theory
01 & 02.	<p><u>Arc Welding</u> 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 & Tee joint. Practice on pipe joint.</p>	<p><u>Welding & Gas Cutting</u> <u>Arc Welding</u> Introduction to arc welding process viz Fusion, Non-fusion & Pressure, its classifications, accessories and its safety. Metal Joining Methods & its advantages, Welding types, Common tools used in welding. Basic Electricity as applied to Welding Arc Length & its effects Arc Welding Machines: - advantages & disadvantages of AC & DC Arc Welding Machine. Safety Precautions: Related to Arc welding m/c & accessories. Manual Metal Arc Welding Electrodes: - Sizes & Coding. Edge Preparation: - Necessity of edge preparation. Nomenclature of butt & fillet welding. Welding Symbols & Weld defects.</p>
03	<p><u>Gas Welding</u> Setting up of a gas welding set. Setting of different types of flames with gas welding & adjustment of flame. Making straight beads with and without filler rod. Making square lap joint, butt joint & Tee joint using plates / sheets of up to 3 mm thickness. Setting up of flames for gas cutting of different material thickness.</p>	<p><u>Gas Welding</u> Introduction to gas welding process, its classifications, accessories and its safety. Principle of gas cutting. Systems of Oxy-Acetylene Welding- Flashback & backfire Types of Oxy-Acetylene flames: - Gases used in welding & 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><u>Hydraulics & Pneumatics</u> Basic principles of Hydraulics - Advantages & limitation of hydraulic system, hydrostatic transmission, Pascal's law, Brahma's press, pressure Temperature & 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 - Hydraulic pumps - Hydraulic actuators.	Function and construction of gear pump, vane pump and piston pump, cylinder & hydraulic motor.
7.	Simulation of hydraulic circuits. - Simple hydraulic circuits. Hydraulic circuit reading practice & constructing hydraulic circuits for single & double acting cylinders, meter in, meter out circuit, pressure control circuits & regenerating circuit.	Auxiliary & fluid conditioner: Reservoir, filter, strainer, pressure gauge, pipe & pipe fitting, accumulator, seals & packing Simple hydraulic circuits : - Hydraulic symbols - Study of different hyd. Circuits Related hazards, risk and precautions.
8.	Practice on constructing hydraulic circuits.	Electro hydraulic circuit, Electrical components - Switches - Solenoid - Relay
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 - Switches - Solenoid - Relay
11	Cutting & Threading of pipe. Fitting of pipes as per sketch.	Pipe Fitting and Valves 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 &	Use of different type of valve like: Gate, Globe, butterfly, Diaphragm. Direction	Pipe colour code. Safety precautions to be observed while working

14	control valve, pressure relief valve, non return valve, flow control valve. Assembly and disassembly of valves. Making and replacement of gaskets.	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 ± 0.2 mm. Step milling (external) operation within the accuracy of ± 0.2 mm. T slot milling	Milling: 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 & calculating roller reading. Concave and convex radius milling. Corner rounding milling	Milling cutter holding devices, work holding 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 ± 0.02 mm, using magnetic chucks and C-clamp. Grinding angular surfaces within an accuracy of ± 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	Grinding: 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	Implant training / Project work (work in a team)
24-25	Revision
26	Examination

SYLLABUS FOR WORKSHOP SCIENCE AND CALCULATION
SEMESTER-III

Week No	Workshop Science and Calculation
1	- Revision of 1 st year course.
2	- Heat and temperature, thermometric scales their conversions.
3	- Rectangle, square, Rhombus, parallelogram and their properties.
4	- Circle and properties circle: regular polygons. - Application of geometrical to shop problems.
5-6	- Forces definition. - Compressive, tensile, shear forces and simple problems.
7	- Temperature measuring instruments. Specific heats of solids & liquids, quantity of heat.
8	- Heat loss and heat gain, with simple problems.
9	- Mensuration: Plain figures-triangles, square, rectangle, parallelogram.
10	- Mensuration : Plain figures-segment and sector of circle, ellipse, fillets. - Plain figures. Trapezium, regular polygons, circle, hollow circles.
11	- Mensuration: Solid figures: Prism, cylinder, pyramid, cone. - Solid figures: frustum of a cone, sphere, spherical segment.
12	- Material weight and cost problems related to trade.
13	- Trigonometry: trigonometric ratios, use of trigonometric table.
14	- Area of triangle by trigonometry.
15	- Finding height and distance by trigonometry.
16	- Application of trigonometry in shop problems. - Industrial visit.
17-18	- Application of trigonometry in shop problems.
19-20	- Levers-definition, types and principles of levers.
21	- Mechanical Advantage, velocity ratio and mechanical efficiency.
22-23	Implant training / Project work (work in a team)
24-25	Revision
26	Examination

SYLLABUS FOR ENGINEERING DRAWING
SEMESTER-III

Week No	Engineering Drawing
1	- Revision of first year topics.
2	- Machined components and surface finish symbols.
3	- Screw thread, their standard forms as per BIS, external and internal thread, conventions on the features for drawing as per BIS.
4	- Sketches for bolts, nuts, screws and other screwed members.
5	- Sketching of foundation bolts and types of washers.
6	- Standard rivet forms as per BIS.
7	- Riveted joints-Butt & Lap.
8-9	- Sketches of keys, cotter and pin joints.
10-11	- Sketches for simple pipe, unions with simple pipe line drawings.
12	- Concept of preparation of assembly drawing and detailing. Simple assemblies & their details of trade related tools/job/exercises with the dimensions from the given sample or models.
13	- Single Tool post for the lathe with washer and screw.
14	- Details and assembly of Vee-blocks with clamps.
15	- Details and assembly of Vee-blocks with clamps.
16	- Details of assembly of shaft and pulley. - Industrial visit.
17	- Details of assembly of shaft and pulley.
18	- Details of assembly of bush bearing.
19	- Details of assembly bush bearing.
20	- Details of assembly of a simple coupling.
21	- Sketching of different gear wheels and nomenclature.
22-23	Implant training / Project work (work in a team)
24-25	Revision
26	Examination

Fourth Semester
(Semester Code no. MMTM - 04)
Duration : Six Month

Week No.	Trade Practical	Trade Theory
01.	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.	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.
02.	Testing of power supply (AC & DC) Demonstration of use of test lamp and megger. Connections of DC/AC motors and its speed control - demonstration only.	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.
03.	Identification of passive and active electronic components. Observation of waveforms in a power supply using oscilloscope. Verification of logic gate operations.	BASIC ELECTRONICS Introduction to electronics and its industrial applications. Introduction to digital electronics – numbers system and logic gates.
04	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 & measurement of their values using multimeter,use of Resistance colour codes.solddering and desoldering of component on printed circuit boards (PCB) precautions to be taken while soldering on PCB.	Study of electronic circuit – macro level with block diagram.
05.	Study of rectifiers available in different	Study of PLC - macro level

	<p>package –lead identification & testing by multimeter. Study of rectifier circuits –half wave full wave & bridge rectifiers.</p> <p>Study of solid state devices such as diodes transistors, SCRS & ICS available in different packages, type & application. Identification leads & testing by multimeter.</p> <p>Assembly of simple battery eliminator circuit using bridge rectifier & filter capacitor. Measurement of input & output voltages.</p>	
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 & 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 & testing / working of power press.</p>	<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.</p>
09. & 10	<p>Practical Demo on CNC lathe / machining centre operation, its essential parts.</p> <p>Functioning of each part. Multi-media demo.</p> <p>Industrial visit to CNC based Workshop/factory. CNC part program simulation practice.</p>	<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.</p>
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 of pumps.</p>	<p>Centrifugal Pump, Fan, Blower and Compressor:- Pump</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> <p>Pump performance and characteristics.</p> <p>Capitation & aeration</p> <p>Preventive & schedule maintenance of pumps.</p> <p>Gland packing changing procedure.</p> <p>Concept of Mechanical seal</p>

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

	feed units of lathe, milling, grinding etc.	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	Implant training / Project work (work in a team)	
24-25	Revision	
26	Examination	

SYLLABUS FOR WORKSHOP SCIENCE AND CALCULATION
SEMESTER-IV

Week No	Workshop Science and Calculation
1-2	- Centre of gravity, simple experimental determination, stable, unstable & neutral equilibrium, simple explanation
3	- Friction- co-efficient of friction. Simple problem related to friction.
4	- Magnetic substances- natural and artificial magnets.
5	- Method of magnetisation. Use of magnets.
6	- Electricity & its uses. Electric current-positive & negative terminals.
7	- Use of fuses and switches, conductors and insulators.
8	- Simple electric circuits, simple calculations.
9	- Simple calculation based on Ohm's law. - electrical insulating materials.
10-11	- Transmission of power by belt, pulleys & gear drive. - Calculation of Transmission of power by belt pulley and gear drive.
12-13	- Read images, graphs, diagrams –bar chart, pie chart. - Graphs: abscissa and ordinates, graphs of straight line, related to two sets of varying quantities.
14	- Stress, strain, Hooks law, ultimate strength, factor of safety definitions and problems on them.
15-16	- Mechanical properties of metals. - Heat treatment and advantages.
17	- Basic Electronic: Introduction to wiring symbols, units, resistor, capacitor and inductor.
18-21	- Solution of NCVT test papers.
22-23	Implant training / Project work (work in a team)
24-25	Revision
26	Examination

SYLLABUS FOR ENGINEERING DRAWING
SEMESTER-IV

Week No	Engineering Drawing
1-2	- Details and assembly of simple hand – vice.
3-4	- Blue print Reading. Simple exercises related to missing lines.
5-6	- Simple exercises relating missing symbols. - Missing views
7-10	- Simple exercises related to missing section.
11-12	- Sketching of different types of bearings and its conventional representation.
13	- Solution of NCVT test. - Basic electrical and electronic symbols
14	- Study of drawing & Estimation of materials.
15-16	- Solution of NCVT test papers.
17	- Solution of NCVT test papers.
18-21	- Revision
22-23	Implant training / Project work (work in a team)
24-25	Revision
26	Examination

LIST OF TOOLS & EQUIPMENTS FOR 20 TRAINEES

TRADE : MECHANIC MACHINE TOOL MAINTENANCE

A1. TRAINEES TOOL KIT

Sr. No.	Name of tools and equipments	Trainees	Instructor	Total
1.	Steel Rule 15 cm both side Graduated in Metric & English.	20 nos.	1 no.	21nos.
2.	Center punch 100 mm	20 nos.	1 no.	21nos.
3.	File flat 2 nd cut 250 mm	20 nos.	1 no.	21nos.
4.	File flat bastard 350 mm	20 nos.	1 no.	21nos.
5.	File flat smooth 200 mm	20 nos.	1 no.	21nos.

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

Sr. No.	Name of tools and equipments	Quantity
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 nd 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

Sr. 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:

Sr. 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 :

Sr. 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 :

Sr. No.	Name of tools	Quantity
1	Cylindrical milling cutter $\varnothing 63 \times 70 \times \varnothing 27$ mm	1 no.
2	Side and face cutter $\varnothing 80 \times 10 \times \varnothing 27$ mm	1 no
3	Slitting Saw cutter $\varnothing 100 \times 6 \times \varnothing 27$ mm	1 no.
4	Slitting Saw cutter $\varnothing 75 \times 3 \times \varnothing 27$ mm	1 no.
5	'T' slot cutter with parallel shank- $\varnothing 17.5 \times 8$ 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 $\varnothing 5$ mm, $\varnothing 6$ mm, $\varnothing 8$ mm, $\varnothing 10$ mm and $\varnothing 12$ mm	1 each
8	Disc type form milling cutter (involute form -1.5 & 2 module, 20° pressure angle)	As required
9	Scribing block universal 300mm	As required
10	V-Block-Approx 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 $\varnothing 4$ mm to $\varnothing 12$ mm in steps of 0.5 mm	1 each
14	Grinding wheel dresser (diamond dresser) with holder 1.5 caret 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 :

Sr. No.	Name of tools and equipments	Quantity
1.	Lathe all gear head type, with Centre height of 150 mm or below, Gap bed, between centers 1000 mm (with 3 jaw and 4 jaw chuck, coolant equipments).	2 nos
2.	Universal Milling machine	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.	Drilling machine pillar 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) :

Sr. No.	Name of tools and equipments	Quantity
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 -

Sr. 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)

Sr. 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 :

Sr. 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
Members of Sector Mentor council			
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
Mentor			
21.	Sunil Kumar Gupta (Director)	DGET HQ, New Delhi.	Mentor
Members of Core Group			
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
Other industry representatives			
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