

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

**TOOL & DIE MAKER
(PRESS TOOLS, JIG & FIXTURES)**

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** : **Tool & Die Maker (Press Tools, Jigs and Fixtures)**
2. **NCO Code No.** : 833.10,
833.40
3. **Duration of Craftsmen Training:** Two years (Four semesters each of six months duration).
4. **Power norms** : 29.6 kw
5. **Space norms** : 130 Sq. mt.
6. **Entry qualification** : Passed 10th Class with Science and Mathematics under
10+2
system of Education or its equivalent
7. **Trainees per unit** : 20
- 8a. **Qualification for Instructor** : Degree in Mechanical Engineering from recognized
university with one year post qualification experience
in the relevant field.

OR

Diploma in Mechanical Engineering/Tool and Die
Making from a recognized Board of Technical
Education with two year post qualification
experience in the relevant field.

OR

NTC/NAC passed in same or relevant trade with 3
years post qualification experience.
- 8b. **Desirable Qualification** : Preference will be given to a candidate with Craft Instructor
Certificate (CIC).

Note:

1. Common First & Second Semester Training for both Tool & Die Making - Press Tools, Jigs and Fixtures and Dies and Moulds.
2. During the remaining two semester of training under CTS, the trainee will undergo training either in Press Tools, Jigs and Fixtures Making or in Dies and Moulds Making.

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	5 Hours	3 Hours	3 Hours	2 Hours	2 Hours

COURSE INFORMATION

1. Introduction:

This course is meant for the candidates who aspire to become a professional **Tool and Die maker (Press Tools, Jig and Fixtures)**.

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 Tool and Die Maker (Press Tool, Jig and Fixtures).
2. The trainee can able to manufacture different components for jigs, fixtures and press tools by operating different machines like lathe, drilling, welding, milling grinding and CNC. Inspection & measurement of different components and observing safety precautions while working.
3. The trainees can work on Dismantle & assemble of various jigs, fixtures and press tools and test.
4. Perform simple repair on machinery,
5. Trainee is able to make simple programme on CNC machine and operate.
6. 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 defense organizations
7. In public sector industries like BHEL, BEML, NTPC, 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 TOOL AND DIE MAKER (Press Tools, Jig & Fixtures)

First Semester
(Semester Code no. TDM(PT,J&F) - 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 - 4	<p>Bench work:</p> <p>Identification of tools & equipments as per desired specifications for marking & sawing. Holding rectangular piece of material in bench vice -filing flat surfaces and edges by maintain 90° angles between all surfaces and edges - checking the dimensions and angles with steel rule and try square.</p> <p>Marking out of parallel lines using odd leg caliper, punching. Hack sawing to a different length as per marking (for step filing). Marking out of parallel lines using odd leg caliper, punching. Hack sawing to a different length as</p>	<p>Bench vice construction –types, uses, care and maintenance. Hacksaw frames – its types, hacksaw blade – description, material, specifications and uses.</p> <p>Method of using hacksaw. Steel rule, calipers- its type, surface plate, surface gauge, scribes, punches – its types, hammer –its types. Metric and FPS system of measurement.</p> <p>Introduction of file, types, materials, classification, filing techniques and operations. Applications of files.</p>

	<p>per marking (for step filing).</p> <p>Identification of tools & equipments as per desired specifications for filing. File steps and finish with smooth file with in the accuracy of $\pm 0.5\text{mm}$. Filing 45° chamfer at all the edges Filing external radius and check with radius gauge.</p>	
5 - 6	<p>Identification of tools & equipments as per desired specifications for drilling and tapping. Making rectangular parallel block and drilling practice for through holes, blind holes, Counter drilling, Counter sinking, chain drilling and tapping.</p>	<p>Drilling machine description – its types, Selection of cutting speed for different materials. Calculation of rotation per minute (rpm), drilling time for drilling. Description of twist drill, counter boring tool, counter sinking tool. Drill material, type (taper shank, straight shank), parts and size. Description and uses of taps, dies and reamers. Care to be taken while using taps, dies and reamers.</p>
7 - 9	<p>Practice of step fitting having curvature/radius fitting</p>	<p>Vernier caliper, micrometer (inside & outside), height gauge, bevel protector – working principle – construction, graduations, calculation of least count, readings-uses and care</p> <p>Introduction to Limit, Fits, Tolerance, Allowance – its application in interchangeable system.</p> <p>Introduction of chisel and scraper - its material, parts, type and method of chipping and scraping.</p> <p>Study of different types of gauges and templates used in fitting.</p>
10.	<p>Practice of Chipping & Scraping</p>	<p>Study of tools used in chipping and scraping. Introduction about metals, difference between Metal and Non Metal, properties of metal, Classification of metals and its applications. Heat treatment of metals, process- such as annealing, nitriding, hardening, tempering, case hardening, carburizing, cyaniding, flame hardening, induction hardening, purposes and its effects on the properties of steel.</p>
11	<p>Prepare three piece Assembly fitting with Filing flat and radius, drilling, countersinking, counter boring and tapping. Identify potential</p>	<p>Manufacturing process of ferrous metals and its classification, uses of wrought iron, cast iron and steel. Alloying elements of steel and</p>

	problems in preparation process and suggest appropriate solutions	its effects on the properties of steel. Types of steels used in cutting tool and their specifications,
12- 13	Dressing of grinding wheels. Grinding of chisel, punch in Pedestal Grinder. Practice of twist drill grinding. Practice of single point turning tools grinding.	Description of pedestal grinder, procedure for mounting the grinding wheel and its application. Introduction to dressing and its importance. Description of single point cutting tool. Tool angles and its importance. Effect of tool setting and tool angles.
14	Lathe: Setting of job in four jaws chuck, truing. Setting of cutting tool on tool post, at centre height. and its effect on metal cutting. Practicals on plain turning and facing.	Lathe: Introduction to lathe machine and its types, specifications, description of main parts – bed, headstock, carriage, tail-stock, feed mechanism and thread cutting mechanisms. Safety precautions while working on lathe. Lathe machine
15.	Lathe operations - step turning, shouldering, undercut, chamfering, grooving, fillet radius within an accuracy of $\pm 0.1\text{mm}$ and its checking of squareness, diameter, length, chamfer, fillets radius using micrometer, vernier caliper and gauges.	Lathe accessories and attachments. Chuck – its types, face plates, lathe dogs, lathe centers - its types, and lathe steady. Coolants and lubricants-its difference and use .
16	Lathe operations – drilling, boring, counter boring, thread making using die and tap.	Nomenclature of Lathe cutting tool - its shapes cutting angles for different lathe operations. Influence of cutting tool angles on metal cutting. Recommended cutting tool materials for lathe operations.
17- 18	Practice of eccentric turning. Practice between centre - plain turning, checking the parallelism and aligning/setting of tailstock and head stock centers – using micrometer, dial test indicator etc.	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.
19- 20	Practice of different taper turning methods on lathe (internal and external).	Different taper turning methods and its calculations.
21-22	Practice screw thread cutting - whit worth/metric (Internal & external)	Definition of screw thread, types, forms and its applications. Calculation of gear train for screw thread cutting on lathe. Change gear and its calculation.
23-25	Revision	

SYLLABUS FOR WORKSHOP SCIENCE AND CALCULATION
SEMESTER-I

Week No	Workshop Science and Calculation
1-4	Introduction to Iron & Steel – its properties & uses. Difference between Iron & Steel. Also other engineering materials
5-7	Solving problems of percentage, ratio and proportions.
8-10	Solving problems of percentage, ratio and proportions. Definition of Various heat treatment processes of Steel and its alloys.
11-13	Decimal & fractions. Algebra – addition, subtraction, multiplication and division.
14-19	Algebra – factors & factorization
20-22	Algebra - solving of simple equations, quadratic equations & simultaneous equation
23-25	Revision
26	Examination

SYLLABUS FOR ENGINEERING DRAWING
SEMESTER-I

Week No	Engineering Drawing
1-4	<p>Introduction to Engineering drawing, drawing board, T- square, set- squares, scales, French curves and its uses.</p> <p>Types of lines their meaning & application as per BIS SP: 46-1988 Use of drawing instruments- Drawing of straight, inclined and curved lines. Simple conventional symbols for material and parts as per BIS SP: 46-1988 Exercise on linear and angular measurements.</p> <p style="text-align: center;">-</p>
5-6	<p>Introduction about Lettering – its practice – types of lettering (single stroke & gothic letters)</p>
6-7	<p>Dimensioning – its types, terms, notations, placing of dimensions, unit of dimensioning and its general rules.</p> <p>Scales - its introduction, types and application in drawing.</p>
10-13	<p>- Geometrical Construction of figures- triangles, square, hexagon, Octagon, circles, ellipses etc. & dividing of lines, angles into equal parts, tangent to a curve -using drawing instruments.</p>
14-15	<p>- Construction of Ellipse, cycloid, epicycloids, hypocycloid, involutes, helix – using French curves.</p>
16-18	<p>Free hand sketching of standard elements like - spanners, hammers, chisels, punches, O/S caliper, I/S caliper, Odd Leg Caliper. Draw different types of bolts, nuts, screws, dowels, rivets etc.</p>
19-20	<p>Introduction Cutting Tool theory</p>
20-22	<p>Free hand sketching of Vice, File, Hacksaw, parallel shank twist drill, drill chuck, etc.</p>
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. TDM(PT,J&F) - 02)
Duration : Six Month

Week No.	Trade Practical	Trade Theory
01	<p>Milling:</p> <p>Preparation of rectangular block by milling – selection of cutters for plain milling, mounting of milling cutters. Milling a block within an accuracy of ± 0.2 mm and check the dimensions.</p>	<p>Milling:</p> <p>Introduction to milling machine, construction, types. Safety precaution followed during milling operation.</p>
02 - 03	<p>Step milling operation within an accuracy of ± 0.2mm</p>	<p>Milling machine attachments – vertical milling attachment, universal milling attachment, circular milling attachment, dividing head attachment etc.</p> <p>Different types of milling cutters used in milling operations.</p>
04	<p>Angular milling.</p>	<p>Nomenclature of milling cutters, different milling cutter angles, Milling cutter materials.</p>
05 - 06	<p>Dovetail milling</p>	<p>Milling cutter holding devices, work holding devices, milling process – Up milling and Down milling.</p> <p>Calculation of cutting speed, feed, machining time for milling machine. Milling machine operations.</p>
07 - 08	<p>Milling Operation using rotary table. T- Slot Milling.</p> <p>Basic programming of CNC Milling</p>	<p>Dividing head – Introduction, construction, types. Simple and universal dividing head.</p> <p>G code M code, co-ordinates, basic programming for CNC</p>
09	<p>Concave and convex radius milling.</p>	<p>Indexing methods – direct indexing, simple indexing, angular indexing, differential indexing and its calculations.</p>
10.	<p>Milling key ways or spline.</p> <p>Diagnose common problems in the machine based on visual inspection, sound, temperature etc.</p>	<p>Gears – types, calculation for spur, helical and bevel gears. Holding of gear blanks. Setting method of cutters and gear blanks.</p>
11.	<p>Gear Cutting (spur)</p>	<p>-do-</p>

	Carryout housekeeping work	
12.	<p>Grinding:</p> <p>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 $\pm 0.02\text{mm}$</p>	<p>Grinding:</p> <p>Grinding machine – introduction, description, types – surface grinding and cylindrical grinding machines. Safety precautions followed while working on grinding machines.</p>
13– 14	<p>Grinding of angular surfaces within an accuracy of ± 5 arc minutes using universal vice</p> <p>Grinding of angular surfaces of die block using sine table.</p>	<p>Grinding wheels – abrasives, bond and bonding process, grit, grade, and structure of grinding wheels.</p> <p>Use of sine table and related calculations</p>
15– 17	<p>Setting of machine for internal & external cylindrical grinding surfaces within an accuracy of $\pm 0.02\text{mm}$.</p> <p>Grinding internal & external steps on cylindrical surfaces within $\pm 0.02\text{mm}$ accuracy.</p> <p>Achieving interference fit of guide pillar and bush.</p>	<p>Grinding wheel shapes and sizes. Standard marking system. Selection of grinding wheel.</p> <p>Procedure for mounting of grinding wheels, balancing of grinding wheels, dressing and truing of grinding wheels, glazing and loading in grinding wheel.</p> <p>Calculation for cutting speed and work speed, feed, depth of cut and machining time.</p>
18	Prepare different types of documentation as per industrial need by different methods of recording information	Importance of Technical English terms used in industry – (in simple definition only) - Technical forms, process charts, activity logs, in required formats of industry, estimation, cycle time, productivity reports, job cards
19– 20	<p>EDM:</p> <p>Machining practice / observation on EDM Machine (Spark Erosion m/c)</p> <p>Preparing simple electrodes from Copper, Graphite.</p>	<p>EDM:</p> <p>Electrical discharge machining (EDM) – Introduction, principle of operation, advantages & disadvantages and its applications.</p>
21	<p>Welding:</p> <p>Introduction to gas welding equipment/arc welding equipment, Simple welding practice. Practice on brazing.</p> <p>Practice on die welding. Welding on Hard die block as well as on die casting.</p>	<p>Welding:</p> <p>Explanation of gas welding and arc welding techniques. Description of welding equipment, types of welding joints.</p> <p>Knowledge about flux, filler rod material.</p> <p>Die welding techniques.</p>
22-23	Implant training / Project work (work in a team)	

24 - 25	Revision
26	Examination

SYLLABUS FOR WORKSHOP SCIENCE AND CALCULATION
SEMESTER-II

Week No	Workshop Science and Calculation
1	Algebra - solving of simple equations, quadratic equations & simultaneous equation
2-4	Definition of mass & weight – their units and differences.
5-6	Definition and calculation of speed, velocity, acceleration & their units. Difference between speed & velocity.
7-9	Forces – definition – its unit, compressive, tensile and shear force. Newton’s laws of motion & gravitation.
10-14	Definition and calculation of speed, velocity, acceleration & their units. Difference between speed & velocity.
15-19	Definition of work, Power & energy – their units’. Calculations of work, Power & energy
20-21	Calculation of volumes of standard solids prisms, cylinder, spheres, cone, pyramid, frustum of cone and pyramids..
22-23	Implant training / Project work (work in a team)
24	Revision
25	Examination

SYLLABUS FOR ENGINEERING DRAWING
SEMESTER-II

Week No	Engineering Drawing
1-6	Free hand sketching of Vice, File, Hacksaw, parallel shank twist drill, drill chuck, etc.
7-12	Drawing of Isometric, views from orthographic projection.
13-17	Sectional views – introduction, application, section line, full sections, half sections, aligned, section, revolve section, remove section
18	Study of drawing & Estimation of materials
19-20	Free hand drawing of different types of Flanges, Coupling and keys..
21	Free hand drawing of different types of Flanges, Coupling and keys.
22-23	Implant training / Project work (work in a team)
24	Revision
25	Examination

System	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. TDM(PT,J&F) - 03)
Duration : Six Month

Week No.	Trade Practical	Trade Theory
01 - 02	<p>Pantograph machine: -</p> <p>Setting of job on machine vice, setting of cutter, stylus, master template, depth of cut. Practice for removing material from work piece (making a job on pantograph machine).</p>	<p>Pantograph machine: - Introduction, types, parts, working principle, advantages for using of pantograph milling m/c, its applications. Setting of enlarging and reducing ratios between master/template and work piece for engraving.</p>
03 - 04	<p>Wire Cut</p> <p>Machining practice / observation on Wire cut Machine.</p>	<p>Wire Cut</p> <p>Wire cut machine – introduction, principle of operation, advantages & disadvantages and its applications.</p>
05 - 06	<p>JIGS & FIXTURES:</p> <p>Manufacture of Drill Jig.</p>	<p>JIGS & FIXTURE:</p> <p>Introduction, definitions, difference, advantages and disadvantages, and types of jigs & fixtures.</p> <p>Jig & Fixture construction, elements of jigs & fixtures and its materials – locating elements, clamping elements, tool guiding element (jigs) or cutter setting elements (fixture), indexing or rotary elements, body, base or frame, fastening parts, power device.</p>
07 - 08	<p>Manufacture of drill jig (indexing and other type)</p> <p>Designing of simple plate type drill jig.</p>	<p>Degree of freedom/possible direction of movement, method of restricting the possible movements (principle of 3 – 2 – 1 pin method), locating methods.</p> <p>Introduction to locating devices, its material, types of locators, locator for flat surface, internal diameter and external profile. Setting blocks in milling fixtures and their applications.</p> <p>Ejectors, clamping devices, types of clamps for jigs & fixtures. Material for ejectors and clamps.</p>
09 - 10	<p>Manufacture of milling fixtures</p>	<p>Methods of removing chips from jigs & fixtures. Drill bushes such as- fixed bush, liner bush, slip bush. Bush materials and its</p>

		<p>heat treatment.</p> <p>Types of fixtures. Functions and types of cutter guide in a fixture.</p>
11	<p>PRESS TOOL:</p> <p>Demonstrate about safety precautions followed during working on press machine. Demonstrate about fly and power press - its parts, function of each part, operating procedure of presses, mounting procedure of die set on press machine, alignment technique between punch and die assembly.</p>	<p>PRESS TOOL:</p> <p>Press – Introduction of press machines, its types. Selection of presses, its specification, calculation of press capacities. Function of different parts of press tools. Mounting procedure of die set on press machine, alignment technique between punch and die assembly.</p>
12-15	<p>Manufacture of Blanking Die Manufacture of Blanking (simple) die set components.</p>	<p>Principle of metal cutting on press tool. Shearing theory, three stages of shearing and calculation of blanking/piercing pressure. Burrs and its effects on press working.</p> <p>Shearing machine – construction, types, parts, setting of shearing blade, stages of shearing and its working. Difference between shearing & cutting.</p> <p>Press working dies – single operation (blanking, piercing, simple trimming and cutting), compound, combination, progressive, forming.</p>
16 - 19	<p>Manufacture of Piercing Die - Manufacture of Piercing (simple) die set components.</p>	<p>Description about strip lay out - its advantages for press work, utilization of maximum strip material as piece part, positioning of press tools stopper – initial stopper and final stopper, calculation of strip width, calculation for utilization of material as piece part and scrap ratio. Different strip lay out methods such as single row, double row, first pass, second pass. Calculate percentage of wastage of strip as scrap.</p> <p>Selection of materials for die set components such as - base plate, top plate, stripper plate, thrust plate, punch holder, shank, guide pillar, guide bushes, die plate, punches etc.</p>

		Importance of clearance and its calculation, effect of insufficient and excessive clearance on die & punch.
20 - 21	Manufacture of Progressive Die Manufacture of Progressive (simple) die set components.	Difference between solid die and split die, application of split die and factors for selecting the split die. Introduction to progressive tool, its parts, functions, materials and heat treatment. Calculation of die clearance
22 – 23	In-plant training / Project work (Work in a team)	22 – 23
24	Revision	
25	Examination	

SYLLABUS FOR WORKSHOP SCIENCE AND CALCULATION
SEMESTER-III

Week No	Workshop Science and Calculation
1	Revision of 1 st year course.
2-4	Elementary trigonometry, using trigonometric tables .
5-6	Friction – definitions, its effect, types. Laws of friction, angle of friction and its related calculations
7-8	Centre of gravity (CG) –definitions, calculation of CG for regular & irregular shape body. Effect of (CG) centre of gravity in the trade work.
9-11	Definition of specific gravity, density and relative density. Difference between specific gravity & density. Calculation of density of a body.
12-15	Force, calculation of unknown force (using moment of forces).
16-19	Definition, difference and unit of heat and temperature. Sources of heat and its effect on bodies. Types of heat transfer methods and their differences. Relation between thermometric scales and their calculations. Calculation of total heat in a body.
20-21	Stress and strain – definitions, types, Hook’s Law. Ultimate strength and factor of safety. Problems on ultimate stress and factors of safety – Poisson’s Ratio-Modules of rigidity.
22-23	Implant training / Project work (work in a team)
24	Revision
25	Examination

SYLLABUS FOR ENGINEERING DRAWING
SEMESTER-III

Week No	Engineering Drawing
1-4	Drawing of different bolt heads, screw heads, nuts, rivet heads, dowels and keys.
5-6	Draw different types of Screw threads forms and its applications. Drawing of rivet joints.
7-10	Application of limits, fits, tolerance and different symbols used in manufacturing drawing. Drawing of assembly for –Bench vice, Tailstock, Clapper Box, and Pedestal Grinder. Drawing of simple plate type drill jig.
11-15	Reading of assembly drawing for –Blanking & Piercing Die assembles. Draw the detailed parts with dimensions, fits and tolerance.
16-19	Drawing of piercing die assembly. Reading of assembly drawing for Progressive Die. Draw the different parts with dimensions, fits and tolerance.
20-21	Drawing of simple Progressive Die Assy. Reading of assembly drawing for Compound Die. Draw the different parts with dimensions, fits and tolerance.
22-23	Implant training / Project work (work in a team)
24	Revision
25	Examination

Fourth Semester
(Semester Code no. TDM(PT,J&F) - 04)
Duration : Six Month

Week No.	Trade Practical	Trade Theory
01- 03	<p>Tool & Cutter Grinder:</p> <p>Grinding of single point cutting tool blank.</p> <p>Grinding of plain and face milling cutter.</p>	<p>Tool & Cutter Grinder:</p> <p>Description of tool and cutter grinding machine. Work (cutting tool) holding devices for tool & cutter grinder machine.</p> <p>Setting process of cutting tools and grinding wheel on tool & cutter grinding machine.</p>
04- 06	<p>Manufacture of Compound Die</p> <p>Manufacture of compound dies components.</p> <p>Ensure that total range of checks are regularly and consistently perform</p> <p>Identify potential causes for non conformities to quality assurance standards</p>	<p>Compound Die:-</p> <p>Introduction, description of different parts, their functions, materials and heat treatment. Calculation of clearance between dies & punches in relation to strip.</p> <p>Introduction to bending tool, description of different parts used in bending operation, their function, materials, heat treatment, clearance calculation for required bending radius in the punch and die, calculation of blank length /size.</p>
07	<p>Assembly, tryout & rectification of compound tool</p>	<p>Spring back and different methods of compensation for spring back in V- bending</p>
08	<p>Manufacture of 'V' Bending Die</p> <p>Manufacturing of simple 'V' bending die components.</p>	<p>Introduction to drawing tool, different parts of drawing tool, their function, materials, heat treatment, calculation of clearances between draw die and draw tool, stages of drawing operation, draw clearance. Process of drawing cylindrical cups. Forces acting on the blank during drawing, wrinkling etc.</p>
09- 12	<p>Manufacture of Drawing Die</p> <p>Manufacture of Drawing die set components.</p>	<p>Redraw die – function, use and advantages over draw die.</p> <p>Ejectors, types, functions in press tool work.</p> <p>Pressure pad, types, functions, application procedure in press work.</p>
13-15	<p><u>Hydraulics & Pneumatics</u></p> <p>Identification and familiarisation of various types of hydraulic & pneumatic elements such as cylinder, valves,</p>	<p><u>Hydraulics & Pneumatics</u></p> <p>Basic principles of hydraulic & pneumatic system. Advantages & disadvantages of hydraulic and pneumatic system. Theory of</p>

	actuators and filters. Study of simple hydraulic & pneumatic circuits.	Pascal's law, Brahma's press, pressure & flow. Type of valves used in hydraulic and pneumatic system.
16	Prepare different types of documentation as per industrial need by different methods of recording information.	Importance of Technical English terms used in industry –(in simple definition only) Technical forms, process charts, activity logs, in required formats of industry, estimation, cycle time, productivity reports, job cards.
17- 21	Program generation & Simulation (Turning, Milling and Machining of punch & dies) with CAD/CAM software. Inspection of machined punch and dies with measuring instruments.	Basic concept of CNC Machine and its different code for programming. Practice of simple programming. CAD (Theory)/ CAM Basic concepts of inspection of 3D surfaces (Finishing of punch and Die).
22-23	Implant training / Project work (work in a team)	
24	Revision	
25	Examination	

SYLLABUS FOR WORKSHOP SCIENCE AND CALCULATION
SEMESTER-IV

Week No	Workshop Science and Calculation
1-3	Magnetism – introduction, magnetization and magnetic materials. Use of magnets. Laws of attraction and repulsion.
4-7	Basic principle of machines, its efficiency. Relation between friction and efficiency in case of idle machines. Relation between efficiency and load.
8	Definition of machines, mechanical advantages (MA), velocity ratio (VR).
9-12	Calculation of machine efficiency for - pulleys, wheel and axle, screw jack etc.
13-16	Calculation of pulley and gear teeth for belt pulley drive & gear drive.
17-21	Electricity – definitions, Ohm’s Law, electrical work, power, energy and units.
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
1-3	Drawing different cutter holding devices for grinding on tool & cutter grinding machine.
4-6	Drawing of simple Compound Die Assembly
7	Reading of assembly drawing for V- Bending Die. Draw the different parts with dimensions, fits and tolerance.
8	Drawing of simple "V"- Bending tool.
9-12	Reading of assembly drawing for - drawing tool. Draw the different parts with dimensions, fits and tolerance.
13-16	Drawing of simple drawing tool. Basic concept of 2D and 3D modeling creation of solid models for punch and die – part program generation with CAD/CAM software. Verification of part programs with graphical simulation.
17-21	Basic concept of 2D and 3D modeling creation of solid models for punch and die – part program generation with CAD/CAM software. Verification of part programs with graphical simulation.
22-23	Implant training / Project work (work in a team)
24-25	Revision
26	Examination

TRADE: TOOL AND DIE MAKER (PRESS TOOLS, JIGS AND FIXTURES)
LIST OF TOOLS & EQUIPMENTS FOR 20 TRAINEES

A : Trainee's Tool Kit :

Sl. No.	Description of Tools	For Instructor	For a batch of 20	Total
1	Steel Rule 150 mm English and Metric combined	1	20 nos.	21 nos.
2	Engineer's Square 150 mm with knife edge	1	20 nos.	21 nos.
3	Hacksaw frame adjustable with pistol grip for 200-300 mm blade	1	20 nos.	21 nos.
4	Centre punch 100 mm	1	20 nos.	21 nos.
5	Prick punch 150 mm	1	20 nos.	21 nos.
6	File flat bastard 300 mm	1	20 nos.	21 nos.
7	File flat 2 nd cut 250 mm	1	20 nos.	21 nos.
8	File flat safe edge 200 mm	1	20 nos.	21 nos.
9	File triangular smooth 200 mm	1	20 nos.	21 nos.

B : Tools and Equipments:

Sl. No.	Name of Tools and Equipments	Quantity
1	Caliper inside spring type-150 mm	4 nos.
2	Caliper outside spring type-150 mm	4 nos
3	Divider spring type – 150 mm	4 nos.
4	Odd leg caliper firm joint 0- 150 mm	2 nos.
5	Screw driver – 150 mm	1 no.
6	Screw driver – 200 mm	1 no.
8	Centre gauge 55 ^o and 60 ^o	2 nos.
9	Oil can 250 ml	1 no.

10	File flat smooth 200 mm	4 nos.
11	File flat smooth with safe edge 200 mm	4 nos.
12	File half round bastard 300 mm	4 nos.
13	File half round smooth 250 mm	4 nos.
14	File triangular bastard 250 mm	4 nos.
15	File triangular smooth 200 mm	4 nos.
16	File round bastard 250 mm	4 nos.
17	File square bastard 300 mm	4 nos.
18	File square smooth 250 mm	4 nos.
19	Knife edge file 150 mm	4 nos.
20	Needle file assorted (12 nos.) 150 mm	4 sets
21	File card	4 nos.
22	Scraper flat 250 mm	4 nos.
23	Hammer Ball Peen 0.5 kg with handle	4 nos.
24	Hammer Cross Peen 0.75 kg with handle	4 nos.
25	Chisel cold flat 18 x 150 mm	4 nos.
26	Chisel Cross Cut 10 x 3 x 200 mm	4 nos.
27	Chisel Half Round 10 x 250 mm	4 nos.
28	Chisel diamond point 10 x 200 mm	4 nos.
29	Scribing block universal 300 mm	2 nos.
30	Cast Iron Surface plate 300 x 300 mm	1 no.
31	Granite Surface plate 600 x 600 x 80 mm	1 no
32	Tap extractor 3 mm to 12 mm x 1.5 mm (ezzy out)	1 set
33	Screw extractor sizes 1 to 8	1 set
34	Taps and dies metric 5 mm to 12 mm complete set in a box	2 sets
35	Twist Drill with St. Shank \varnothing 5 to \varnothing 12 mm in steps of 0.5 mm	1 set
36	Twist Drill St. Shank \varnothing 8 mm to \varnothing 12 mm in steps of 2 mm	1 set
37	Taper shank drills \varnothing 6 mm to \varnothing 20 mm in steps of 1 mm	1 set

38	D.E spanners 3-4 , 6-8, 10-12, 13-14, 15-16, 18-19, 20-22, 24-26 (8 spanners)	2 sets
39	Letter punch 5 mm set	1 set
40	Number punch 5 mm set	1 set
41	Drill chuck 12 mm capacity with key	1 no.
42	Allen key metric 3 to 12 mm set	2 sets
43	Centre drills 3, 4,5 mm	2 each
44	Parallel hand reamer 6 mm to 12 mm in steps of 1 mm	1 set
45	Star dresser	2 nos.
46	Diamond dresser with holder	2 nos.
47	Safety goggles (Personal Protective Equipments)	4 nos.
48	Demagnetizer	1 no.
49	Snips 200 mm blade	1 no.
50	Workbench 240 cm x 120 cm x 75 cm with 150 mm vice (Each bench fitted with 4 vices)	4 nos.
51	Bench Vice 150 mm	16 nos.
52	Steel lockers for 16 trainees (Pigeon Cup Board)	2 nos.
53	Steel cupboard 180 cm x 60 cm x 45 cm	6 nos.
54	Metal rack 180 cm x 60 cm x 45 cm	1 nos.
55	Fire extinguisher	2 nos.
56	Fire buckets with stand	4 nos.
57	Feeler gauge 0.05 mm to 0.3 mm by 0.05 and 0.4 mm to 1 mm by 0.1 mm (13 leaves)	1 set
58	Metric Screw pitch gauge-Range 0.4 -6 mm pitch 60 ⁰ (21 leaves)	1 set
59	Radius gauge 1 - 3 mm by 0. 25 mm and 3.5-7mm by 0.5 mm (34 leaves)	1 no.
60	Vernier height gauge - Range 300 mm, with 0.02 mm least count	1 no.
61	Universal vernier caliper-Range 200 mm, with 0.02 mm least count	2 nos.
62	Dial vernier caliper 0-200 mm, with 0.02 mm least count	1 no.
63	Vernier caliper-Range 300 mm Vernier scale 0.02 mm	2 nos.

64	Vernier bevel protractor-Blade range 150 and 300 mm, dial 1° , least count 5' (min.) with head, Acute Angle attachment	1 no.
65	Outside micrometer 0-25 mm, with 0.01 mm least count	2 nos.
66	Outside micrometer 25-50 mm, with 0.01 mm least count	1 no.
67	Outside micrometer 50-75mm, with 0.01 mm least count	1 no.
68	Combination square sets-300 mm blade with square head, centre head, protractor head	1 set
69	Telescopic gauge range 8 -150 mm (6 pcs/set)	1 set
70	Sine bar 150 mm with stopper plate	1 no.
71	Sine table 200 mm length with magnetic bed	1 no.
72	Slip Gauge Box (workshop grade) -87 pieces per set	1 set
73	Gauge block accessories consisting holders, half round jaws, scriber point, centre point, triangular straight edge (14 pcs/set)	1 set
74	Central square – Size 400 x 250 mm blade	1 no.
75	V-Block-Approx. 32 x 32 x 41 mm with clamping capacity of 25 mm with clamps	2 pairs
76	V-Block-Approx 65x65x80 mm with clamping capacity of 50 mm with clamps	1 pairs
77	Magnetic V-Block 100x100x125 mm	2 pairs
78	Angle plate 150 x 150 x 200 mm	1 no.
79	Angle plate-adjustable 250x250x300 mm	1no.
80	Inside micrometer – Range 50-63 mm with std extension rods upto 200mm..	1 set
81	Depth micrometer – Range 0-25 mm, accuracy 0.01 mm with std set of extension rod s.	1set.
82	Magnetic stand with magnetic base 60 x 47.5 mm and with universal swivel clamp, dial holding rod (150 mm) scriber	2 nos.
83	Dial test indicator-Lever type- Range 0-0.8 mm –Graduation 0.01mm, reading 0-50-0 with accessories	1 nos.
84	Dial test indicator – Plunger type-Range 0-10 mm, Graduation 0.01 mm, Reading 0-100 with revolution counter	1 nos.
85	Bore gauge with dial indicator (1 mm range, 0-0.01 mm graduation)-Range	1 set

	of bore gauge 18-150 mm	
86	Straight edge-Single beveled-Size 150 mm and 250 mm	1 each
87	Tool makers clamp 50 mm & 75 mm	2 nos. each
88	C – clamp- 50 mm & 75 mm	2 nos. each

C : Cutting Tools:

Sl. No.	Name of Tools and Equipments	Quantity
1	Side and face milling cutter $\varnothing 100 \times 10 \times \varnothing 25$ mm	2 nos.
2	Side and face cutter $\varnothing 80 \times 10 \times \varnothing 27$ mm	2 nos.
3	Cylindrical milling cutter $\varnothing 63 \times 70 \times \varnothing 27$ mm	2 nos.
4	Slitting Saw cutter $\varnothing 75 \times 3 \times \varnothing 27$ mm	2 nos.
5	Slitting Saw cutter $\varnothing 100 \times 6 \times \varnothing 27$ mm	2 nos.
6	Single angle cutter $\varnothing 75 \times 16 \times \varnothing 27$ mm - 60°	2 nos.
7	Single angle cutter $\varnothing 75 \times 20 \times \varnothing 27$ - 45°	2 nos
8	Equal angle cutter $\varnothing 75 \times 30 \times \varnothing 27$ - 90°	2 nos
9	Shell End Mill $\varnothing 50 \times 36 \times \varnothing 22$ (preferably inserted tip type)	2 nos.
10	Shell End Mill $\varnothing 75$ mm $\times 50 \times \varnothing 22$ (preferably inserted tip type)	2 nos.
11	Parallel shank end mills $\varnothing 6$, $\varnothing 10$ and $\varnothing 16$ are (double fluted), $\varnothing 20$ mm & $\varnothing 25$ mm (four fluted)	4 nos. each
12	'T' slot cutter with parallel shank- $\varnothing 17.5 \times 8$ mm width \times dia. of shank 8 mm	2 nos.
13	Concave Milling cutter $\varnothing 63 \times 6$ radius $\times \varnothing 27$ mm	1 nos.
14	Convex Milling cutter $\varnothing 63 \times 6$ radius $\times \varnothing 27$ mm	1 nos.
15	Disc type form milling cutter (involute form -2 module, 20° pressure angle)	1 set
16	Tool holder (straight) to suit 6, 8 mm sq. bit size	2 nos. each
17	Parting tool holders to suit 3 and 4 mm thick tool blade.	2 nos.
18	Boring bars with holders to accommodate 4, 6 and 8 mm HSS tool bits	3 each
19	Knurling tool (straight & diamond)	2 nos. each

20	Tool bits, inserts, carbide tool bits, reamers, special counter bore, counter sink tools(CNC tooling setup)	As required
----	---	-------------

D : General Machinery & Installation:

(Note: The specifications given under “General Machinery & Installation” can be purchased to the nearest size according to the availability in the Indian Market.)

Sl. No.	Name of Tools and Equipments	Qty.
1.	Sensitive drilling machine - capacity 12 mm Motorized –with drill chuck and key etc.	1No.
2.	Pillar/column type Drilling machine – 25 mm capacity-motorized with drill chuck, key etc.	1No.
3.	Radial Drill machine to drill up to 32 mm diameter.	1No.
4.	Power hacksaw machine to accommodate 21” or more length blade.	1no.
5.	Double ended Pedestal Grinder with 178 mm wheels(one fine and one rough wheel)	1 no.
6.	SS and SC centre lathe (all geared) with centre height 150 mm and centre distance 1000 mm along with 3 jaws, 4 jaw chuck, auto feed system, taper turning attachment, coolant pump, safety guard, dog carriers, face plate and machine light arrangement.	3 sets.
7.	Shearing machine (lever type)hand operated complete with 300 mm blade length	1 no.
8.	Welding Equipment (It is not required if Welding Trade is available in the Institute) Latest welding kits in Die making	2 set.

	(i) Transformer welding set 300 amps-continuous welding current with all accessories and electrode holder	1 set
	(ii) Welding cable to carry 400 amps 50 meter with flexible rubber cover.	12 nos.
	(iii) Lugs for cable	2 nos.
	(iv) Earth clamps	1 set
	(v) Arc welding table (all metal top) 122cm x 12 cm x 60 cm with positioner	1 no.
	(vi) Oxy-acetylene gas welding set-equipment with hoses, regulator and other accessories	1 set
	(vii) Gas welding table with positioner	6 nos.
	(viii) Welding torch tips of different sizes	1 no
	(ix) Gas lighter	2 nos.
	(x) Trolley for gas cylinders	2 pairs
	(xi) Chipping hammer	2 nos.
	(xii) Gloves (Leather)	1 set
	(xiii) Leather apron	2 nos.
	(xiv) Welding torches 5 to 10 nozzles	4 pair
	(xv) Spindle key for cylinder valve	2 nos.
	(xvi) Welding goggles	10 sets
	(xvii) Welding helmets with coloured glass	2 nos.
	(xviii) Tip cleaner	1 no.
9.	Universal Milling Machine -	2 no
	Longitudinal traverse	700 - 800 mm
	Cross traverse	300 - 400 mm
	Vertical traverse	200 - 350 mm
	Swivel of table on either side	45 ⁰
	Speed range rpm	30 to 1800
	With universal dividing head, circular table, long arbors, slab arbor, slotting attachment, vertical indexing head, etc.	

	radius and face dressers, find hand feed attachment etc.	
14.	Pantograph / Engraving 3D machine	1set.
	Working area (rectangle) 320 x 145 mm	
	Max. height of work 380 mm	
	Work table traverse:	
	Longitudinal x Transverse 160 x300 mm	
	Work clamping area 360x200 mm	
	With attachment like index head, roll engraving attachment, type template holders, circular table, raised and sunk letters etc.	
15.	Fly press 5 ton capacity	1No.
16.	Muffle furnace – heating chamber 300 x 300 x 450 mm for 1050 ⁰ C Quenching tank-600 x600 x 600 mm	1No.
17.	Rockwell hardness testing machine with standard accessories	1No.
18.	Wire EDM with CAM software	1 No.
19.	CAD/CAM software(Standard/latest available in the market)	4 set
20.	Desktop computers with latest configuration suitable for CAD/CAM software with necessary furniture	5 sets
21.	Spark Erosion EDM (Optional)	1No.
22.	CNC vertical milling machine (Optional)	1 no
23.	CNC lathe (optional)	1 no
24.	Co-ordinate measuring machine (Optional)	01
25.	Profile projector (Optional)	01
26.	Unit height master (Optional)	01
27.	Polishing kits (Optional)	1 set
28.	Hydraulic press 16T with all safety measures (Optional)	01

Note: Any institute not having the optional machines may tie up with an industry having the above machine for exposure.

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
