



**COMPETENCY-BASED CURRICULUM**

**FOR THE TRADE OF**

**MECHANIC MACHINE TOOL MAINTENANCE**

**UNDER**

**CRAFTSMAN TRAINING SCHEME (CTS)**

**IN SEMESTER PATTERN**

**Government of India**  
**Ministry of Skill Development and Entrepreneurship**

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## 1. INTRODUCTION

India is one of the youngest nations in the world. Our youth are our strength. However, a challenge facing the country is that of skilling our youth as per the demands of the industry. Recognizing the need for quickly coordinating the skill development and entrepreneurship efforts of all concerned stakeholders, the Government of India created the Ministry of Skill Development and Entrepreneurship on 9<sup>th</sup> November, 2014. To create further convergence between the Vocational Training System through Industrial Training Institutes (ITIs) and the new skill initiatives of the Government, the Training and Apprenticeship Training divisions from the Directorate General of Employment and Training (DGET) under the Ministry of Labour and Employment stand transferred to the Ministry of Skill Development and Entrepreneurship (MSDE) with effect from 16<sup>th</sup> April, 2015. This move brings over 11000 ITIs and scores of other institutions, and the Apprenticeship and Training divisions, under the Ministry.

The Ministry of Skill Development and Entrepreneurship is an apex organization for the development and coordination of the vocational training including Women's Vocational Training in our country. The Ministry conducts the vocational training programmes through the Craftsmen Training Scheme (CTS), Apprenticeship Training Scheme (ATS), Modular Employable Scheme (MES) under the Skill Development Initiative (SDI) Scheme, and Craftsmen Instructor Training Scheme (CITS) to cater the needs of different segments of the Labour market. The National Council for Vocational Training (NCVT) acts as a central agency to advise Government of India in framing the training policy and coordinating vocational training throughout India. The day-to-day administration of the ITIs rests with the State Governments/ Union Territories.

- Training courses under the CTS is being offered through a network of more than 11000 Government and Private Industrial Training Institutes (ITIs) located all over the country with a total seating capacity of more than 16 Lakhs with an objective to provide skilled workforce to the industry in 126 trades. Skill development courses exclusively for women are also being offered under CTS and other schemes through Government and Private ITIs and Regional Vocational Training Institutes (RVTIs) for Women.
- The Apprentices Act, 1961 was enacted with the objective of regulating the program of apprenticeship training in the industry by utilizing the facilities available within for imparting on-the-job training. The Act makes it obligatory for employers in specified industries to engage apprentices in designated trades to impart on the job training for school leavers, and ITI passed outs to develop skilled manpower for the industry.
- The Ministry is implementing the Employable Scheme (MES) under the Skill Development Initiative Scheme to provide vocational training to people to develop skilled manpower for the industry through a network of Vocational Training Providers (VTPs) located across the country.

Central Staff Training and Research Institute (CSTARI), Kolkata is the nodal institute for the development/revision of curricula under all vocational training schemes of the Ministry. National Instructional Media Institute (NIMI), Chennai is to make available instructional material in various trades for the use of trainees and trainers to ensure overall improvement in the standard of institutional training under the CTS and ATS schemes. The institute is actively involved in the development, production and dissemination of instructional media Packages (IMPs) comprising of books on Trade Theory, Trade Practical, Test/Assignment, and Instructor's Guide.

The National Skills Qualification Framework (NSQF), published in the Gazette of India on 27<sup>th</sup> December, 2013, is a national framework that aims to integrate general and vocational streams of education and training. The main goal of the NSQF is to focus on competency-based qualifications, which in turn facilitate and enhance transparency, both within and between general and vocational streams. The National Skill Development Agency (NSDA) under the Ministry is responsible for anchoring and implementation of the Framework, by bringing together the key stakeholders through the National Skill Qualifications Committee (NSQC).

The competency-based framework organizes qualifications into ten levels, with the entry level being 1, and the highest level being 10. Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are (1) Process, (2) Professional knowledge, (3) Professional skill, (4) core skill, and (5) Responsibility. The paradigm shift from learning focused on inputs to an outcome/competency-based education would help in the Recognition of Prior Learning (RPL), and simultaneously enable the alignment of the Indian qualifications with international ones. Government funding is expected to be on a preferential basis for NSQF compliant courses. The NSQF notification provides a Qualification Register, which is the official national database of all qualifications aligned to NSQF levels. Through this Register, learners can expect access to all NSQF compliant qualifications.

The Ministry has set up Mentor Councils to focus on courses under NCVT in various sectors with representation from thought leaders among different stakeholders viz., industries, innovative entrepreneurs who have proved to be game-changers, academic/professional institutions, and champion ITIs for each of the sectors. The Mentor Council for each sector reviews curriculum, admission criteria, course duration, and requirement of trainers and assessment/evaluation systems for the sector on a continuous basis and make recommendations regarding the same. Sector-wise Core Groups are formed to plan and prepare the documentation for the competency-based curricula for the courses under each sector.

## 2. GENERAL INFORMATION

1	Qualification	<b>MECHANIC MACHINE TOOL MAINTENANCE</b>
2	N.C.O./NOS Code No.	8281.55
3	NSQF Level	Level 5
4	Duration of the course/qualification	Two years
5	Entry Qualification	Passed class 10 <sup>th</sup> Exam. Under 10+2 system of Education or its Equivalent.
6	Trainees per unit	16 (Supernumeraries/Ex-Trainee allowed: 5)

Note:

- i) Out of the two Instructors required for a unit of 2(1+1), one must have Degree/Diploma, and other must have NTC/NAC qualifications, in the relevant field.
- ii) Qualification of the Instructor for WCS and ED must be as per the training manual.

Distribution of notional training hours of the training per week:

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

### 3. COURSE STRUCTURE

Name of the Qualification: **MECHANIC MACHINE TOOL MAINTENANCE**

Total duration of the course: 24 Months

Training duration details:

<b>Course Elements</b>	<b>Hourly Distribution</b>
Professional Skills	2200 hrs
Professional Knowledge	530 hrs
Workshop Calculation & Science	180 hrs
Engineering Drawing	265 hrs
Employability Skills	110 hrs
Extra Curricular Activities	180 hrs
In-plant Training/Project Work	240 hrs
Admission & Examination	160 hrs
Total	3865 hrs

## 4. JOB ROLES

### 4.1 Brief description

Installs, erects and changes layout of machines and equipments in mills, factories, workshops etc. according to instructions or specifications. Studies drawings and lay out sketches of machines or equipment to be erected. Calculates available floor area in relation to dimension of machines, working space required etc. and marks areas on floor for foundations of machines. Guides' construction of foundations and setting of foundation bolts and fixtures according to type of machines to be installed and allows foundations to dry up and settle for required number of days. Places base or holding device of machines through foundation bolts or on fixture one by one, using lifting equipment and aligns and levels them with spirit level. Fastens or secures machines tightly to foundation bolts or fixtures and rechecks alignment and leveling to ensure correctness. Makes adjustment if necessary and gets grouting of foundations done. Allows grouting to dry up and adjust position of different parts of machine for efficient operation. Gives necessary power supply to machine or connects machine to line shaft. May run machine and observe performance. May assemble, repair and overhaul machines. May specialize in erecting particular type of machine or equipment such as printing machine, lathe, pneumatic hammer, grinder, pumps, etc.

Plan and organize assigned work and detect & resolve issues during execution. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

### 4.2 NOS & QP/NCO Mapping:

Reference NCO & NOS:

- i)NCO-2004 : 8281.55
- ii) NCO-2004: 8281.10

NOS:-

- i) CSC/N0901 (Perform maintenance activities on mechanical equipments)
- ii) CSC/N1335 (Use basic health and safety practices at the work place)
- iii) CSC/N1336 (Work effectively with others)
- iv) CSC/N0304 (Perform fitting and assembly operations on metal components)
- v) CSC/N0501 (Install Mechanical equipments at the site)
- vi) CSC/ N0502 (Commission mechanical equipment after installation at site)
  
- vii) CSC/ N0503 (Deliver breakdown service on mechanical equipment commissioned on site)
  
- viii) CSC/ N0901 (Perform maintenance activities on mechanical equipment)
  
- viii) CSC/ N0304 (Perform fitting and assembly operations on metal components)

## 5. NSQF LEVEL COMPLIANCE

The Broad Learning outcomes of **MECHANIC MACHINE TOOL MAINTENANCE** trade under CTS matches with the Level descriptor at Level 5.

The NSQF level 5 descriptor is given below:

LEVEL	Process required	Professional knowledge	Professional skill	Core skill	Responsibility
Level 5	Job that requires well developed skill, with clear choice of procedures in familiar context.	knowledge of facts, principles, processes and general concepts, in a field of work or study	a range of cognitive and practical skills required to accomplish tasks and solve problem by selecting and applying basic methods, tools, materials and information.	Desired mathematical skill, understanding of social, political and some skill of collecting and organizing information, communication.	Responsibility for own work and Learning and some responsibility for other's works and learning.



## **6. GENERAL TRAINING PLAN, EXAMINATION & PASS REGULATION**

### **General Training Plan**

The knowledge and skill components as stated in the section for 'learning outcomes' are to be imparted in accordance with the instructions in respect of the content and time structure.

### **Assessment**

The assessment for the semester-based qualification is carried out by conducting formative assessments, and end-of-semester examinations, as per the guidelines given in the Curriculum. The internal assessments for theory subjects and practical are conducted for evaluating the knowledge and skill acquired by trainees and the behavioural transformation of the trainees as per the learning outcomes. Theory examinations are conducted in Trade Theory, Workshop Calculation & Science, Engineering Drawing and Employability Skills. Trade practical examinations are conducted by the respective State Governments. The details of the examination and assessment standard are in a latter section. NCVT prepares the question papers for the Trade practical. Candidates are to demonstrate that they can:

1. Read& interpret technical parameters/documentation, plan and organize work processes, and identify necessary materials and tools,
2. Perform a task/job with due consideration to safety rules, accident prevention regulations and environmental protection stipulations,
3. Apply Professional Knowledge, Core Skills, and Employability Skills while performing the task/job.
4. Check the task/job as per the drawing for proper functioning, and identify and rectify errors in the job, if any.
5. Document the technical parameters related to the task/job.

### **Pass regulation**

For the purposes of determining the overall result, weightage of 25 percent is applied to each semester examination. The minimum pass percent for Practical is 60% & minimum pass percent for Theory subject is 40%.

## 7. LEARNING OUTCOMES

The following are minimum broad learning outcomes after completion of the **MECHANIC MACHINE TOOL MAINTENANCE** course of Two years duration:

### A. GENERIC OUTCOMES

1. Recognize & comply safe working practices, environment regulation and housekeeping.
2. Work in a team, understand and practice soft skills, technical English to communicate with required clarity.
3. Demonstrate knowledge of concept and principles of basic arithmetic, algebraic, trigonometric, statistics, co-ordinate system and apply knowledge of specific area to perform practical operations.
4. Understand and explain basic science in the field of study including basic electrical, and hydraulics & pneumatics.
5. Read and apply engineering drawing for different application in the field of work.
6. Understand and explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.
7. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.
8. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.
9. Understand and apply basic computer working, basic operating system and uses internet services to get accustomed & take benefit of IT developments in the industry.

### B. SPECIFIC OUTCOMES

#### SEMESTER – I

10. Perform marking out the components for filing, drilling, fitting and allied operations with clear choice of procedures.
11. Plan and organize the work for different types of fitting operations and check for work result.
12. Understand and explain the constructional features and working principles of Pedestal grinding machine and perform to align the grinding wheel.
13. Understand and explain the constructional features and working principles of drilling machines and set up different work and tool holding devices required to accomplish tasks with required alignment.
14. Carry out chipping operation on flat surfaces.
15. Develop flat surface by scraping and check surface finish.

#### SEMESTER – II

16. Dismantle, Repair and Assemble of mechanical power transmission elements in machine tools and check for functionality.

17. Understand and explain the constructional features and working principles of lathe, Shaper and set up different work and tool holding device required to accomplish tasks on these machines with required alignment.
18. Prepare machine foundation for erection, install of heavy duty machines and carry out geometrical tests.
19. Conduct preventive & break down maintenance of lathe, drilling and shaper and ensure functionality of the machine.

### SEMESTER – III

20. Make / Produce different joints by setting up of gas and arc welding machines and carry out the welding.
21. Understand & demonstrate working principles of Hydraulic & Pneumatic systems, overhaul and check the functionality of the Hydraulic & Pneumatic systems of machine tools.
22. Make pipe/tube fittings and valve connections for lubricants and coolants ,test for leakages,
23. Trouble shoot & overhaul of milling and surface grinding machines.
24. Conduct the preventive maintenance of milling, surface grinding machine without any assistance.

### SEMESTER - IV

25. Identify and test basic electronic components of viz., resistor, capacitors & inductor using multimeter and assemble simple battery eliminator circuit, measure its Input & Output voltages.
26. Overhaul and maintain the hydraulic press and check its functionality.
27. Trouble shoot & Overhaul of pumps, fans, blowers & compressors and perform preventive maintenance
28. Joining of flat belt in belt drive
29. Perform fault finding and attend break downs of different machineries/ equipments viz., shaper, surface grinding, drilling, lathe, milling, hydraulic press in the shop floor.

## 8. ASSESSABLE OUTCOMES WITH ASSESSMENT CRITERIA

**Note:**

1. The training shall be conducted as per the syllabus.
2. The trainee shall demonstrate the competencies that are defined below in the assessable outcomes highlighted below.
3. The trainee shall be assessed for his/her achievement levels in all the assessable outcomes on the basis of the formative assessment, Theory & Practical examinations, observation, and viva-voce.
4. The trainee shall be assessed for his/her achievement levels in all the assessable outcomes of the Employability Skills, Workshop Calculation & Science, and Engineering Drawing, on the basis of Theory Examinations, and for his/her ability to apply the concepts in Practical.
5. The assessable outcomes and assessment criteria will serve as a set of guidelines for Trainers, Paper setters, Moderators, and Assessors.

**Assessable outcomes along with assessment criteria to be achieved after each semester and completion of qualification:**

**Generic assessable outcomes:**

ASSESSABLE OUTCOMES	ASSESSMENT CRITERIA
1. Recognize & comply safe working practices, environment regulation and housekeeping.	1.1 Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements and according to site policy.
	1.2 Recognize and report all unsafe situations according to site policy.
	1.3 Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
	1.4 Identify, handle and store / dispose off dangerous goods and substances according to site policy and procedures following safety regulations and requirements.
	1.5 Identify and observe site policies and procedures in regard to illness or accident.
	1.6 Identify safety alarms accurately.
	1.7 Report supervisor / Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to site accident / injury procedures.
	1.8 Identify and observe site evacuation procedures according to site policy.
	1.9 Identify Personal Productive Equipment (PPE) and use the same as per related working environment.
	1.10 Identify basic first aid and use them under different circumstances.
	1.11 Identify different fire extinguisher and use the same as per requirement.
	1.12 Identify environmental pollution & contribute to the avoidance

	of instances of environmental pollution.
	1.13 Deploy environmental protection legislation & regulations
	1.14 Take opportunities to use energy and materials in an environmentally friendly manner
	1.15 Avoid waste and dispose waste as per procedure
	1.16 Recognize different components of 5S and apply the same in the working environment.
2. Work in a team, understand and practice soft skills, technical English to communicate with required clarity.	2.1 Obtain sources of information and recognize information.
	2.2 Use and draw up technical drawings and documents.
	2.3 Use documents and technical regulations and occupationally related provisions.
	2.4 Conduct appropriate and target oriented discussions with higher authority and within the team.
	2.5 Present facts and circumstances, possible solutions & use English special terminology.
	2.6 Resolve disputes within the team
	2.7 Conduct written communication.
3. Demonstrate knowledge of concept and principles of basic arithmetic, algebraic, trigonometric, statistics, co-ordinate system and apply knowledge of specific area to perform practical operations.	3.1 Semester examination to test basic skills on arithmetic, algebra, trigonometry and statistics. 3.2 Their applications will also be assessed during execution of assessable outcome and also tested during theory and practical examination.
4. Understand and explain basic science in the field of study including basic electrical, and hydraulics & pneumatics.	4.1 Semester examination to test basic skills on science in the field of study including basic electrical and hydraulics & pneumatics. 4.2 Their applications will also be assessed during execution of assessable outcome and also tested during theory and practical examination.
5. Read and apply engineering drawing for different application in the field of work.	5.1 Semester examination to test basic skills on engineering drawing. 5.2 Their applications will also be assessed during execution of assessable outcome and also tested during theory and practical examination.
6. Understand and explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.	6.1 Semester examination to test the concept in productivity, quality tools and labour welfare legislation. 6.2 Their applications will also be assessed during execution of assessable outcome.
7. Explain energy	7.1 Semester examination to test knowledge on energy

conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	conservation, global warming and pollution. 7.2 Their applications will also be assessed during execution of assessable outcome.
8. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	8.1 Semester examination to test knowledge on personnel finance, entrepreneurship. 8.2 Their applications will also be assessed during execution of assessable outcome.
9. Understand and apply basic computer working, basic operating system, simulate part programme using simulation software and uses internet services to get accustomed & take benefit of IT developments in the industry.	9.1 Semester examination to test knowledge on basic computer working, basic operating system and uses internet services. 9.2 Their applications will also be assessed during execution of assessable outcome.

### Specific assessable outcomes:

#### Semester-I

ASSESSABLE OUTCOME	ASSESSMENT CRITERIA
10. Perform marking out the components for filing, drilling, fitting and allied operations with clear choice of procedures.	10.1 Identify tools and equipments for marking and use of these tools & equipments.
	10.2 Select raw material and inspect visually for defects.
	10.3 Identify basic hand tools for cutting, filing, drilling, fitting operations and uses of these tools.
	10.4 Mark according to drawing.
	10.5 Follow relevant legislation, industry guidelines and enterprises policies / procedures.
	10.6 Check all dimensions in accordance with specifications.
11. Plan and organize the work for different types of fitting operations and check for work result.	11.1 Plan and select tools, equipments for fitting operation.
	11.2 Mark according to drawing by using marking tools on flat and round surfaces.
	11.3 File the job using different methods and perform in accordance with standard specifications and tolerances.
	11.4 Drill on Mild Steel flat and cylindrical surfaces.
	11.5 Identify & use hand tools for internal and external threading (dies and taps).
	11.6 Measure all dimensions in accordance with standard specifications and tolerances.
12. Understand and explain	12.1 Understand basic working principles and safety aspect of

the constructional features and working principles of Pedestal grinding machine and perform to align the grinding wheel.	Pedestal grinding machine.
	12.2 Explain functional applications of Pedestal grinding machine.
	12.3. Inspect the wheel for defects by visual and knocking method.
	12.4 Mount the grinding wheels with bushes & gaskets on both ends of motor shaft.
	12.5 Carry out the grinding wheel truing by dressing.
	12.6 Grind different hand tools such as chisel, scriber, centre punch, divider, trammel, scraper and check sharpness visually.
	12.7 Observe safety procedure during mounting of grinding wheels as per standard norms.
13. Understand and explain the constructional features and working principles of drilling machines and set up different work and tool holding devices required to accomplish tasks with required alignment.	13.1 Understand basic working principles and safety aspect of drilling machines.
	13.2 Explain functional applications of Drilling machine.
	13.3 Select work & tool holding devices and tools for drilling of the required job.
	13.4 Mount the job and tool on the machine.
	13.5 Operate the machine by selecting the required speed & feed according to the tool and job material.
	13.6 Measure all dimensions to check for job accuracy as per drawing.
14. Carry out chipping operation on flat surfaces	14.1 Understand safety aspects of chipping process.
	14.2. Explain different chipping techniques and the classification, construction, materials & functional details of chisels and hammers.
	14.3 Select proper tool as per the required operation and perform the task.
15. Develop flat surface by scraping and check surface finish.	15.1 Understand safety aspect of scrapping process.
	15.2 Explain different types, material and uses of scrappers.
	15.3 Select the scrapper and perform the scrapping operation on mating components (dovetail fitting) as per required drawing.
	15.4 Check the scrapped surface by the application of Prussian blue.

## Semester-II

16. Dismantle, Repair and Assemble of mechanical power transmission elements in machine tools and check for functionality.	16.1 Understand safety aspects while working with power transmission system.
	16.2 Explain the functions and constructional features of various mechanical power transmission elements and drives.
	16.3 Drain out lubrication oil from the power transmission system.
	16.4 Select proper tools for the required task.
	16.5 Dismantle the shaft, coupling, gears, belt, clutch, pulley, chain & sprockets. keys, bearing from the power transmission system..
	16.6 Clean and check for damage of all dismantled parts.
	16.7 Repair / replace damaged parts..
	16.8 Assemble the power transmission system in sequence.
	16.9 Fill lubrication oil and check functionality.
17. Understand and explain	17.1 Understand basic working principles and safety aspect of lathe

the constructional features and working principles of lathe, Shaper and set up different work and tool holding device required to accomplish tasks on these machines with required alignment.	and shaping machine.
	17.2 Acquaint with functional application of different levers, stoppers, stroke adjustment etc.
	17.3 Select and apply proper lubricant at different lubrication points of lathe and shaping machine.
	17.4 Identify and select different work and tool holding devices.
	17.5 Mount the work and tool holding devices with required alignment and check for its functional usage, perform lathe and shaper operations.
	17.6 Solve problem by applying basic methods, tools, materials and information during setting.
18. Prepare machine foundation for erection, install of heavy duty machines and carry out geometrical tests.	18.1 Understand safety aspects related to the erection & installation of heavy machines.
	18.2 Plan and prepare machine foundation as per drawing.
	18.3 Place the machine on the foundation for erection.
	18.4. Provide electrical power connections as per the requirement
	18.5 Level the machine and install all standard accessories and check the functional requirement.
	18.6 Conduct the geometrical test as per standards for installed machine.
	18.7 Carry out component trial machining test and check the dimensional accuracy of the component.
19. Conduct preventive & break down maintenance of lathe, drilling and shaper and ensure functionality of the machine.	19.1 Plan and prepare preventive maintenance chart for lathe, drilling machine & shaper.
	19.2 Conduct preventive maintenance for lathe, drilling machine and shaper.
	19.3 Execute break down maintenance of lathe, drilling machine and shaper.
	19.4 Perform the machine operations to meet the functional requirements.

### Semester-III

20. Make / Produce different joints by setting up of gas and arc welding machines and carry out the welding.	20.1 Acquaint the safety practices related to welding.
	20.2 Plan and prepare the gas & arc welding machines to perform welding.
	20.3 Understand to set up the welding machine parameters and selection of electrode, welding torch adjustments according to the task.
	20.4 Operate the welding machine and perform different welding joints, check visually for common welding defects.
	20.5 Interpret the applications of different welding joints with respect to machine tool maintenance.



21. Understand & demonstrate working principles of Hydraulic & Pneumatic systems, overhaul and check the functionality of the Hydraulic & Pneumatic systems of machine tools.	21.1 Acquaint the safety practices related to hydraulic and pneumatic systems.
	21.2 Identify the various elements of hydraulic and pneumatic systems and persuade functionalities of each element.
	21.3 Overhaul the hydraulic & pneumatic valves, pumps, actuators and check their functionality.
	21.4 Construct and simulate hydraulic & pneumatic circuits on hydraulic & pneumatic trainers.
	21.5 Solve problems related to fluid and air flow in the circuits.
22. Make pipe/tube fittings and valve connections for lubricants and coolants ,test for leakages,	22.1 Acquaint the safety practices related to pipe fittings.
	22.2 Plan and perform cutting, bending, threading, ferruling on tubes.
	22.3 Dismantle and assemble of different valves and replace gaskets.
	22.4 Prepare pipe/tube joints, connect valves and check for leakages.
	22.5 Interpret the applications of different pipe/tube joints with respect to machine tool maintenance.
23. Trouble shoot & overhaul of milling and surface grinding machines.	23.1 Acquaint the safety practices in overhauling the milling and surface grinding machines.
	23.2 Understand different parts & sub assemblies of milling & surface grinding machine and their functionalities.
	23.3 Plan and prepare trouble shooting chart for milling & surface grinding machines.
	23.4 Plan and execute the overhauling of milling & surface grinding machine.
	23.5 Conduct the operational test of the machines.
24. Conduct the preventive maintenance of milling, surface grinding machine without any assistance.	24.1 Acquaint the safety practices related to preventive maintenance of milling & surface grinding machines.
	24.2 Plan and prepare the preventive maintenance schedule for milling & surface grinding machines.
	24.3 Execute the preventive maintenance of milling & surface grinding machines.
	24.4 Carry out the operational test of the machines.
	24.5 Conduct case studies related to break down maintenance of milling & surface grinding machines and prepare case study reports.

### Semester-IV

25 Identify and test basic electronic components of viz., resistor, capacitors & inductor using multimeter and assemble simple battery eliminator circuit, measure its Input & Output voltages.	25.1 Acquaint the safety practices related to basic electronics.
	25.2 Identify, test the passive components and understand their applications in industrial electronic printed circuit boards.
	25.3 Carry out soldering, de-soldering of electronic components in different printed circuit boards.
	25.4 Assemble simple battery eliminator circuit and check its Input/Out-put power supply.

26 Overhaul and maintain the hydraulic press and check its functionality.	26.1 Acquaint the safety practices related to the maintenance of hydraulic press.
	26.2 Execute the overhauling of hydraulic press and check for its functionality.
	26.3 Interpret the industrial applications of hydraulic press.
27 Trouble shoot & Overhaul of pumps, fans, blowers & compressors and perform preventive maintenance	27.1 Acquaint the safety practices related to the pumps, fans, blowers & compressors.
	27.2 Understand & identify the different types of pumps, fans, blowers and compressors.
	27.3 Plan and prepare trouble shoot chart for pumps, fans, blowers & compressors and perform the task.
	27.4 Carry out the preventive maintenance of pumps, fans, blowers and compressors.
	27.5 Interpret the industrial applications of pumps, fans, blowers and compressors in different machine tools.
28 Joining of flat belt in belt drive	28.1 Plan and prepare for joining of flat belt.
	28.2 Carry out flat belt joining by fasteners and links.
	28.3 Check and adjust the belt tension.
	28.4 Conduct the performance test.
29 Perform fault finding and attend break downs of different machineries/ equipments viz., shaper, surface grinding, drilling, lathe, milling, hydraulic press in the shop floor.	29.1 Acquaint the safety practices related to the break down maintenance of machine tools.
	29.2 Understand & identify various machine tools under break down.
	29.3 Demonstrate the faults arised in the machine tools.
	29.4 Conduct the break down maintenance of faulty machine.
	29.5 Carry out the performance test.

## 9. SYLLABUS CONTENT WITH TIME STRUCTURE

### SYLLABUS FOR THE TRADE OF MECHANIC MACHINE TOOL MAINTENANCE

#### 9.1 Syllabus Content for Professional Skill & Knowledge

**First Semester** ( Code No. MMTM 01)

Duration: Six Months

#### Learning Objectives (1<sup>st</sup> Semester)

1. Apply safe working practices.
2. Comply environmental regulations and housekeeping.
3. Interpret & use Company terminology and technical communication.
4. Perform basic fitting operations used in industrial workshop practices and inspection of dimensions.
5. Mounting of different work & tool holding devices in drilling machines.
6. Operate drill machine and perform manual tapping and dieing.
7. Mounting and truing of grinding wheel in bench/pedestal grinder.
8. Sharpening of hand tools on pedestal grinding machine.
9. Develop flat surface by scrapping.

#### Detailed Syllabus:

Week No.	Trade Practical	Trade Theory
1.	<p>Importance of trade training, List of tools &amp; Machinery used in the trade.                      Health &amp; Safety: Introduction to safety equipments and their uses. Introduction of first aid, operation of Electrical mains.</p> <p><b>Occupational Safety &amp; Health</b>  <b>Importance of housekeeping &amp; good shop floor practices.</b>                      Health, Safety and Environment guidelines, legislations &amp; regulations as applicable. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Basic safety introduction, Personal protective Equipments(PPE):-                      Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution &amp; personal safety message.                      Preventive measures for electrical</p>	<p>Importance of safety and general precautions observed in the in the industry/shop floor. All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. <b>Soft Skills: its importance and Job area after completion of training.</b> Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept &amp; its application.                      Response to emergencies eg; power failure, fire, and system failure.</p>

	accidents & steps to be taken in such accidents. Use of Fire extinguishers.	
2.	Usage of First aid box and practice of Cardiopulmonary Resuscitation (CPR)  Usage of - Fire extinguishers - Safety appliances- personal protective equipment (PPEs). Identification of Various tools & Equipments in work shop	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.
3-4	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.	<b>Basic Fitting Skill</b> 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.
5.	Marking of flat job as per drawing and parallel filing practice within the accuracy of 0.5mm.	Classification, construction, material and functional details of Files. Specification of files & Filing technique. Marking media, Prussian blue, red lead, chalk and their special application and description
6-7	Filing- flat, square and steps surfaces to an accuracy of 0.4mm. (Measurement by caliper and steel rule).	Linear measurements & its units Classification, construction, materials and functional detail of following basic measuring and marking tools : - <ul style="list-style-type: none"> <li>• Steel Rule</li> <li>• Calipers(Inside &amp; outside),</li> <li>• Divider, Trammel</li> <li>• Try Square</li> <li>• Marking Punch</li> </ul> Measuring Instruments.
8	Checking and setting of Vernier calipers, vernier height gauge & vernier bevel protractor. Filing flat, square, steps and contour surfaces to an accuracy of 0.4 mm	Vernier calipers, vernier height gauge & vernier bevel protractor - principle, construction, calculation of least count and its use and care.
9	Checking and setting of micrometer. Filing flat, square and steps to an accuracy of 0.3mm (Measurement by Precision Instrument).	Precision Measuring Instruments: Concept of precision & accuracy Micrometer (outside, inside and depth) – working principle, construction, use & care, calculation of least count.

10	Transfer of dimensions from drawing to work pieces. Finding center of a round bar with the help of 'V' block and marking block. Filing flat, square, steps and contour surfaces to an accuracy of 0.2mm.	Classification, construction and functional detail of following marking devices- Surface plate, angle plate, marking block and V-Block.
11-12	Fixing of hammer handle. Chipping practice on flat surface, slots & oil grooves, and chamfer at different angle on MS plate. Scraping practice on flat & curved surfaces	Classification, construction, materials and functional detail of Chisels & Hammers. Chipping technique. Related hazards, risk and precautions while working. <b>Scrapers:</b> Introduction, Its types, material and use.
13 - 14	Truing of Pedestal grinding wheels. Grinding/Repair and maintenance of ordinary fitter's hand tools such as chisel, Screw driver, Scriber, Centre punches, dividers, trammel, scrapers and Hammer.	Pedestal grinder – Introduction, care & use. Procedure of wheel mounting & wheel dressing. Related hazards, risk and precautions.
15 - 16	Grinding practice of Drill. Use of drilling machine for drilling through & blind holes, counter boring and counter sinking on mild steel (MS) flat. Drilling on cylindrical surface. Reaming of drilled hole. Making internal & external thread by Taps & Dies. Prepare studs and nut.  Identification of various parts of Drilling machines.	<b>Drilling machines:</b> Introduction to Drilling machines. Types of drilling machines like bench, pillar & radial drilling machines and their constructional details. Types of drilling operations, calculation of cutting speed, feed & drilling time. Related hazards, risk and precautions. Introduction to theory of metal cutting - cutting speeds, feeds etc. about tools and their geometry. Drill & Reamer- its classification, construction, materials and functional detail. Study of drill chuck, drill chuck key, drill sockets, sleeves – its construction, materials, its specifications and use. <b>Taps &amp; Dies:</b> Classification, construction, material and functional detail of Taps & Dies.
17 -- 18	Filing & fitting mating components by filing within an accuracy of $\pm 0.15$ mm & angular 30 minutes	Surface finish - importance, symbol, measuring techniques. Lapping & honing process. <b>Gauges:</b> Classification and uses of Sine bar, Slip gauge, Limit gauge, Feeler gauge, thread gauge, screw pitch gauge, taper gauge.
19	Fitting of mating components by filing and scrapping within an accuracy of $\pm 0.10$	<b>Tolerances &amp; interchangeability</b> -Definition

	mm & angular within 30 minutes	and its necessity, basic size, actual size, limits, deviation, Tolerance, allowance, clearance, interference, Fits- definition, types, description with sketches. Method of expressing Tolerance as per BIS, Hole and Shaft basis (BIS standard).  Related calculation on Limit, Fit and Tolerance.
20	Practice on dovetail fitting mating components by filing and scrapping within an accuracy of $\pm 0.10$ mm & angular within 30 minutes for cylindrical surfaces.	<b>Fasteners:</b> Introduction to fasteners, screw threads, related terminology and specification. Keys- types & use, (parallel, sunk, tangential, gib head, woodruff, key ways.) Related hazards, risk and precautions, while working.
21 - 22	Preparation of flat surfaces and scraping practice on flat surface taking impression on face high spots using prussian blue sharpening by diamond dresser & wheel and lapping stone.	Types of nuts, bolts, studs, locking devices for nut, wrench and spanner, pliers, screw drivers, Circlip, split pin, washers, spring washer. Concept of torque & torque wrench. Different types of rivets and their applications. Identification of different fasteners & operating them by using proper hand tool
23-24	<b>Revision</b>	
25	<b>Examination</b>	

## Second Semester ( Code No. MMTM 02)

Duration: Six Months

### Learning Objectives (2<sup>nd</sup> Semester)

1. Apply safe working practices.
2. Comply environment regulation and housekeeping
3. Working practice on lathe & shaping machine.
4. Maintenance of mechanical power transmission system.
5. Installation of lathe and shaper.

### Detailed Syllabus:

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

04	<p>Installing drive belts, Measuring and adjusting the belt tension. Related hazards, risk and precautions while working.</p>	<p><b>Belts-</b> Belt types (Flat and V) and specifications. Pulleys used for belt drive. Installation, Alignment of belts. Problems related to belts(Creep and slip) Belt maintenance. Sheave alignment, Chain drive- Roller chain, Silent chain, alignment of sprockets, and maintenance of chain drive.</p>
05 & 06	<p>Identification of various types of bearings. Checking dimensions of solid bush bearing, split bush bearing, journal and housing comparing of fits with its mating components as per BIS. Checking split bush bearing for proper contact on journal and housing by impression testing. Mounting of split bush bearing with proper clearance, measuring clearance with the help of lead wires. Identification of various types of bearing and bearing mounting arrangements in machine tools. Tackles used for mounting and dismounting of bearing. Inspection and mounting of ball bearing on shaft with proper fit by i) Impact sleeve ii) Hydraulic or iii) Mechanical Press Mounting of ball &amp; roller bearing in gear box housing. Dismounting of rolling contact bearing by using i) Hydraulic puller ii) Hydraulic press and iii) Mechanical pullers. Inspection of bearing for its smooth rolling, allowable-side play, noises. Practice of Mounting and dismounting of</p>	<p><b>Bearing:</b> Description and function of bearing, its types - Solid Bush, Split Bush, Collar, Pivot and Plummer Block Bearing. Mounting of bearings, measurement and adjustment of clearances in bearings. Types of bearing fitting on shaft and hubs. Type of Roller contact bearings- Ball bearings-single row &amp; double row, Deep groove ball bearing, Angular contact, Self aligning and Thrust bearing. Roller bearing- Cylindrical, Needle roller, Taper roller, Spherical roller, self aligning and Spherical roller thrust bearing. Use of ISO bearing designation code to generate market survey and purchase. Checking and adjustment of bearing clearance. Methods of Mounting and dismounting of roller contact bearing, taper roller bearing and angular contact ball bearing. (Back-to-back, Face-to-face, tandem) Mounting-dismounting and adjustment of Taper bore bearings with adopter and withdrawal sleeve. Handling and storage of bearings. Related hazards, risk and precautions.</p>



	<p>bearings. Practice of Dismantling &amp; assembly of simple m/c parts &amp; units like cross slide, compound slide &amp; tailstock of lathe.</p>	
07.	<p>Identification of various types of Gears &amp; Gear boxes. Inspection of various aspects of Gears &amp; Gear boxes such as PCD checking by Cylindrical Pin, Checking of gear tooth thickness, clearance, concentricity &amp; wear etc. Gear meshing: Checking of backlash and root clearances with Feeler Gauge, Dial Test Indicator and Lead Wire.</p>	<p><b>Gear:</b> Type, description and function of gears- Spur, Helical, Spiral, Bevel, Straight and Spiral bevel, Worm gears, Rack and pinion. Gear Terminology. Gear train- simple, compound, reverted and epicyclic. Types of Gear box Gear meshing: Checking of backlash and root clearances with Feeler Gauge, Dial Test Indicator and lead wire. Impression testing of gear mesh with Prussian blue. Running maintenance Related hazards, risk and precautions</p>
08	<p>Practice on oil removing &amp; filling from gear box. Inspection of the drained oil for contaminants &amp; wear debris with focus on visual inspection. Overhauling procedure of gear box (Pre cleaning, dismantling, cleaning, inspection, repair/ replacement, assembly).of speed &amp; feed gearboxes of lathe &amp; milling m/c 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 &amp; fitting of different type of seals and oil rings. Preparation &amp; 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 -</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 &amp; 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>

	Practice	
11	Preparation of coolants. Identification of various parts of cooling systems. Preventive & breakdown maintenance of coolant systems	<b>Cutting Fluids and Coolants.</b> <b>Essential parts of a basic cooling system used in the cutting of metals.</b> <b>Various types of coolants, its properties and uses , cooling system type-soluble oils- soaps, sudsparaffin, soda water etc.</b>  Effect of cutting fluids in metal cutting. Difference between coolant and lubricants.
12	Demonstration for location & excavation for foundation bolts, method employed for installation & erection of precision & heavy duty machines.	<b>MACHINE FOUNDATION</b>  Purpose & methods employed for installation & erection of precision & heavy duty machines.  <b>Location &amp; excavation for foundation.</b> <b>Different types of foundations – foundation bolts, structural, reinforced, wooden, isolated foundations.</b>
13	Leveling of a machine – Practice on models	<b>Leveling</b> Definition and importance of leveling. Types of levels- Spirit level, Water level, Dumpy level, Method of leveling. Preparation of packing and shim.
14	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 builder. Locating static unbalance in a rotor, finding the correction weight. Checking & adjusting radial & axial play of spindles & eliminating play of slide units.	<b>Alignment:</b> 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. <b>Balancing</b> Understanding importance of balancing and reasons of unbalance. Type of unbalance. Method of static balancing and its correction -Adding and removing mass -Mass centering.

15 & 16	<p>Safety precautions in dismantling &amp; assembly of Drilling machines.</p> <p>Dismantling and assembly of various parts such as Motors, Spindle &amp; Spindle head, Gear box and Arm.</p>	Maintenance and Repairs of Various types of drilling machines.
17 & 18	<p>Practice of Lathe tool grinding, tool setting.</p> <p>Lathe operations – plain turning, facing, step turning, undercut, chamfering, grooving, drilling, boring, counter boring, fillet radius within the accuracy of <math>\pm 0.1\text{mm}</math> 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.</p> <p>Practice of different taper turning methods on lathe. Practice screw thread cutting - whit worth/metric (Internal &amp; external).</p>	<p><b><u>Machine Tool Operation &amp; Maintenance</u></b></p> <p><b>Lathe Machine</b></p> <p>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.</p> <p>Calculation of cutting speed, feed and turning time.</p> <p>Lathe accessories and attachments. Chuck – its types, face plates, lathe dogs, lathe centers - its types, and lathe steady. Related hazards, risk and precautions.</p> <p>Regular maintenance of a machine tool.</p> <p>Nomenclature of cutting tool. Lathe cutting tools geometry. Recommended cutting tool materials for lathe operations. Different taper turning methods and its calculations.</p> <p>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 &amp; Assembly of various parts &amp; sub assemblies of lathe such as head stock, apron, saddle, tool post, tail stock etc</p> <p>Checking &amp; accuracy of lathe after assembly.</p> <p>Practice of preventive maintenance on machines and Demo with case studies on breakdown maintenance &amp; Trouble shooting</p>	Breakdown maintenance and preventive maintenance of a lathe.
21 & 22	Holding the job on shaping machine vice, setting of	<b>Shaper:</b>

	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	Introduction to Shaper machine parts & constructional details, its function and operations.  Quick return mechanism of shaper.  Calculation of cutting Speed, feed & depth of cut.
23-24	<b>Implant training</b> / Project work (work in a team)	
25	<b>Revision</b>	
26	<b>Examination</b>	

### Third Semester ( Code No. MMTM 03)

Duration: Six Month

#### Learning Objectives (3<sup>rd</sup> Semester)

1. Apply safe working practices.
2. Comply environment regulation and housekeeping
3. Interpret & use Company terminology and technical communication
4. Operate milling and surface grinding machine.
5. Arc & gas welding operations.
6. Maintenance of hydraulic & pneumatic system.
7. Make pipe/tube fittings.

#### Detailed Syllabus:

Week No.	Trade Practical	Trade Theory
01 & 02.	<u><b>Arc Welding</b></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.	<u><b>Welding &amp; Gas Cutting</b></u> <u><b>Arc Welding</b></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

		<p>Arc Length &amp; its effects</p> <p>Arc Welding Machines: - advantages &amp; disadvantages of AC &amp; DC Arc Welding Machine. Safety Precautions: Related to Arc welding m/c &amp; accessories.</p> <p>Manual Metal Arc Welding Electrodes: - Sizes &amp; Coding.</p> <p>Edge Preparation: - Necessity of edge preparation. Nomenclature of butt &amp; fillet welding. Welding Symbols &amp; Weld defects.</p>
03	<p><b><u>Gas Welding</u></b></p> <p>Setting up of a gas welding set. Setting of different types of flames with gas welding &amp; adjustment of flame.</p> <p>Making straight beads with and without filler rod.</p> <p>Making square lap joint, butt joint &amp; Tee joint using plates / sheets of up to 3 mm thickness.</p> <p>Setting up of flames for gas cutting of different material thickness.</p>	<p><b><u>Gas Welding</u></b></p> <p>Introduction to gas welding process, its classifications, accessories and its safety.</p> <p>Principle of gas cutting.</p> <p>Systems of Oxy-Acetylene Welding- Flashback &amp; backfire</p> <p>Types of Oxy-Acetylene flames: - Gases used in welding &amp; Gas flame combination.</p> <p>Filler Rods for Gas Welding.</p> <p>Safety in gas cutting process.</p> <p>Description about types of welding joints.</p> <p>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.</p> <p>Overhauling of valves</p>	<p><b><u>Hydraulics &amp; Pneumatics</u></b></p> <p>Basic principles of Hydraulics - Advantages &amp; limitation of hydraulic system, hydrostatic transmission, Pascal's law, Brahma's press, pressure Temperature &amp; flow, speed of an actuator.</p> <p>Control valves: Different type of control valves used in hydraulic System.</p> <p>Function of pressure control valve, directional control valve, check valve, flow control valve.</p>
05 & 06.	<p>Overhauling of</p> <ul style="list-style-type: none"> <li>- Hydraulic pumps</li> <li>- Hydraulic actuators.</li> </ul>	<p>Function and construction of gear pump, vane pump and piston pump, cylinder &amp; hydraulic motor.</p>
7.	<p>Simulation of hydraulic circuits.</p> <ul style="list-style-type: none"> <li>- Simple hydraulic circuits.</li> </ul> <p><b>Hydraulic</b> circuit reading practice &amp; constructing hydraulic circuits for single &amp; double acting cylinders, meter in, meter out</p>	<p>Auxiliary &amp; fluid conditioner: Reservoir, filter, strainer, pressure gauge, pipe &amp; pipe fitting, accumulator, seals &amp; packing</p> <p>Simple hydraulic circuits :</p> <ul style="list-style-type: none"> <li>- Hydraulic symbols</li> </ul>

	circuit, pressure control circuits & regenerating circuit.	- 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.	<b><u>Pipe Fitting and Valves</u></b> Types of pipe, tubes and different fittings. Tools used in pipe work.
12	Bending of pipes as per drawing. Making pipe joint (flaring and ferrule).	Pipe bending and jointing methods. Different types of expansions joints and their applications.
13 & 14	Use of different type of valve like: Gate, Globe, butterfly, Diaphragm. Direction control valve, pressure relief valve, non return valve, flow control valve. Assembly and disassembly of valves. Making and replacement of gaskets.	Pipe colour code. Safety precautions to be observed while working at pipeline. Constructional detail of different type of valve & their uses like: Gate, Globe, butterfly, Diaphragm.
15.	Setting of milling cutters, machine vice (job holding device), cutting speed, feed, setting of table movement. Preparation of rectangular block by milling with in an accuracy of $\pm 0.2$ mm. Step milling (external) operation within the accuracy of $\pm 0.2$ mm. T slot milling	<b><u>Milling:</u></b> Introduction to milling machine, parts & constructional details, types. Safety precaution followed during milling operation. Milling machine attachments. Different types of milling cutters and its materials. Nomenclature of milling cutters.

16	Angular milling (external) & Dovetail milling & 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 $\pm 0.02\text{mm}$ , using magnetic chucks and C-clamp. Grinding angular surfaces within an accuracy of $\pm 0.02$ minutes using universal vice. Setting of machine for cylindrical grinding for internal & external surfaces. Setting of machine for Grinding taper holes on cylindrical grinding machine	<b>Grinding:</b> Grinding machine – introduction, parts & constructional details, types – surface grinding and cylindrical grinding machines. Safety precaution followed while working on grinding machines. Grinding wheels – abrasives, bond and bonding process, grit, grade, and structure of grinding wheels and its marking system. Procedure for mounting of grinding wheels, balancing of grinding wheels, dressing and truing of grinding wheels, glazing and loading in grinding wheel.
20 & 21	Dismantling & Assembly of various parts & sub assemblies of grinding machine such as grinding head, ,lead screw, table, hydraulic cylinder etc Checking & accuracy of grinding machine after assembly. Practice of preventive maintenance on grinding machines and Demo with case studies on breakdown maintenance & Trouble shooting	Preventive and breakdown maintenance of grinding machine.
22-23	<b>Implant training / Project work (work in a team)</b>	
24-25	<b>Revision</b>	
26	<b>Examination</b>	

## Fourth Semester ( Code No. MMTM 04)

Duration: Six Month

### Learning Objectives (4<sup>th</sup> Semester)

1. Apply safe working practices.
2. Comply environment regulation and housekeeping
3. Interpret & use Company terminology and technical communication
4. Familiarization with basic electronics circuits.
5. Familiarization of hydraulic power pack.
6. Basic knowledge in CNC Part programming and CNC machines.
7. Working knowledge with pumps, blowers, fans and compressor.
8. Fault finding and break down attention in machine tools.

### Detailed Syllabus:

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.	<p>Identification of passive and active electronic components.</p> <p>Observation of waveforms in a power supply using oscilloscope.</p> <p>Verification of logic gate operations.</p>	<p><b>BASIC ELECTRONICS</b></p> <p>Introduction to electronics and its industrial applications.</p> <p>Introduction to digital electronics – numbers system and logic gates.</p>
04	<p>Scope of industrial electronics with reference to its application in machine tools operation.</p> <p>Identification of basic components - such as Resistor capacitors Inductors.etc,from their out look.Types specifications and general applications of these components</p> <p>Testing &amp; measurement of their values using multimeter,use of Resistance colour codes.solddering and desoldering of component on printed circuit boards (<b>PCB</b>) precautions to be taken while soldering on PCB.</p>	<p>Study of electronic circuit – macro level with block diagram.</p>
05.	<p>Study of rectifiers available in different package –lead identification &amp; testing by multimeter. Study of rectifier circuits –half wave full wave &amp; brige rectifiers.</p> <p>Study of solid state devices such as diodes trasnsisters, SCRS &amp; ICS available in different packages,type &amp; application. Identification leads &amp; testing by multimeter.</p> <p>Assembly of simple battery eliminator circuit using bright rectifier &amp; filter capacitor.</p> <p>Measurment of input &amp; output voltages.</p>	<p>Study of PLC - macro level</p>
06.	<p>Instrumentation</p> <p>Demonstration on various measuring devices</p> <p>Demonstration of PLC</p>	<p>Introduction to industrial process control system and equipment - sensors, transmitters and final control elements.</p> <p>Measurement of displacement, pressure,</p>

	Trouble shooting of mechanical elements with case studies.	temperature, flow, level and speed. Application of encoders. Programmable logic controller (PLC) – General concept of working, Relay Logic Control vs. PLC, Block diagram, applications.
07 & 08	Safety precautions in use & maintenance of hydraulic presses. Dis-assembly of hydraulic power pack from press unit. Removal, replacing / refitting of hydraulic pipes, ferrules, O rings, etc. Dismantling of hydraulic cylinder, piston, seals, reassembly, pipe reconnection, air bleeding & testing / working of power press.	Study & working of a hydraulic press along with its components. Breakdown & preventive maintenance of a hydraulic press. Safety in use of and maintenance of hydraulic presses.
09. & 10	Practical Demo on CNC lathe / machining centre operation, its essential parts. Functioning of each part. Multi-media demo. Industrial visit to CNC based Workshop/factory. CNC part program simulation practice.	Introduction to CNC lathe and machining center, constructional details, Mechanical, electrical and Electronic elements of CNC machine, CNC Part program. study of hydraulic diagram, hydraulics valves etc.
11 & 12.	Identification of various types of centrifugal pumps, their parts. Overhauling of pump. Priming of pump, Fitting gland packing. Starting and stopping of pumps. Trouble shooting in pump operation. Preventive and schedule maintenance of pumps.	<b>Centrifugal Pump, Fan, Blower and Compressor:-</b> <b>Pump</b> Function of pump. Types and working principle of centrifugal pump. Constructional detail of pump Starting and stopping Pump performance and characteristics. Capitation & aeration Preventive & schedule maintenance of pumps. Gland packing changing procedure. Concept of Mechanical seal Trouble shooting in pump.
13. & 14	Identification of various types of fans, Blowers, their parts. Dismantling, cleaning and assembly of parts. Identification of various types of compressors, their parts. Starting and stopping of compressors Cleaning and changing of filters Preventive & schedule maintenance	<b>Fan &amp; Blowers:</b> Types and working principle Constructional detail of Fans & Blowers. Starting and stopping of Fans and Blowers Different parts of Fans & Blowers Concept of surge. Preventive & scheduled maintenance. <b>Compressors:</b> Compression theory, Types of compressors Constructional detail of compressors, working

	of Blower & Compressor	mechanism Different parts and their function. Loading unloading system Concept of air dryer. Preventive & schedule maintenance.
15.	Practice of different type of knots & hitches used in material handling Raving sets of pulley block. Splicing of manila rope. Inspection of wire rope/steel rope/belts.	Rigging Knowledge of different tools & tackles used in rigging. Construction and capacity of wire rope/steel rope/belts. Application of knots and hitches. Care and maintenance of all types of ropes.
16	Use of mechanical & hydraulic jack, rope puller, chain puller, chain block, winch. Inspection of tools and tackles Loading, unloading and shifting of common and uncommon shapes of material. Hand signal used in rigging.	Different type of jacks, chain block and pull lift. Knowledge of different types of scaffolding. Material movement by using different rigging tools and techniques. Safety appliances & precautions in rigging. Maintenance of tools and tackles.
17 & 18	Demonstration on Belt conveyor system, Vibratory screen & feeder. Demonstration & practice on flat belt jointing	Bulk Material Handling (Conveyor belt, Vibratory screen, Feeders) Principle & mode of material handling. Various components used in belt conveyor system & their functions. (Pulleys, idlers, scrapers, skirts, belt, take up unit system and safety devices). Vibratory screen- working mechanism. Feeders- types, working mechanism. Maintenance practice- Pulley lagging, belt sway control belt joining methods.
19	Revision of Dismantle, inspect and do minor repairs and assemble machine tools such as drill, shaper, lathe and power saw machines.  Practice of dismantling & assembly of feed units of lathe, milling, grinding etc.	Breakdown Maintenance, Preventive Maintenance, Predictive Maintenance & Concepts of TPM, OEE.(without calculations)  Difference between breakdown and preventive maintenance – Its importance in productivity, types.  Normal procedure followed for maintenance of

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

## 9.2 SYLLABUS CONTENT OF CORE SKILLS

**First Semester**(Code No. MMTM 01)

Duration: Six Month

### Detailed Syllabus

#### LEARNING OBJECTIVES OF 1<sup>ST</sup> SEMESTER

1. Demonstrate basic arithmetic to derive value of unknown quantity / variable.
2. Understand & apply engineering material, their classification, properties and applications in the day to day technical application.
3. Explain & apply speed, velocity, work, power & energy for application in field of work.
4. Understand & explain importance of engineering drawing, drawing instruments, their standard & uses.
5. Draw lines, geometrical figures, free hand sketches.
6. Understand and apply sizes & layout of drawing sheet, method of presentation of engineering drawing & symbolic representation as per BIS standards

Sl. No.	Professional Knowledge	Professional Knowledge & Skills
	Workshop Calculation and Science	Engineering Drawing
1.	<b>Unit:</b> Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units	Engineering Drawing: Introduction and its importance <ul style="list-style-type: none"> <li>- Relationship to other technical drawing types</li> <li>- Conventions</li> <li>- Viewing of engineering drawing sheets.</li> <li>- Method of Folding of printed Drawing Sheet as per BIS SP:46-2003</li> </ul>
2.	<b>Fractions:</b> Fractions, Decimal fraction, L.C.M., H.C.F., Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems using Scientific Calculator.	Drawing Instruments : their Standard and uses <ul style="list-style-type: none"> <li>- Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.</li> </ul>
3.	<b>Square Root:</b> Square and Square Root, method of finding out square roots, Simple problem using calculator.	Lines : <ul style="list-style-type: none"> <li>- Definition, types and applications in Drawing as per BIS SP:46-2003</li> <li>- Classification of lines (Hidden, centre, construction, Extension, Dimension, Section)</li> <li>- Drawing lines of given length (Straight, curved)</li> <li>- Drawing of parallel lines, perpendicular line</li> <li>- Methods of Division of line segment</li> </ul>
4.	<b>Ratio &amp; Proportion:</b> Simple calculation on related problems.	Drawing of Geometrical Figures: Definition, nomenclature and practice of <ul style="list-style-type: none"> <li>- Angle: Measurement and its types, method of bisecting.</li> </ul>

		<ul style="list-style-type: none"> <li>- Triangle -different types</li> <li>- Rectangle, Square, Rhombus, Parallelogram.</li> <li>- Circle and its elements.</li> </ul>
5.	<b>Percentage:</b> Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	Lettering and Numbering as per BIS SP46-2003: <ul style="list-style-type: none"> <li>- Single Stroke, Double Stroke, inclined, Upper case and Lower case.</li> </ul>
6.	<b>Material Science</b> : properties -Physical & Mechanical, Types –Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys.	Dimensioning: <ul style="list-style-type: none"> <li>- Definition, types and methods of dimensioning (functional, non-functional and auxiliary)</li> <li>- Types of arrowhead</li> <li>- Leader Line with text</li> </ul>
7.	<b>Mass, Weight and Density:</b> Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals.	Free hand drawing of <ul style="list-style-type: none"> <li>- Lines, polygons, ellipse, etc.</li> <li>- geometrical figures and blocks with dimension</li> <li>- Transferring measurement from the given object to the free hand sketches.</li> </ul>
8.	<b>Speed and Velocity:</b> Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation, equations of motions, simple related problems.	Sizes and Layout of Drawing Sheets <ul style="list-style-type: none"> <li>- Basic principle of Sheet Size</li> <li>- Designation of sizes</li> <li>- Selection of sizes</li> <li>- Title Block, its position and content</li> <li>- Borders and Frames (Orientation marks and graduations)</li> <li>- Grid Reference</li> <li>- Item Reference on Drawing Sheet (Item List)</li> </ul>
9.	<b>Work, Power and Energy:</b> work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.	Method of presentation of Engineering Drawing <ul style="list-style-type: none"> <li>- Pictorial View</li> <li>- Orthogonal View</li> <li>- Isometric view</li> </ul>
10.	-----	Symbolic Representation (as per BIS SP:46-2003) of : <ul style="list-style-type: none"> <li>- Fastener (Rivets, Bolts and Nuts)</li> <li>- Bars and profile sections</li> <li>- Weld, brazed and soldered joints.</li> <li>- Electrical and electronics element</li> <li>- Piping joints and fittings</li> </ul>

## Second Semester ( Code No. MMTM 02)

Duration: Six Months

### LEARNING OBJECTIVES OF 2<sup>ND</sup> SEMESTER

1. Demonstrate basic algebraic, mensuration, trigonometric facts and formulas to derive value of unknown quantity / variable.
2. Apply the factual knowledge of basic heat & temperature, basic electricity for day to day practical application.
3. Explain & apply principles of simple machine & levers for mechanical advantage, efficiency for practical application.
4. Draw & practice dimensioning, construction of solid figures and projections as per IS specifications.

Sl. No.	Professional Knowledge	Professional Knowledge & Skills
	Workshop Calculation and Science	Engineering Drawing
1.	<b>Algebra:</b> Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	Construction of Scales and diagonal scale
2.	<b>Mensuration :</b> Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi-circle,  Volume of solids – cube, cuboids, cylinder and Sphere.  Surface area of solids – cube, cuboids, cylinder and Sphere.	Practice of Lettering and Title Block
3.	<b>Trigonometry:</b> Trigonometrical ratios, measurement of angles.  Trigonometric tables	Dimensioning practice: <ul style="list-style-type: none"><li>- Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003)</li><li>- Symbols preceding the value of dimension and dimensional tolerance.</li><li>- Text of dimension of repeated features, equidistance elements, circumferential objects.</li></ul>
4.	<b>Heat &amp; Temperature:</b> Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation.	Construction of Geometrical Drawing Figures: <ul style="list-style-type: none"><li>- Different Polygons and their values of included angles. Inscribed and Circumscribed polygons.</li><li>- Conic Sections (Ellipse &amp; Parabola)</li></ul>
5.	<b>Basic Electricity:</b> Introduction, use of electricity, how electricity is produced, Types	Drawing of Solid figures (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid.) with

	of current_ AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Types of connections – series, parallel, electric power, Horse power, energy, unit of electrical energy.	dimensions.
6.	<b>Levers and Simple Machines:</b> levers and its types.  Simple Machines, Effort and Load, Mechanical Advantage, Velocity Ratio, Efficiency of machine, Relationship between Efficiency, velocity ratio and Mechanical Advantage.	Free Hand sketch of hand tools and measuring tools used in respective trades.
7.		Projections:  - Concept of axes plane and quadrant. - Orthographic projections - Method of first angle and third angle projections (definition and difference) - Symbol of 1 <sup>st</sup> angle and 3 <sup>rd</sup> angle projection as per IS specification.
8.		Drawing of Orthographic projection from isometric/3D view of blocks
9.		Orthographic Drawing of simple fastener (Rivet, Bolts, Nuts & Screw)
10.		Drawing details of two simple mating blocks and assembled view.

### Third Semester (Semester Code No. MMTM-03)

Duration: Six Months

#### Learning Objectives (3<sup>rd</sup> Semester)

1. Demonstrate & apply calculation of area of cut-out regular & irregular surfaces, Volume of geometrical shapes and their cut section in related shop floor problems.
2. Calculate value of unknown sides and angles of geometrical shapes by trigonometrical methods and apply in shop floor problems.
3. Understand & apply concept of forces, stress & strain, factor of safety for practical application.
4. Factual knowledge of thermal conductivity, temperature measuring instruments, average velocity and circular motion for day to day application.
5. Understanding drawing of machined components & related symbols for use in manufacturing purpose.
6. Draw free hand sketches for fasteners, hand tools and components.



7. Prepare simple assembly drawings & their details.

Sl. No.	Professional Knowledge	Professional Knowledge & Skills
	Workshop Calculation and Science	Engineering Drawing
1.	- Geometrical construction & theorem: division of line segment, parallel lines, similar angles, perpendicular lines, isosceles triangle and right angled triangle.	- Revision of first year topics.
2.	- Area of cut-out regular surfaces: circle and segment and sector of circle.	- Machined components; concept of fillet & chamfer; surface finish symbols.
3.	- Area of irregular surfaces. - Application related to shop problems.	- Screw thread, their standard forms as per BIS, external and internal thread, conventions on the features for drawing as per BIS.
4.	- Volume of cut-out solids: hollow cylinders, frustum of cone, block section. - Volume of simple machine blocks.	- Free hand Sketches for bolts, nuts, screws and other screwed members.
5.	- Material weight and cost problems related to trade.	- Free hand Sketching of foundation bolts and types of washers.
6.	- Finding the value of unknown sides and angles of a triangle by Trigonometrical method.	- Standard rivet forms as per BIS (Six types).
7.	- Finding height and distance by trigonometry.	- Riveted joints-Butt & Lap (Drawing one for each type).
8.	- Application of trigonometry in shop problems. (viz. taper angle calculation).	- Orthogonal views of keys of different types
9.	- Forces definition. - Compressive, tensile, shear forces and simple problems. -Stress, strain, ultimate strength, factor of safety. -Basic study of stress-strain curve for MS.	- Free hand Sketches for simple pipe, unions with simple pipe line drawings.
10.	- Temperature measuring instruments. Specific heats of solids & liquids.	- Concept of preparation of assembly drawing and detailing. Preparation of simple assemblies & their details of trade related tools/job/exercises with the dimensions from the given sample or models.
11.	- Thermal Conductivity, Heat loss and heat gain.	-Free hand sketch of trade related components / parts (viz., single tool post for the lathe, etc.)
12.	- Average Velocity, Acceleration & Retardation. - Related problems.	- Study of assembled views of Vee-blocks with clamps.
13.	- Circular Motion: Relation between circular motion and Linear motion, Centrifugal force, Centripetal force	- Study of assembled views of shaft and pulley.

14.		- Study of assembled views of bush bearing.
15.		- Study of assembled views of a simple coupling.
16.		- Free hand Sketching of different gear wheels and nomenclature.

#### Fourth Semester (Semester Code No. MMTM-04)

Duration: Six Months

#### Learning Objectives (4<sup>th</sup> Semester)

1. Read & interpret different types graphs.
2. Solve simple statistical problem and apply sampling method for inspection purpose.
3. Factual knowledge of friction, magnetism and their application and affects.
4. Understand the application of electrical insulating materials & concept of earthing.
5. Understand & apply transmission of power, heat treatment & their advantages.
6. Factual knowledge of pressure, its units and measuring system and understand basic concept of pneumatics & hydraulic system.
7. Draw free hand sketches of bench vice and bearing.
8. Understand & identify missing lines, symbols & views.
9. Estimate material required as per drawing.

Sl. No.	Professional Knowledge	Professional Knowledge & Skills
	Workshop Calculation and Science	Engineering Drawing
1.	<p><b>Graph:</b></p> <ul style="list-style-type: none"> <li>- Read images, graphs, diagrams</li> <li>- Bar chart, pie chart.</li> <li>- Graphs: abscissa and ordinates, graphs of straight line, related to two sets of varying quantities.</li> </ul>	- Free hand Details and assembly of simple bench vice.
2.	<p>Simple problem on Statistics:</p> <ul style="list-style-type: none"> <li>- Frequency distribution table</li> <li>- Calculation of Mean value.</li> <li>- Examples on mass scale productions.</li> <li>-Cumulative frequency</li> <li>-Arithmetic mean</li> </ul>	- Reading of drawing. Simple exercises related to missing lines, dimensions. How to make queries.
3.	Acceptance of lot by sampling method (within specified limit size) with simple examples (not more than 20 samples).	<ul style="list-style-type: none"> <li>- Simple exercises relating missing symbols.</li> <li>- Missing views</li> </ul>
4.	- Friction- co-efficient of friction, application and effects of friction in Workshop practice.	- Simple exercises related to missing section.

	<b>Centre of gravity</b> and its practical application.	
<b>5.</b>	- Magnetic substances- natural and artificial magnets. - Method of magnetization. Use of magnets.	-Free hand sketching of different types of bearings and its conventional representation.
<b>6.</b>	- Electrical insulating materials. - Basic concept of earthing.	- Free hand sketching of different gear wheels and nomenclature/ Simple duct (for RAC). Free hand sketch of Reciprocating compressor – open type (for RAC)
<b>7.</b>	- Transmission of power by belt, pulleys & gear drive. - Calculation of Transmission of power by belt pulley and gear drive.	- Solution of NCVT test. - Simple exercises related to trade related symbols. - Basic electrical and electronic symbols
<b>8.</b>	- Heat treatment and advantages.	- Study of drawing & Estimation of materials.
<b>9.</b>	Concept of pressure – units of pressure, atmospheric pressure, absolute pressure, gauge pressure – gauges used for measuring pressure	- Solution of NCVT test papers.
<b>10.</b>	Introduction to pneumatics & hydraulics systems.	

## 10. SYLLABUS CONTENT OF EMPLOYABILITY SKILLS

### General Information

Name of the subject	EMPLOYABILITY SKILLS
Applicability	CTS- Mandatory for all trades ATS- Mandatory for fresher only
Hours of Instruction	110 Hrs.
Examination	: The examination shall be held at the end of semesters.
Instructor Qualification	<ul style="list-style-type: none"> <li>• MBA or 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 ITIs and</li> <li>• Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above or</li> <li>• Existing Social Studies Instructors duly trained in Employability Skills from DGET institutes</li> </ul>
Instructor	<ul style="list-style-type: none"> <li>• One full-time instructor is required for 1000 seats and above</li> <li>• For seats less than 1000, the instructor may be out sourced/ hired on contract basis.</li> </ul>

### Semester-wise Distribution of Topics (Employability Skill)

Course Duration	Topics		Examination
	Semester 1	Semester 2	
01 Year (Two semesters)	1. English Literacy 2. I.T. Literacy 3. Communication Skills	1. Entrepreneurship Skills 2. Productivity 3. Occupational Safety , Health, and Environment Education 4. Labour Welfare 5. Legislation 6. Quality Tools	Final examination at the end of second semester

## SYLLABUS CONTENT OF EMPLOYABILITY SKILL SEMESTER-I

### LEARNING OBJECTIVES OF 1<sup>ST</sup> SEMESTER

1. Read, write and communicate in English language for day to day work.
2. Communicate in written and oral and with required clarity ensuring that the information communicated is clear, concise and accurate.
3. Understand and apply basic computer working, basic operating system and uses internet services to get accustomed & take benefit of IT developments in the industry.

<b>1. English Literacy</b>	
<b>Hours of Instruction: 20 Hrs.</b>	
<b>Marks Allotted: 09</b>	
<b>Pronunciation</b>	Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)
<b>Functional Grammar</b>	Transformation of sentences, Voice change, Change of tense, Spellings.
<b>Reading</b>	Reading and understanding simple sentences about self, work and environment
<b>Writing</b>	Construction of simple sentences Writing simple English
<b>Speaking / Spoken English</b>	Speaking with preparation on self, on family, on friends/ classmates, on known, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Cardinal (fundamental) numbers ordinal numbers. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.
<b>2. I.T. Literacy</b>	
<b>Hours of Instruction: 20 Hrs.</b>	
<b>Marks Allotted: 09</b>	
<b>Basics of Computer</b>	Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.
<b>Computer Operating System</b>	Basics of Operating System, WINDOWS, The user interface of Windows OS, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc, Use of Common applications.
<b>Word processing and Worksheet</b>	Basic operating of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & creation of Tables. Printing document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets

<b>Computer Networking and INTERNET</b>	<p>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), Meaning of World Wide Web (WWW), Web Browser, Web Site, Web page and Search Engines. Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites and its implication.</p> <p>Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT – ACT, types of cyber-crimes.</p>
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**3. Communication Skills**  
**Hour of Instruction: 15 Hrs. Marks Allotted: 07**

Topic	Contents
<b>Introduction to Communication Skills</b>	Communication and its importance
	Principles of Effective communication
	Types of communication – verbal, nonverbal, written, email, talking on phone.
	Nonverbal communication –characteristics, components-Para-language
	Body – language
	Barriers to communication and dealing with barriers.
	Handling nervousness/ discomfort.
<b>Listening Skills</b>	Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening.
	Triple- A Listening – Attitude, Attention & Adjustment.
	Active Listening Skills.
<b>Motivational Training</b>	Characteristics Essential to Achieving Success
	The Power of Positive Attitude
	Self-awareness
	Importance of Commitment
	Ethics and Values
	Ways to Motivate Oneself
	Personal Goal setting and Employability Planning.
<b>Facing Interviews</b>	Manners, Etiquettes, Dress code for an interview
	Do's & Don'ts for an interview
<b>Behavioral Skills</b>	Problem Solving
	Confidence Building
	Attitude

## **SEMESTER-II**

### **LEARNING OBJECTIVES OF 2<sup>ND</sup> SEMESTER**

1. Knowledge of business activities, ability to interact with consumers for development of businesses.
2. Understand and apply productivity, its benefits and factors affecting the productivity.
3. Follow and maintain procedures to achieve a safe working environment in line with occupational health, safety, environment regulations and Labour welfare legislation and requirements.
4. Understand and apply quality concepts as per ISO and BIS system and its importance.
5. Recognize different components of 5S and apply the same in the working environment.

<b>4. Entrepreneurship skill</b> <b>Hour of Instruction: 15 Hrs. Marks Allotted: 06</b>	
<b>Topic</b>	<b>Content</b>
<b>Business &amp; Consumer:</b>	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
<b>Self-Employment:</b>	Need and scope for self-employment, Qualities of a good Entrepreneur (values attitude, motive, etc.), SWOT and Risk Analysis
<b>Govt Institutions :</b>	Role of various Schemes and Institutes for self-employment i.e. DIC, SIDBI, MSME, NSIC, Financial institutions and banks
<b>Initiation Formalities :</b>	Project Formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment Procedure - Loan Procurement - Agencies - banking Process
<b>5. Productivity</b> <b>Hour of Instruction: 10 Hrs. Marks Allotted: 05</b>	
Productivity	Definition, Necessity, Meaning of GDP.
Benefits	Personal / Workman – Incentive, Production linked Bonus, Improvement in living standard. Industry Nation.
Affecting Factors	Skills, Working Aids, Automation, Environment, Motivation How improves or slows down.

Comparison with developed countries	Comparative productivity in developed countries (viz. Germany, Japan and Australia) in selected industries e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages.
Personal Finance Management	Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.
<b>6. Occupational Safety, Health &amp; Environment</b> <b>Hour of Instruction: 15 Hrs. Marks Allotted: 06</b>	
<b>Safety &amp; Health :</b>	Introduction to Occupational Safety and Health and its importance at workplace
<b>Occupational Hazards :</b>	Occupational health, Occupational hygiene, Occupational Diseases/ Disorders & its prevention
<b>Accident &amp; safety :</b>	Accident prevention techniques- control of accidents and safety measures
<b>First Aid :</b>	Care of injured & Sick at the workplaces, First-aid & Transportation of sick person
<b>Basic Provisions :</b>	Idea of basic provisions of safety, health, welfare under legislation of India
<b>7.Labour Welfare Legislation</b> <b>Hour of Instruction: 05 Hrs. Marks Allotted: 03</b>	
<b>Labour Welfare Legislation</b>	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
<b>8.Quality Tools</b> <b>Hour of Instruction: 10 Hrs. Marks Allotted: 05</b>	
<b>Quality Consciousness :</b>	Meaning of quality, Quality Characteristic
<b>Quality Circles :</b>	Definition, Advantage of small group activity, objectives of Quality Circle, Roles and Functions of Quality Circles in organization, Operation of Quality Circle, Approaches to Starting Quality Circles, Steps for Continuation Quality Circles
<b>Quality Management System:</b>	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.
<b>House Keeping :</b>	Purpose of Housekeeping, Practice of good Housekeeping.5S Principles of Housekeeping: SEIRI – Segregation, SEITON – Arrangement, SEISO – Cleaning, SEIKETSU – maintenance of Standards, SHITSUKE - Discipline



## 11. INFRASTRUCTURE

1. Instructors' Qualification	<p>Degree in Mechanical Engineering from recognized Engineering College /university with one year experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>Diploma in Mechanical Engineering from recognized board of technical education with two years' experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>10th Class Pass + NTC/NAC in the Trade of "Mechanic Machine Tool Maintenance" With 3 years post-qualification experience in the relevant field.</p>
Desirable qualification	Preference will be given to a candidate with CIC (Craft Instructor Certificate) in Mechanic Machine Tool Maintenance Trade.
3. Space Norms	192 Sq.m
4. Power Norms	17 KW
5. Tools, Equipment & General Machinery	(As per Annexure II)

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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.
- iii) The list of Tools, Equipment & General Machinery listed in Annexure – II is for a particular trade **MECHANIC MACHINE TOOL MAINTENANCE** comprising of four semesters and not for a single semester.

## 12. ASSESSMENT STANDARD

### 11.1ASSESSMENT GUIDELINES:

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking the assessment. Due consideration shall be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitive to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude shall be considered while assessing competency.

Assessment shall be evidence based comprising the following:

- 1) Job carried out in labs/workshop
- 2) Record book/ daily diary
- 3) Answer sheet for assessment
- 4) Viva-voce
- 5) Progress Chart
- 6) Attendance and punctuality
- 7) Assignment
- 8) Project work

Evidence of internal assessment should be preserved for an appropriate period of time for audit and verification by examination body.

The following marking pattern to be adopted while assessing:

a) Weightage in the range of 60-75% to be allotted during assessment under following performance level:

For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work that demonstrates attainment of an acceptable standard of craftsmanship. In this work there is evidence of:

- Demonstration of good skill in the use of hand tools, machine tools, and workshop equipment
- Below 70% tolerance dimension achieved while undertaking different work with those demanded by the component/job.
- A fairly good level of neatness and consistency in the finish
- Occasional support in completing the project/job.

b) Weightage in the range of above75%- 90% to be allotted during assessment under following performance level:

For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work that demonstrates attainment of a reasonable standard of craftsmanship. In this work there is evidence of:

- Good skill levels in the use of hand tools, machine tools, and workshop equipment
- 70-80% tolerance dimension achieved while undertaking different work with those demanded by the component/job.
- A good level of neatness and consistency in the finish
- Little support in completing the project/job

c) Weightage in the range of above 90% to be allotted during assessment under following performance level:

For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship. In this work there is evidence of:

- High skill levels in the use of hand tools, machine tools, and workshop equipment
- Above 80% tolerance dimension achieved while undertaking different work with those demanded by the component/job.
- A high level of neatness and consistency in the finish.
- Minimal or no support in completing the project.

## 12.2. INTERNAL ASSESSMENT (FORMATIVE ASSESSMENT)

Comp. No.	ASSESSABLE OUTCOME	INTERNAL ASSESSMENT Marks
<b>GENERIC</b>		
1.	Recognize & comply safe working practices, environment regulation and housekeeping.	
2.	Work in a team, understand and practice soft skills, technical English to communicate with required clarity.	
3.	Demonstrate knowledge of concept and principles of basic arithmetic, algebraic, trigonometric, statistics, co-ordinate system and apply knowledge of specific area to perform practical operations.	
4.	Understand and explain basic science in the field of study including basic electrical, and hydraulics & pneumatics.	
5.	Read and apply engineering drawing for different application in the field of work.	
6.	Understand and explain the concepts of productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.	
7.	Explain energy conservation, global warming, and pollution and contribute in the day to day work by optimally using available resources.	
8.	Explain personnel finance, entrepreneurship, and manage/organize related task in the day to day work for personal & societal growth.	
9.	Understand and apply basic computer working, basic operating system, simulate part program using simulation software and uses internet services to get accustomed & take benefit of IT developments in the industry.	
<b>SPECIFIC</b>		
10.	Perform marking out the components for filing, drilling, fitting and allied operations with clear choice of procedures.	
11.	Plan and organize the work for different types of fitting operations and check for work result.	
12.	Understand and explain the constructional features and working principles of Pedestal grinding machine and perform to align the grinding wheel.	
13.	Understand and explain the constructional features and working principles of drilling machines and set up different work and tool holding devices required to accomplish tasks with required alignment.	
14.	Carry out chipping operation on flat surfaces	
15.	Develop flat surface by scraping and check surface finish.	
<b>Sub-Total of Internal assessment for Semester- I</b>		<b>100</b>
16.	Dismantle, Repair and Assemble of mechanical power transmission elements in machine tools and check for functionality.	
17.	Understand and explain the constructional features and working principles of lathe, Shaper and set up different work and tool holding	

	device required to accomplish tasks on these machines with required alignment.	
18.	Prepare machine foundation for erection, install of heavy duty machines and carry out geometrical tests.	
19.	Conduct preventive & break down maintenance of lathe, drilling and shaper and ensure functionality of the machine.	
	<b>Sub-Total of Internal assessment for Semester- II</b>	<b>100</b>
20.	Make / Produce different joints by setting up of gas and arc welding machines and carry out the welding.	
21.	Understand & demonstrate working principles of Hydraulic & Pneumatic systems, overhaul and check the functionality of the Hydraulic & Pneumatic systems of machine tools.	
22.	Make pipe/tube fittings and valve connections for lubricants and coolants ,test for leakages,	
23.	Trouble shoot & overhaul of milling and surface grinding machines.	
24.	Conduct the preventive maintenance of milling, surface grinding machine without any assistance.	
	<b>Sub-Total of Internal assessment for Semester- III</b>	<b>100</b>
25.	Identify and test basic electronic components of viz., resistor, capacitors & inductor using multimeter and assemble simple battery eliminator circuit, measure its Input & Output voltages.	
26.	Overhaul and maintain the hydraulic press and check its functionality.	
27.	Trouble shoot & Overhaul of pumps, fans, blowers & compressors and perform preventive maintenance	
28.	Joining of flat belt in belt drive	
29.	Perform fault finding and attend break downs of different machineries/ equipments viz., shaper, surface grinding, drilling, lathe, milling, hydraulic press in the shop floor.	
	<b>Sub-Total of Internal Assessment for Semester- IV</b>	<b>100</b>
	<b>Total of Internal Assessment</b>	<b>400</b>

Note: The generic outcome to be assessed along with the specific outcome.

### 12.3 FINAL ASSESSMENT- All India Trade TEST (SUMMATIVE ASSESSMENT)

- There shall be a single objective type Examination paper for the subjects Engineering Drawing and Workshop Calculation & Science.
- There shall be a single objective type Examination paper for the subjects Trade Theory and Employability Skills.
- The two objective type Examination papers as mentioned above shall be conducted by National Council for Vocational Training (NCVT), whereas examination for the subject Trade Practical shall be conducted by the State Governments. NCVT shall supply the Question Paper for the subject Trade Practical.

<b>MARKING PATTERN</b>		
<b>Sl. No.</b>	<b>Subject for the trade test</b>	<b>Maximum marks for the each subject</b>
	Practical	300
	Trade Theory	200 Objective type Written Test of 200 marks (Trade Theory 150 Marks & Employability Skills 50 marks)
	Employability Skills	
	Workshop Calculation and Science.	100 Objective Type Written test of 100 marks (Engineering Drawing 50 marks & Workshop Calculation and Science 50 marks)
	Engineering Drawing	
	Internal assessment	100
<b>TOTAL:</b>		<b>700</b>

### 13. 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.	UdayApte	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.Venkaatesh Reddy. JTO	Govt. ITI, Tumkur Road, Banglore, Karnataka	Member
37.	N.M.Kajale, Principal,	Govt. ITI Velhe, Distt: Pune, Maharashtra	Member
38.	SubrataPolley, Instructor	ITI Howrah Homes, West Bengal	Member
39.	VINOD KUMAR.R Sr.Instructor	Govt.ITIDhanuvachapuram Trivandrum, 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
42.	R. N. Manna, TO	CSTARI, Kolkata	Member
Other industry representatives			
43.	VenugopalParvatikar	Skill Sonics, Bangalore	Member
44.	VenkataDasari	Skill Sonics, Bangalore	Member
45.	Srihari, D	CADEM Tech. Pvt. Ltd., Bengaluru	Member
46.	Dasarathi.G.V.	CADEM Tech. Pvt. Ltd., Bengaluru	Member
47.	L.R.S.Mani	Ohm Shakti Industries, Bengaluru	Member



**TRADE : MECHANIC MACHINE TOOL MAINTENANCE****LIST OF TOOLS & EQUIPMENTS FOR 16 TRAINEES+1****A1. TRAINEES TOOL KIT**

Sl. No.	Name of tools and equipments	Trainees	Instructor	Total
1.	Steel Rule 15 cm both side Graduated in Metric & English.	16 nos.	1 no.	17nos.
2.	Center punch 100 mm	16 nos.	1 no.	17nos.
3.	File flat 2 <sup>nd</sup> cut 250 mm	16 nos.	1 no.	17nos.
4.	File flat bastard 350 mm	16 nos.	1 no.	17nos.
5.	File flat smooth 200 mm	16 nos.	1 no.	17nos.

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

Sl. 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 <sup>nd</sup> cut 250 mm	4 nos.
10.	File triangular smooth 200 mm	4 nos.
11.	File round smooth 200 mm	4 nos.
12.	File square smooth 200 mm	4 nos.
13.	Round nose pliers 200 mm	4 nos.
14.	Combination pliers 200 mm	4 nos.
15.	Scraper A 250 mm (Bearing)	4 nos.
16.	Scraper B 250 mm (Triangular)	4 nos.
17.	Scraper D 250 mm (Half Round)	4 nos.
18.	Spindle blade screw driver 100 mm	4 nos.
19.	Allen keys 2 to 16 mm (Hexagonal)	4 nos.
20.	Card file	4 nos.

## B. TOOLS AND EQUIPMENT FOR MAINTENANCE SHOP

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

41	Number punch 5mm set	1 set
42	Deep cutting hacksaw frame 300 mm	1 no.
43	Bearing puller	1 no

### C. PRECISION INSTRUMENTS:

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

32	Wire stripper cum cutter	1 No.
33	Crimping Tool	1 No.

#### D. LATHE TOOLS:

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

#### E. MILLING MACHINE TOOLS:

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

## F. GENERAL MACHINERIES:

Sl. No.	Name of tools and equipments	Quantity
1.	Lathe all gear head type, with Centre height of 150 mm, 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):

Sl. 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 -

Sl. No.	Name of tools and equipments	Quantity
1.	Oxy-acetylene welding Cylinder Trolley	1 no.
2.	Welding hose P.V.C. flexible internal dia. 6 mm (Blue and red)	5m
3.	Hose coupling Nipples	2 nos.
4.	Hose Protractor	2 nos.
5.	Double stage Pressure regulator for Oxygen and Acetylene	1no. each

6.	High Pressure blow pipe with tips	1 no.
7.	Gas cutting torch with cutting tips	1 no
8.	Welding gloves pair (Leather)	1 pair
9.	Goggles (4A) for Gas. Welding	4 nos.
10.	Spark lighter	2 nos.
11.	Spindle key	1 no.
12.	Gas Welding table with fire bricks.	1 no.

## 2. ARC WELDING -

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

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

## 1. ERECTION TOOLS :

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

**GUIDELINES FOR INSTRUCTORS AND PAPER SETTERS**

1. All questions of theory paper for the trade will be in objective type format.
2. Due care to be taken for proper & inclusive delivery among the batch. Some of the following method of delivery may be adopted:
  - a. Lecture
  - b. Lesson
  - c. Demonstration
  - d. Practice
  - e. Group discussion
  - f. Discussion with peer group
  - g. Project work
  - h. Industrial visit
3. Maximum utilization of latest form of training viz., audio visual aids, integration of IT, etc. May be adopted.
4. The total hours to be devoted against each topic may be decided with due diligence to safety & with prioritizing transfer of required skills.
5. Questions may be set based on following instructions:-

Sl. No.	Question on different aspect	Weightage in %age	Key Words may be like
1	Information received	25	What, Who, When
2	Knowledge	50	Define, Identify, Recall, State, Write, List & Name
3	Understanding	15	Describe, Distinguish, Explain, Interpret & Summarize
4	Application	10	Apply, Compare, Demonstrate, Examine, Solve & Use

6. Due weightage to be given to all the topics under the syllabus while setting the question paper.