

**COMPETENCY BASED CURRICULUM**

**FOR THE TRADE OF**

**MACHINIST**

**UNDER**

**CRAFTSMAN TRAINING SCHEME (CTS)**

**IN SEMESTER PATTERN**

**BY**



**GOVERNMENT OF INDIA  
MINISTRY OF SKILL DEVELOPMENT AND ENTREPRENEURSHIP  
DIRECTORATE GENERAL TRAINING**

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## 1. INTRODUCTION

The Ministry of Skill Development & Entrepreneurship is the apex organization for development and coordination at National level for the programmes relating to vocational training including Women's Vocational Training and Employment Services. Employment service is operated through a countrywide network of Employment Exchanges. Industrial Training Institutes are under the administrative and financial control of State Governments or Union Territory Administrations. The Ministry also operates Vocational Training Schemes in some of the specialized areas through field institutes under its direct control. Development of these programmes at national level, particularly in the area concerning common policies, common standards and procedures, training of instructors and trade testing are the responsibility of the Ministry. But, day-to-day administration of employment Exchanges and Industrial Training Institutes rests with the State Governments/ Union Territories Administrations.

CSTARI one of the field institute of the Ministry is mandated to develop curricula for various courses under different schemes viz., CTS, ATS, MES, CoE& CITS. All the courses are certificate level and run on pan India basis under the aegis of NCVT. The curricula developed so far by this institute are skill based which catered the need of the industry manpower there by contributing significantly in the development of technical manpower. Hence vocational training provides country wide manpower and this trained manpower actually builds the wealth for the nation.

The broad concept of industry competency concerns the ability to perform particular tasks and duties to the standard of performance expected in the workplace. Competency requires the application of specified skills, knowledge and attitudes relevant to effective participation in an industry, industry sector or enterprise.

Competency covers all aspects of workplace performance and involves performing individual tasks; managing a range of different tasks; responding to contingencies or breakdowns; and dealing with the responsibilities of the workplace, including working with others. Workplace competency requires the ability to apply relevant skills, knowledge and attitudes consistently over time and in the required workplace situations and environments.

In line with this concept of competency based curriculum focus on what is expected of a competent individual in the workplace as an outcome of learning, rather than focusing on the learning process itself.

“The Competency Based Training” establishes a direct link between the things which trainees must learn in institutions and knowledge and skills expected from them for employability “The Competency Based Training” is a means of instruction which :

- i) Identifies the competencies required for work performance,
- ii) Prepares the trainees through precise learning objectives,
- iii) Is based on the realities of the world of work

When learning deals with performance type activities, it is necessary to analyse each job performed under a particular vocation. Skills required for doing a job may be manipulative and may require sequential and chronological order of performance. Therefore, teaching and learning content shall be presented in a psychological and methodological manner. Hence, identification of competencies becomes an essential exercise for planning and design a curriculum for vocational courses.

The elements of competency are the basic building blocks of the unit of competency. They describe in terms of outcomes the significant functions and tasks that make up the competency.

The performance criteria specify the required performance in relevant tasks, roles, skills and in the applied knowledge that enables competent performance. They are usually written in passive voice. Critical terms or phrases may be written in bold italics and then defined in range statement, in the order of their appearance in the performance criteria.

The essential skills and knowledge are either identified separately or combined. Knowledge identifies what a person needs to know to perform the work in an informed and effective manner. Skills describe the application of knowledge to situations where understanding is converted into a workplace outcome.

The procedure followed for this purpose is as follows:

- I) listing of job opportunities,
- II) identification of duties for each job,
- III) analyzing the elements of competencies and setting Performance criteria against each elements of competencies,
- IV) determining courses objectives,

Preparing course content by projecting elements of competencies, Performance criteria, skills and knowledge and personality traits.

## 2. JOB ROLES: Reference NOS & NCO

Brief description of Job roles:

Machinist General operates various types of power driven metal cutting or grinding machines for cutting and grinding metal. Studies drawings or measures out sample with appropriate measuring instruments to note different dimensions and sequence of operations required. Selects metal piece and marks it or gets it marked for machining operations required. Fastens metal in chuck, jig or other fixture and respective tool or cutter, according to sequence of operation, on appropriate machine (lathe, shaper, milling, slotting, drilling, grinding). Checks machine setting or sets it for stipulated machine operations. Selects machine feed and speed and starts machine. Controls flow of coolant (cutting lubricant) and manipulates hand wheels or applies automatic controls to feed tool to metal or metal to tool. Observes cutting or grinding both from marking and machine readings, checks for dimensions as necessary and removes parts when machining is completed, checks completed part with measuring instruments and gauges to ensure prescribed accuracy. Makes adjustments if necessary and repeats operations, as required, on same or other machines. May assist in setting up machine for repetitive work, change tools, make simple adjustments, clean and oil machine. Demonstrate the operation of CNC Machining Center (3-axes) and producing components as per drawing by preparing part programmes.

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.

Reference NCO & NOS:

- i)NCO-2004: 8211.10
- ii) NCO-2004: 8211.15
- iii) NCO-2004: 8211.22
- iv) NCO-2004: 8211.28
- v) NCO-2004: 8211.30
- vi)NCO-2004: 8211.32
- vii) NCO-2004: 8211.36
- viii) NCO-2004: 8211.38

**NOS:-**

- i) CSC/Q0303 (Fitting & Assembly)**
- ii) CSC/Q0302 (Grinder hand & hand held Power tool)**
- iii) CSC/Q0110 (Operator-Conv. Turning)**
- iv) CSC/Q0116 (Operator (CNC) Vertical Machining Centre)**
- v) CSC/Q0123 (CNC setter cum operator-Vertical machining Centre)**
- vi) CSC/Q0108 (Operator conventional milling)**
- vii) ASC/Q1901 (Lathe operator)**
- viii) ASC/Q1903 (CNC operator)**
- ix) ASC/Q3503 (Machining technician Level-IV)**

### 3. NSQF LEVEL COMPLIANCE

NSQF level for Machinist trade under CTS: **Level 5**

As per notification issued by Govt. of India dated- 27.12.2013 on National Skill Qualification Framework total 10 (Ten) Levels are defined.

Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

- a. Process
- b. professional knowledge,
- c. professional skill,
- d. core skill and
- e. Responsibility.

The Broad Learning outcome of Machinist trade under ATS mostly matches with the Level descriptor at Level- 5.

The NSQF level-5 descriptor is given below:

<b>LEVEL</b>	<b>Process required</b>	<b>Professional knowledge</b>	<b>Professional skill</b>	<b>Core skill</b>	<b>Responsibility</b>
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.

## **4. Learning outcome**

The following are minimum broad learning outcome after completion of the Machinist course of 02 years duration:

### **A. GENERIC OUTCOME**

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, simulate part programme using simulation software and uses internet services to get accustomed & take benefit of IT developments in the industry.

### **B. SPECIFIC OUTCOME**

#### **SEM-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 shaping, slotting and set up different work and tool holding devices required to accomplish tasks with required alignment.
13. Produce finished components on a shaping, slotting machine and check for accuracy without any assistance.

#### **SEM-II**

14. Understand and explain the constructional features and working principles of planning, lathe machine and set up different work and tool holding devices required to accomplish tasks on these machines with required alignment.
15. Produce finished components on a planning and lathe machine and check for accuracy without any assistance.



16. Set up different work and tool holding devices required to accomplish tasks on a milling machine with required alignment.
17. Demonstrate practical skills in aligning/truing the work pieces and cutting tools for different turning operations.

### SEM-III

18. Produce different forms of threads viz., “V”, Square and Acme thread applying basic methods, tools, materials and information.
19. Work out and apply cutting parameters for different turning, drilling & milling operations with different work and tool material for producing quality output.
20. Grind Form tool and parallel & stepped using grinding machine with accuracy using appropriate tools & materials and with required quality.
21. Manufacture different components viz., V-block, Key-way, concave & convex surface, horizontal, angular, vertical, male-female T-slot & dovetail, multiple jobs at a time by determining use of shaping /and slotting /and planning machine.
22. Demonstrate practical skills involved in different operation viz., step milling, straddle milling, square & hexagonal milling, T-slot & dovetail milling using milling machine to produce different components with clear choice of procedures in familiar context.
23. Demonstrate practical skills to ream the drilled hole using radial drill machine as per drawing.

### SEM-IV

24. Make different components viz., spur gear, helical, Bevel, worm & worm wheel, rack & pinion as per drawing by setting the milling machine.
25. Cut different components viz., end mill/drum cam, face cam, plate cam using milling machine and by applying quality concept.
26. Manufacture different components viz., spline (external), straight fluted reamer, cylindrical cutter, slab milling cutter, twist drill using milling machine with clear choice of procedures in familiar context.
27. Manufacture and assemble tongue and groove by performing different milling operations.
28. Set and operate CNC Vertical Machining Centre (3 – axes) to produce components as per drawing by preparing part programmes & applying range of cognitive and practical skills.
29. Produce components on CNC Lathe involving different operations

***NOTE: Learning outcomes are reflection of total competencies of a trainee. Each learning outcome may include multiple assessment components. However assessment will be carried out as per assessable outcome and assessment criteria.***

## **5. GENERAL INFORMATION**

1. **Qualification** : **MACHINIST**
2. **N.C.O./NOS Code No.** : **8211.10**
3. **NSQC Level** : Level-V
4. **Duration of Craftsmen Training:** Two years (Four semesters each of six months duration).
5. **Entry Qualification** : Passed 10<sup>th</sup> Class with Science and Mathematics under 10+2 system of Education or its equivalent
6. **Trainees per unit:** 12 (Supernumeraries/Ex-Trainee allowed: 4)

**Note:**

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

**Distribution of training on Hourly basis:**

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

## 6. COURSE STRUCTURE

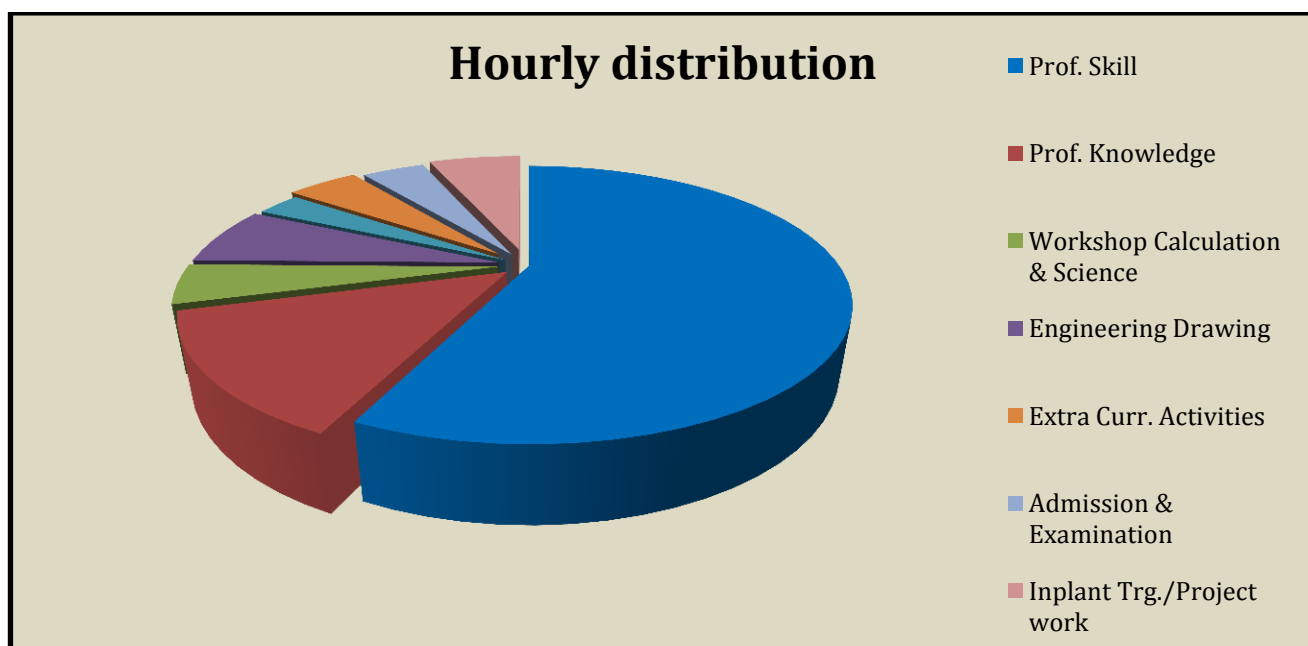
**1. Name of the Qualification :-MACHINIST**

**2. Total duration of the course: - 24 Months**

**3. Training duration details : -**

	COURSE ELEMENTS	HOURLY DISTRIBUTION
A	PROFESSIONAL SKILL	2200 HRS
B	PROFESSIONAL KNOWLEDGE	530 HRS
C	WORKSHOP CALCULATION & SCIENCE	180 HRS
D	ENGINEERING DRAWING	265 HRS
E	EMPLOYABILITY SKILLS	110 HRS
F	EXTRA CURRICULAR ACTIVITIES/LIB.	180 HRS
G	INPLANT TRG./PROJECT WORK	240 HRS
H	ADMISSION & EXAMINATION	160 HRS

### PIE-CHART



## **7. General Training Plan, Examination & Pass regulation**

### **General Training Plan**

The skills stated in assessment outcome are to be imparted in accordance with the instructions contained within Section 10 in respect of the content and time structure of the vocational education and training (General Training Plan).

### **Examination**

Each Semester examination is to take place after the end of the six months of training. The each semester examination encompasses such skills as are listed for that period of training (Detail in Section -8) and also includes theoretical knowledge, Core skills & E/S. The E/S will be covered in first two semesters only.

### **Candidates are to demonstrate that they are able to:**

1. Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools;
2. Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
3. Apply professional knowledge, core skills & employability skills while performing the task.
4. Check the job as per drawing/assembly for functioning, identify and rectify errors in job/assembly.
5. Document the technical parameters related to the task undertaken.

The details of the examination and assessment standard are as per section-11.

### **Pass regulation**

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

## **8. ASSESSABLE OUTCOME WITH ASSESSMENT CRITERIA**

### ASSESSABLE OUTCOME ALONGWITH ASSESSMENT CRITERIA TO BE ACHIEVED AFTER EACH SEMESTER & COMPLETION OF QUALIFICATION

- i) The training shall be conducted as per syllabus defined in reference no: Section 10.
- ii) The trainee shall demonstrate the competencies which are defined below in assessable outcome and assessment criteria.
- iii) All the assessable outcomes are to be tested during formative assessment, Theory & Practical examinations, various observation and viva-voce.
- iv) Assessable outcome of Employability Skills, Workshop Calculation & Science and Engineering Drawing shall be tested separately and also be applied in Theory and Practical examinations.
- v) These assessable outcomes and assessment criteria will serve as guide lines for Trainers, Paper setters, Moderators and Assessors.

### **GENERIC ASSESSABLE OUTCOME:**

<b>ASSESSABLE OUTCOMES</b>	<b>ASSESSMENT CRITERIA</b>
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

	<p>requirement.</p> <p>1.12 Identify environmental pollution &amp; contribute to the avoidance of instances of environmental pollution.</p> <p>1.13 Deploy environmental protection legislation &amp; regulations</p> <p>1.14 Take opportunities to use energy and materials in an environmentally friendly manner</p> <p>1.15 Avoid waste and dispose waste as per procedure</p> <p>1.16 Recognize different components of 5S and apply the same in the working environment.</p>
2. Work in a team, understand and practice soft skills, technical English to communicate with required clarity.	<p>2.1 Obtain sources of information and recognize information.</p> <p>2.2 Use and draw up technical drawings and documents.</p> <p>2.3 Use documents and technical regulations and occupationally related provisions.</p> <p>2.4 Conduct appropriate and target oriented discussions with higher authority and within the team.</p> <p>2.5 Present facts and circumstances, possible solutions &amp; use English special terminology.</p> <p>2.6 Resolve disputes within the team</p> <p>2.7 Conduct written communication.</p>
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.	<p>3.1 Semester examination to test basic skills on arithmetic, algebra, trigonometry and statistics.</p> <p>3.2 Their applications will also be assessed during execution of assessable outcome and also tested during theory and practical examination.</p>
4. Understand and explain basic science in the field of study including basic electrical, and hydraulics & pneumatics.	<p>4.1 Semester examination to test basic skills on science in the field of study including basic electrical and hydraulics &amp; pneumatics.</p> <p>4.2 Their applications will also be assessed during execution of assessable outcome and also tested during theory and practical examination.</p>
5. Read and apply engineering drawing for different application in the field of work.	<p>5.1 Semester examination to test basic skills on engineering drawing.</p> <p>5.2 Their applications will also be assessed during execution of assessable outcome and also tested during theory and practical examination.</p>
6. Understand and explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve	<p>6.1 Semester examination to test the concept in productivity, quality tools and labour welfare legislation.</p> <p>6.2 Their applications will also be assessed during execution of assessable outcome.</p>

productivity & quality.	
7. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	7.1 Semester examination to test knowledge on energy 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 OUTCOME:  
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 equipment's for measuring and use of these tools.
	10.2 Select raw material and visual inspect for defects.
	10.3 Identify basic hand tools for filing, drilling, fitting operations and used this 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 and equipment's 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 flat and round surfaces.
	11.5 Identify & use hand tools for threading (internal and external) with dies and taps.
	11.6 Measure all dimensions in accordance with standard specifications and tolerances.
12. Understand and explain the constructional features and working principles of shaping, slotting and set up different work and tool holding devices required to accomplish tasks with required alignment.	12.1 Acquaintance of basic working principles and safety aspect of shaping and slotting machine.
	12.2 Explain functional application of different levers, stoppers, adjustment etc.
	12.3 Identify different lubrication points of shaping and slotting machine.
	12.4 Identify lubricants and their usage for application in shaping and slotting machine as for machine manual.
	12.5 Identify different work and tool holding devices and acquaint with functional application of each device.
	12.6 Mount the work and tool holding devices with required alignment and check for its functional usage to perform shaping and slotting operations.
	12.7 Solve problem by applying basic methods, tools, materials and information during setting.
	12.8 Observe safety procedure during mounting as per standard norms.
13. Produce finished components on a shaping, slotting machine and check for accuracy without any assistance.	13.1 Select appropriate tools and equipment and operate the machine to produce components as per required dimension.
	13.2 Measure all dimensions to check for accuracy with respect to the drawing
	13.3 Solve problem by applying basic methods, tools, materials and information during machining.



	13.4 Avoid waste and dispose waste as per procedure.
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## Semester-II

14. Understand and explain the constructional features and working principles of planning, lathe machine and set up different work and tool holding devices required to accomplish tasks on these machines with required alignment	14.1 Acquaintance of basic working principles and safety aspect of planning, lathe, milling, grinding machine.
	14.2 Explain functional application of different levers, stoppers, adjustment etc.
	14.3 Identify different lubrication points of planning, lathe machine.
	14.4 Identify lubricants and their usage for application in Planning, lathe machine as for machine manual.
	14.5 Identify different work and tool holding devices and acquaint with functional application of each device.
	14.6 Mount the work and tool holding devices with required alignment and check for its functional usage to perform planning and lathe operations.
	14.7 Solve problem by applying basic methods, tools, materials and information during setting.
	14.8 Observe safety procedure during mounting as per standard norms.
15. Produce finished components on a planning and lathe machine and check for accuracy without any assistance.	15.1 Select appropriate tools and equipment and operate the machine to produce components as per required dimension.
	15.2 Solve problem by applying basic methods, tools, materials and information during machining.
	15.3 Avoid waste and dispose waste as per procedure.
16. Set up different work and tool holding devices required to accomplish tasks on a milling machine with required alignment.	16.1 Identify different work and tool holding devices and acquaint with functional application of each device.
	16.2 Mount the work and tool holding devices with required alignment and check for its functional usage to perform milling operations.
	16.3 Observe safety procedure during mounting as per standard norms.
	16.4 Solve problem by applying desired mathematical skill, basic methods, tools, materials and collect and organize information during setting.
17. Demonstrate practical skills in aligning/truing the work pieces and cutting tools for different turning operations.	17.1 Ascertain and select tools, equipment and materials for the aligning / truing operation and make this available for use in a timely manner.
	17.2 Plan work in compliance with standard safety norms.
	17.3 Set up job on lathe machine in accordance with standard operating procedure.
	17.4 Check the alignment of job to machine as per standard procedure using dial gauge indicator.

## Semester-III

18. Produce different forms of threads viz., “V”, Square and Acme thread applying basic methods, tools, materials and information.	18.1 Plan and select appropriate method to produce components with different forms of thread.
	18.2 Plan and prepare thread cutting tool in compliance to standard thread parameters.
	18.3 Apply desired mathematical skills, collect and organize information to work out the machining parameters.
	18.4 Produce components as per drawing.
	18.5 Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement and suit to male /female part.
19. Work out and apply cutting parameters for different turning, drilling & milling operations with different work and tool material for producing quality output.	19.1 Plan work in compliance with standard safety norms.
	19.2 Work out and apply cutting parameters as per different machining operations, materials and tools to set up the tool for machining.
	19.3 Produce components as per standard operating procedure by using appropriate tools.
	19.4 Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
20. Grind Form tool and parallel & stepped using grinding machine with accuracy using appropriate tools & materials and with required quality.	20.1 Plan and select appropriate method to produce the work piece as per drawing.
	20.2 Select appropriate tools, equipment and machine to produce the work piece as per drawing and make these available for use in a timely manner.
	20.3 Grind the cutting tool following Standard operating practice.
	20.4 Set the job on grinding machine and grind the surfaces as per specification/drawing (parallel and stepped) following Standard operating practice.
	20.5 Check the dimension of parallel and stepped job by precession instrument (micrometer)
	20.6 Observe safety precautions during operation per during machine.
	20.7 Check for desired performance
21. Manufacture different components viz., V-block, Key-way, concave & convex surface, horizontal, angular, vertical, male-female T-slot & dovetail, multiple jobs at a time by determining use of shaping /and slotting /and	21.1 Plan and select appropriate method to produce components.
	21.2 Demonstrate possible solutions within the team using desired mathematical skills, knowledge of facts, principles, processes and general concept in the field of work and collect and organize information to determine use of specific machine.
	21.3 Set up and produce component V-block, Key-way, concave & convex surface, horizontal, angular, vertical, male-female T-slot & dovetail, multiple jobs as per standard operating procedure of shaping /and slotting /and planning machine.

planning machine.	21.4 Measure the dimensions with instruments/gauges as per drawing.
	21.5 Comply with safety rules when performing the above operations.
22. Demonstrate practical skills involved in different operation viz., step milling, straddle milling, square & hexagonal milling, T-slot & dovetail milling using milling machine to produce different components with clear choice of procedures in familiar context.	22.1 Plan and select appropriate method to produce components.
	22.2 Work out and apply indexing parameters as per different machining operations.
	22.3 Set up job, tools and other attachment and produce component by step milling, straddle milling, square & hexagonal milling, T-slot & dovetail milling as per standard operating procedure of milling machine.
	22.4 Measure the dimensions with instruments/gauges.
	22.5 Comply with safety rules when performing the above operations.
23. Demonstrate practical skills to ream the drilled hole using radial drill machine as per drawing.	23.1 Plan and select appropriate tools & instrument to perform reaming operation.
	23.2 Set up and produce component by reaming as per standard operating procedure of radial drill machine.
	23.3 Measure the dimensions with instruments/gauges.
	23.4 Comply with safety rules when performing the above operations.

### Semester-IV

24. Make different components viz., spur gear, helical, Bevel, worm & worm wheel, rack & pinion as per drawing by setting the milling machine.	24.1 Select cutters as per specification of gear and plan to make spur gear, helical, Bevel, worm & worm wheel, rack & pinion as per drawing.
	24.2 Comply with safety rules when performing the above operations.
	24.3 Work out and apply indexing parameters as per different components to be produced to determine gear setting and set indexing head, milling machine.
	24.4 Demonstrate possible solutions within the team using desired mathematical skills, knowledge of facts, principles, processes and general concept in the field of work to set the indexing head.
	24.4 Solve problems during operation by selecting and applying basic methods, tools, materials and collect and organize information for quality output.
	24.5 Set job and produce component following the standard operating procedure.
	24.6 Measure with instruments/gauges as per drawing and check functionality of gear.
	24.7 Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
25. Cut different	25.1 Select cutter as per specification of cam and plan to make end

components viz., end mill/drum cam, face cam, plate cam using milling machine and by applying quality concept.	mill/drum cam, face cam, plate cam as per drawing.
	25.2 Comply with safety rules when performing the above operations.
	25.3 Demonstrate possible solutions within the team using desired mathematical skill, knowledge of facts, principles, processes and general concept in the field of work to set the indexing head.
	25.4 Solve problems during operation by selecting and applying basic methods, tools, materials and information and using quality concept.
	24.5 Work out and apply indexing parameters as per different components to be produced to determine gear setting and set indexing head & milling machine.
	25.6 Set job and produce component following the standard operating procedure.
	25.7 Measure with instruments/gauges as per drawing and check functionality of gear.
	25.8 Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
26. Manufacture different components viz., spline (external), straight fluted reamer, cylindrical cutter, slab milling cutter, twist drill using milling machine with clear choice of procedures in familiar context.	26.1 Select cutter as per specification of job and plan to make spline (external), straight fluted reamer, cylindrical cutter, slab milling cutter, twist drill as per drawing.
	26.2 Comply with safety rules when performing the above operations.
	26.3 Demonstrate possible solutions within the team.
	26.4 Solve problems during operation by selecting and applying basic methods, tools, materials and information and using quality concept.
	26.5 Apply mathematical skill, knowledge of facts, principles, processes and general concepts in the field of work to determine gear setting and set indexing head, milling machine.
	26.6 Set job and produce component following the standard operating procedure.
	26.7 Measure with instruments/gauges as per drawing and check functionality of component.
27. Manufacture and assemble tongue and groove by performing different milling operations.	27.1 Plan and select tools and materials for the part components and make this available for use in a timely manner.
	27.2 Produce part components as per drawing.
	27.3 Solve problems during operation by selecting and applying basic methods, tools, materials and information and using quality concept.
	27.4 Assemble the part components as per the guide lines given in the drawing
	27.5 Check for accuracy of the part components and suitability of the assembly.
	27.6 Check for functionality of the tongue and groove.
	27.7 Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and

	prepare for disposal.
	27.8 Observe safety/ precaution during machining.
28. Set and operate CNC Vertical Machining Centre (3 – axes) to produce components as per drawing by preparing part programmes&applying range of cognitive and practical skills.	28.1 Plan and prepare part programme as per drawing applying range of cognitive and practical skills, simulate for its correctness with simulation software.
	28.2 Demonstrate possible solutions within the team.
	28.3 Prepare tooling layout and select tools as required
	28.4 Set selected tools on to the machine
	28.5 Test/Dry run the part programme on the machine
	28.6 Set up the job and produce the component as per standard operating procedure involving face milling, contour milling with tool radius compensation, pocket milling, drilling, peck drilling, countersinking, tapping operations using canned cycle for hole operations.
	28.7 Solve problems during operation by selecting and applying basic methods, tools, materials and information and using quality concept.
	28.8 Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
	28.9 Observe safety/ precaution during machining.

## 9. SYLLABUS CONTENT WITH TIME STRUCTURE

### 9.1 SYLLABUS CONTENT FOR PROFESSIONAL SKILL & KNOWLEDGE

## **SYLLABUS FOR THE TRADE OF MACHINIST**

### **First Semester**

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

**Duration: Six Month**

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

1. Apply safe working practices.
2. Comply environment regulation 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. Operate drill machine and perform tapping and dieing.
6. Mounting of different work holding devices and operate shaping and slotting machine.
7. Sharpening of cutting tools used on shaping and slotting machines.

### **First Semester**

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

**Duration: Six Month**

<b>Week No.</b>	<b>Trade Practical</b>	<b>Trade Theory</b>
1.	<p>Importance of trade training, List of tools &amp; Machinery used in the trade.</p> <p>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></p> <p><b>Importance of housekeeping &amp; good shop floor practices.</b></p> <p>Health, Safety and Environment guidelines, legislations &amp; regulations as applicable.</p> <p>Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Basic safety introduction,</p> <p>Personal protective Equipments(PPE):-</p> <p>Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution</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></p> <p>Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept &amp; its application.</p> <p>Response to emergencies eg; power failure, fire, and system failure.</p>

	<p>&amp;personal safety message.</p> <p>Preventive measures for electrical accidents &amp; steps to be taken in such accidents.</p> <p>Use of Fire extinguishers.</p>	
2.	<p>Identification of tools &amp; equipments as per desired specifications for marking &amp; sawing( Hand tools , Fitting tools &amp; Measuring tools)</p> <p>Selection of material as per application</p> <p>Visual inspection of raw material for rusting, scaling, corrosion etc., Marking out lines, gripping suitably in vice jaws, hack sawing to given dimensions, sawing different types of metals of different sections.</p>	<p>Hand tools and its importance, steel rule, Try square, chisel, surface gauge and care &amp; maintenance, Hacksaw frame, blades.</p>
3.	<p>Chipping flat surfaces and grinding various angles to chisels, filing flat surface. Grooving with Hammer and chisel.</p>	<p>Classification and types of chisels, files &amp; uses, vices - its constructions and uses. Hammers and its types. Related safety.</p>
4.	<p>Filing Flat surfaces, Uses of marking tools, Punch, Try square &amp; basic measuring tools, caliper, steel rule.</p>	<p>Marking block, Steel rule, and calipers- different types and uses. Combination set-its components and uses.</p>
5.	<p>Filing flat surfaces, checking with steel rule and Try square. Hack sawing.</p>	<p>Hacksaw blade, Hacksaw frame and its types. Drill bits- parts, Types &amp; uses.</p>
6&7	<p>Marking and Drilling holes on flat pieces. Tapping as per simple drawing.</p>	<p>Introduction to Hand Taps &amp; Dies and their types, applications, care and maintenance. Familiar with tap and drill size, Thread Terminology.</p>
8.	<p>Filing Tee shape job.</p>	<p>Forging tools, its importance and types such as tongs, swage block, anvil etc.</p>
9.	<p>Filing flat type polygon.</p>	<p>Heat treatment process Annealing, Normalizing, Tempering, Hardening, case hardening and its importance. Use of vernier caliper and its parts, construction, principle &amp; reading, use &amp; care.</p>
10.	<p>Fitting male and female square piece to close limit. Application of vernier caliper in making job.</p>	<p>Outside micrometer, its types and construction, parts, reading use, care and maintenance.</p>
11.	<p>Fitting male and female square piece to</p>	<p>Study about Depth gauge, micrometers and</p>

	close limit. Application of vernier caliper in making job.	dial test indicator - their parts and construction.
12.	Introduction to Shaping machine and its construction. Setting of strokes, tools, job on table machining of Rectangular block, steps, with the use of Basic tools. Safety points to be observed while working on a shaper.  Setting of vice, setting of block on vice checking accuracy.	Introduction of shaper, types classification, General principles of power transmission on shaping mechanism.  Shaping parts, construction use of parts, quick return mechanism ratio etc.
13.	Shaping Hexagonal, Rectangular block as per sketch checking with caliper & steel rule, angle protractor.	Various tools of shaping machine and their angles and importance of angles.
14.	Shaping "V" blocks with slides, measurement of 'V' groove with vernier bevel protractor, measurement of slots by vernier caliper with 0.02 mm accuracy.	Various methods of holding jobs, use of clamps, nuts & bolts V- blocks, angle plates shaping operations, their importance.
15.	Shaping Tee slots, shaping angular surfaces.	Tool head - its parts and application, function of each part of tool head.
16.	Cutting of external keyway on shaper.	Shaping tools and types. Speed, feed, depth of cut.
17.	Shaping concave & convex surface with use of tee slot tools, form tools.	Surface finish as per ISI system.
18.	General introduction to slotting. Safety points to be observed while working on a slotter.	Slotter-principle, construction, details, driving mechanism, quick return motion and speed ratio. Safety precaution comparative study with a shaping machine. Classification of slotting machine.
19.	Slotting a rectangular job checking and measuring with gauges & precision measuring instruments.	Job holding devices-vice, clamps, V-block, parallel block etc.
20.	Slotting square and hexagon internal and external. Slotting a double ended spanner.	Slotting tools different types of work tool angles comparison of tool shape with that of shaper
21.	Practice on slotting key ways on pulley- Internal and external slotting irregular shaped jobs having curved surfaces.	Use of tool with holder for internal operations. Precautions to be observed during slotting internal operations.



22.	Slotting internal operations. Slotting concave and convex surfaces.	Introduction to coolant & lubricant-difference between them, types and uses of each.  Use of circular marks on the table for slotting curves.
23-25	<b>Revision</b>	
26	<b>Examination</b>	

**Second Semester**  
**(Semester Code no. MCN - 02)**  
**Duration: Six Months**

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

1. Apply safe working practices.
2. Comply environment regulation and housekeeping
3. Produce different components on lathe and planner machine.
4. Manufacture components using milling machine.

<b>Week No.</b>	<b>Trade Practical</b>	<b>Trade Theory</b>
1	Introduction of planning machines, Adjustment of stroke, setting of tool, vice on planer table machining of rectangular block on planer. Safety points to be observed while working on a planer.	Introduction to Planing M/c. parts, types, constructions, details of Driving mechanism of planer, quick return motion etc.
2	Planing angular, Horizontal, vertical operations, planing Dovetail.	Tool head of planer its construction and various function of each part v- block, clamps, bolts, step block and other holding devices.
3	Planing of various key ways (open & blind). Types of operation, concave & convex surface i.e. goose neck clamp.	Cutting tools for Planer - their material and types. Templates, gauges, their fixtures and vices.
4	Planing V Block machining of planer gauge.	Hydraulic mechanism of planer their advantages, disadvantages.
5	Planing male & female dovetail, grinding of tools, checking with Vernier bevel protractor & roller methods.	Dovetail measurement external and internal by vernier bevel protractor.  Checking of Dovetail by roller method.
6	Introduction to lathe. Holding of round job in an independent chuck and truing it. Holding the tool in a tool post, centering the job with the tool. Facing & drilling.	Introduction to lathe. Its types, engine lathe construction, detail function of parts size and specification. Safety points to be observed while working on a lathe.
7	Parallel turning between centers, parting off, chamfering using roughing, finishing and parting off tools.	Lathe tools their angles & uses. Driving mechanism, speed and feed mechanism & lathe accessories.
8	Holding the job in jaw chuck truing, centering facing. Step turning undercutting, knurling drilling and boring.	Chucks-different types of job holding devices on lathe and advantages of each type. Mounting and dismounting of chucks.

9	Taper turning by offset method checking of the taper with precision instruments. Taper turning by swiveling compound rest, setting the compound rest to correct degree, checking the tool height, clamping the saddle for no longitudinal movement, checking up with precision instruments.	Taper introduction, types and uses. Calculations of tapers. Measurement of taper by sine bar and slip gauges.
10&11	Cutting V thread external and internal in a lathe. Checking up with screw pitch gauge. Cutting square thread external & internal on a lathe.	Different thread forms their related dimensions and calculations screw cutting in a lathe. Measurement of threads by three wire methods.
12	Introduction to milling machine, demonstration on working principle, setting of job, setting of cutter in arbor, setting of vice on table. Safety points to be observed while working on a milling machine.	Milling machine importance of milling machine, types and specification of milling machine, driving and feed mechanism of milling machine.
13	Sequence of milling six faces of a solid block. Checking the accuracy with the help of try-square scribing block and vernier height gauge.	Classification & different types of milling cutters & their use. Parts and nomenclature.
14	Step milling using side and face cutter checking with micrometer.	Vernier height gauge construction, graduations vernier setting & reading, vernier bevel protractor, construction graduation setting and reading. Care and maintenance of vernier height gauge and bevel protractor.
15	Straddle and gang milling operations including up-milling and down milling.  Milling concave and convex surfaces.	Different milling operations plain-face, angular, form, slot, gang and straddle milling etc. Up and down milling. Different types of milling attachments and their uses.
16	Introduction to indexing head types, setting and aligning of indexing head with reference to job on milling machine.	Indexing-introduction & types. Indexing head-constructural details, function of indexing plates and the sector arms. Calculation for various types of indexing.
17	Milling square and hexagonal job by simple indexing method.	-do-
18	Milling dovetail and 'T'slots both male and female matching each other. Milling Rack of straight teeth.	Gear introduction, use and type. Elements of a spur gear. Gear tooth of each forms types, merits and demerits of each. Spur gear calculations, curves and their uses.
19	Milling of spur gear having even and odd number of teeth.	Selection of gear cutter type and form & various methods of checking gear and its parts.

20 & 21	Introduction to grinding machine surface grinder, cylindrical grinder. Driving and feed mechanism, job holding devices mounting of wheels. Wheel balancing & truing. Grinding of parallel and stepped jobs. Dressing of grinding wheels.	Grinding machine introduction types, specification, their parts and functions & uses. Safety points to be observed while working on a Grinding machine. Types of Abrasives and their uses, Glazing and loading of wheels. Explain the importance and necessity of quality.
22-23	<b>Implant training</b> / Project work (work in a team)	
24-25	<b>Revision</b>	
26	<b>Examination</b>	

**Third Semester**  
**(Semester Code no. MCN - 03)**

**Duration: Six Month**

**LEARNING OBJECTIVES OF 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. Operatedrilling machine.
5. Produce matching parts on Slotting machine.
6. Grind tools using tool &cutter grinding machine.

<b>Week No.</b>	<b>Trade Practical</b>	<b>Trade Theory</b>
01	Checking of alignment of lathe centers and their adjustments. Center drilling, step turning between centers recessing and chamfering & measurement with vernier caliper. Taper turning by taper turning attachment.	Turning of taper by taper turning attachment advantages and dis-advantages taper calculations.
02	Cutting square threads (left & right hand) on a lathe-checking with thread gauge-grinding of tool and setting in correct position.	Screw cutting on a lathe. Terms relating screw thread major/ minor diameter pitch and lead of the screw, depth of thread simple gear train and compound gear train change gears for fractional pitches.
03	<ol style="list-style-type: none"> <li>1. Cutting multi-start V thread on lathe.</li> <li>2. Cutting key way broaches.</li> </ol>	Difference between single and multi-start threads-their uses merits and demerits. Broach - its types and uses.
04	Cutting ACME threads (Male and female) on a lathe. Lead screw.	Square thread its form and calculation of depth, core dia, pitch dia. Acme thread its forms use and calculations.
05	Cutting acme threads on lathe (Male and female).	Square threads-its forms and calculations of depth, core dia, pitch dia, Acme threads-its forms, use and calculations.
06	Turning of irregular jobs using face plate.	Face plate- its construction safety precaution in

	Balancing the face plate.	holding jobs on face plate.
07	Exercise on use of pillar drill in drilling, counter sinking, counter boring. Spot facing and use of spot facing tools.  Further practice of drilling of Radial drills. Practice of reaming on drilled holes.	Pillar drill machine constructional details, functions of parts. Application of pillar drill.  Radial drills function parts etc. Reamer- parts, types, uses.  Special tools – use and precautions to be observed for shaping internal keyways dovetails & ‘T’ slots.
08	‘T’ slots cutting in shaping machine.	Various material for single point cutting tools, tipped tools, their brazing and grinding process. Tool angles and their effect on cutting various materials.
09	Cross Dovetail cutting on shaper.	Cutting speed, feed, depth of cut for slotting, shaping and time calculation.
10	Shaping cross dovetails mating jobs male and female.	Checking of dovetail grooves with vernier caliper and roller. Their calculations and use of sine bar, slip gauge and dial test indicator.
11	Shaping of casting jobs, using angle plate, jack and clamps. Machining of complex shaped intricate casting.	Properties of metals general idea of physical, mechanical properties of metals, colour, weight, hardness toughness, malleability, ductility their effect on machine ability.
12	Grinding of form tools and shaping of convex and concave surfaces.	Use of radius gauges and template. Introduction to jigs and fixtures. Types and uses.
13	Machining of profiles on a slotting machine. Slotting of a double ended spanner.	Interchangeability – Limit, Fit, Tolerances and allowances.
14	Machining of internal spline and external spline on slotter uses to match each other.	Introduction and their indexing process on a slotter by its rotary table graduations.
15	Cutting external and internal sprocket teeth on slotting machine, use of rotary table.	Form tool for slotting machines. Calculation for spur gear in relation to graduation of circular table.
16	Slotting regular & irregular job and contours and sprockets.	Calculation for cutting sprocket.
17	Planning long jobs having ‘T’ slots and dovetail grooves.	Tool setting for dovetail use of relevant tool and their grinding process. Alignment of long jobs with precision instruments.

18	Setting and planning multiple jobs at a time.	Hydraulic transmission in machine tool- its advantages and application hydraulic system of a planer. Use of planer gauge for setting tool and template for profile checking.
19	Boring a cast block on a vertical milling machine, measurement of bore size.	Vertical milling machine its parts, construction, method of boring in a vertical milling. Difference between horizontal and vertical milling machine.
20	Milling hexagonal hole on a plate by attachment.	Elements of milling cutter Rake angle, primary, secondary and clearance angles, lead etc.
21	Demonstration of marking system of Grinding wheels. Different Tool and Cutter grinding practices on Tool & Cutter grinding m/c.  Milling tongue and groove on a mating job. Checking with precision instruments and gauges.	Selection procedure of grinding wheels. Abrasives its types Bonds, Grade Grit, structure, different shape of wheels and their uses. Inside micrometer, Principle, construction graduation reading both in English and metric system gauge types and uses.
22-23	<b>Implant training</b> / Project work (work in a team)	
24-25	<b>Revision</b>	
26	<b>Examination</b>	

**Fourth Semester**  
**(Semester Code no. MCN - 04)**

**Duration : Six Month**

**LEARNING OBJECTIVES OF 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. Simple programme and produce components on CNC Lathe involving different operations
5. Milling different types of gear on milling machine.
6. Manufacture of components using different milling cutters viz - slab milling cutter, cylindrical cutter, drill flute milling etc.
7. Milling different types of cams.

Week No.	Trade Practical	Trade Theory
01.	Demo of parts of CNC machining center – control switches, console buttons and machines specifications (spindle power, axes traverse, etc.). Demonstration of machine parts - bed, spindle motor and drive, tool changer, axes motors and ball screws, guideways, LM guides, console, electrical, coolant system, hydraulic system, chip conveyor. Working of parts explained using multimedia CNC teach ware. Parts shown on machine.	CNC technology basics: Difference between CNC and conventional lathes. Advantages and disadvantages of CNC machines over conventional machines. Schematic diagram of CNC system. Axes convention. Working of parts explained using multimedia CNC teach ware. Parts shown on machine.
02.	CNC part programming with simple exercises and various programming codes. Practice on CNC machine simulator.	Programming – sequence, formats, different codes, canned cycles. Absolute and incremental programming. Tool nose radius compensation (G41/42). Cutting tool materials, cutting tool geometry – insert types, holder types, insert cutting edge geometry. Cutting parameters - cutting speed, feed rate, depth of cut. Process planning, tool selection and cutting parameters selection. Explained using multimedia CNC teachware and CNC machine simulator.
03-04	CNC machining center operation in various modes: jog, single block, auto, MDI, edit, etc. Program entry. Setting of tool offsets, entry of tool radius.  Practice on CNC machine simulator.	Program execution in different modes like single block, manual and auto. Tool and work offsets setting. Prepare various programs as per drawing. Concepts taught using multimedia CNC teach ware.



05-06	Program and cut parts on CNC machining center with face milling, contour milling with tool radius compensation, pocket milling, drilling, peck drilling, countersinking, tapping operations using canned cycles for hole operations. First 80 % of the practice is on CNC machine simulator, followed by 20 % on machine.	Surface finish. Surface roughness related BIS symbols
07.	Prepare different types of documentation as per industrial need by different methods of recording information	Importance of Technical English terms used in industry –(in simple definition only) Technical forms, process charts, activity logs, in required formats of industry, estimation, cycle time, productivity reports, job cards
08-09	Milling cylindrical cutter.	Spiral introduction, type and elements. Difference between helix & spiral. Difference between R.H. and L.H. helix
10-11	Milling end mill/drum cam.	Spiral-lead, helix angle and calculation. Cam Introduction development and use.
12	Cutting face cam.	Use of proper cutting speed and feed for various metals. Calculation for the machining time, machining allowances. Lubricant/coolants and various ways of their application.
13.	Cutting a plate cam with angular setting	Cam-lobe, lead setting of dividing head, Calculation.
14.	Milling gears by differential indexing, Measuring the teeth with a vernier gear tooth caliper.	Vernier gear tooth caliper, its construction and application in checking gear tooth.
15.	Milling spline (external) Milling straight fluted Reamer.	Introduction to broaching methods of milling splines. Its calculations and selection of cutters.
16.	Milling a helical groove in a vertical milling machine. Milling a slab mill cutter. Milling twist drill.	Spiral milling lead, pitch, helix angle R.H. and L.H. swiveling the table in relation to the helix angle, selection of cutter for spiral milling. Calculations for spiral milling.
17.	Milling a drum cam. Milling a plate cam.	Cam-types, application in modern m/c. tools, its special advantages, manufacturing process, calculation for milling a drum cam.
18.	Milling helical gears. Cutting bevel gears on a milling machine by using bevel gear cutter.	Helical gear introduction elements and calculation. Introduction geometry and uses of bevel gears. Quality control types of variation, causes of variation, measurement of testing, gear & error.

19.	Milling a rack. Milling face cam.	Introduction to rack, its use & application. Rack cutting attachment, calculation for linear pitch, circular pitch, Gear ratio, Indexing movement, etc
20.	Cutting worm and worm wheel on a milling machine, gashing and finishing.	Introduction, geometry and use of worm and worm wheel.
21.	Cutting graduations on a steel rule on milling machine. Use of tolly cutter.	-do-
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**  
**(Semester Code no. MCN - 01)**  
**Duration: Six Month**

### **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</li> </ul>

		bisecting. - Triangle -different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.
5.	<b>Percentage:</b> Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	Lettering and Numbering as per BIS SP46-2003: - Single Stroke, Double Stroke, inclined, Upper case and Lower case.
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: - Definition, types and methods of dimensioning (functional, non-functional and auxiliary) - Types of arrowhead - Leader Line with text
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 - Lines, polygons, ellipse, etc. - geometrical figures and blocks with dimension - Transferring measurement from the given object to the free hand sketches.
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 - Basic principle of Sheet Size - Designation of sizes - Selection of sizes - Title Block, its position and content - Borders and Frames (Orientation marks and graduations) - Grid Reference - Item Reference on Drawing Sheet (Item List)
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 - Pictorial View - Orthogonal View - Isometric view
10.	-----	Symbolic Representation (as per BIS SP:46-2003) of : - Fastener (Rivets, Bolts and Nuts) - Bars and profile sections - Weld, brazed and soldered joints. - Electrical and electronics element - Piping joints and fittings

**Second Semester**  
**(Semester Code no. MCN - 02)**  
**Duration: Six Month**

**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:  - Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003) - Symbols preceding the value of dimension and dimensional tolerance. - Text of dimension of repeated features, equidistance elements, circumferential objects.
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:  - Different Polygons and their values of included angles. Inscribed and Circumscribed polygons. - Conic Sections (Ellipse & Parabola)
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.
<b>6.</b>	<b><u>Levers and Simple Machines:</u></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.
<b>7.</b>		Projections:  <ul style="list-style-type: none"> <li>- Concept of axes plane and quadrant.</li> <li>- Orthographic projections</li> <li>- Method of first angle and third angle projections (definition and difference)</li> <li>- Symbol of 1<sup>st</sup> angle and 3<sup>rd</sup> angle projection as per IS specification.</li> </ul>
<b>8.</b>		Drawing of Orthographic projection from isometric/3D view of blocks
<b>9.</b>		Orthographic Drawing of simple fastener (Rivet, Bolts, Nuts & Screw)
<b>10.</b>		Drawing details of two simple mating blocks and assembled view.

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

**LEARNING OBJECTIVES OF 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.	- Free hand Sketches for simple pipe, unions with simple pipe line drawings.

	-Stress, strain, ultimate strength, factor of safety. -Basic study of stress-strain curve for MS.	
<b>10.</b>	- 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.
<b>11.</b>	- Thermal Conductivity, Heat loss and heat gain.	-Free hand sketch of trade related components / parts (viz., single tool post for the lathe, etc.)
<b>12.</b>	- Average Velocity, Acceleration & Retardation. - Related problems.	- Study of assembled views of Vee-blocks with clamps.
<b>13.</b>	- Circular Motion: Relation between circular motion and Linear motion, Centrifugal force, Centripetal force	- Study of assembled views of shaft and pulley.
<b>14.</b>		- Study of assembled views of bush bearing.
<b>15.</b>		- Study of assembled views of a simple coupling.
<b>16.</b>		- Free hand Sketching of different gear wheels and nomenclature.



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

**LEARNING OBJECTIVES OF 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><u>Graph:</u></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.	<p>Acceptance of lot by sampling method (within specified limit size) with simple examples (not more than 20 samples).</p>	<ul style="list-style-type: none"> <li>- Simple exercises relating missing symbols.</li> <li>- Missing views</li> </ul>
4.	<ul style="list-style-type: none"> <li>- Friction- co-efficient of friction, application and effects of friction in Workshop practice.</li> </ul> <p><b>Centre of gravity</b> and its practical application.</p>	- Simple exercises related to missing section.
5.	<ul style="list-style-type: none"> <li>- Magnetic substances- natural and artificial magnets.</li> <li>- Method of magnetization. Use of magnets.</li> </ul>	-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. Employability Skills**

## 10.1 GENERAL INFORMATION

1. **Name of the subject** : **EMPLOYABILITY SKILLS**
2. **Applicability** :
  - CTS- Mandatory for all trades
  - ATS- Mandatory for fresher only
3. **Hours of Instruction** : 110 Hrs.
4. **Examination** : The examination will be held at the end of semesters.
5. **Instructor Qualification** :

**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 DGET institutes**

**AND**

**Must have studied English/ Communication Skills and Basic Computer at 12<sup>th</sup> / Diploma level and above**

**OR**

**Existing Social Studies Instructors duly trained in Employability Skills from DGET institutes**

6. **Instructor** :
  - One full time instructor is required for 1000 seats and above
  - For seats less than 1000, the instructor may be out sourced/ hired on contract basis.

**10.2 DISTRIBUTION OF TOPICS BETWEEN SEMESTERS FOR EMPLOYABILITY SKILL**

<b>Course Duration</b>	<b>Semester1</b>	<b>Semester2</b>	<b>Examination</b>
	<b>Topics</b>	<b>Topics</b>	
<b>01 Year (Two semesters)</b>	<ol style="list-style-type: none"> <li>1. English Literacy</li> <li>2. I.T. Literacy</li> <li>3. Communication Skills</li> </ol>	<ol style="list-style-type: none"> <li>4. Entrepreneurship Skills</li> <li>5. Productivity</li> <li>6. Occupational safety , Health and Environment Education</li> <li>7. Labour Welfare Legislation</li> <li>8. Quality Tools</li> </ol>	<b>Final examination at the end of second semester</b>
<b>02 Years (Four Semesters)</b>	<ol style="list-style-type: none"> <li>1. English Literacy</li> <li>2. I.T. Literacy</li> <li>3. Communication Skills</li> </ol>	<ol style="list-style-type: none"> <li>4. Entrepreneurship Skills</li> <li>5. Productivity</li> <li>6. Occupational safety , Health and Environment Education</li> <li>7. Labour Welfare Legislation</li> <li>8. Quality Tools</li> </ol>	<b>Final examination at the end of second semester</b>

## 10.3 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),</p> <p>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 : Degree in Mechanical Engineering from recognized Engineering College /university with one year experience in the relevant field.  
OR  
Diploma in Mechanical Engineering from recognized board of technical education with two years' experience in the relevant field.  
OR  
10<sup>th</sup> Class Pass + NTC/NAC in the Trade of "Machinist" With 3 years post qualification experience in the relevant field.
2. DESIRABLE QUALIFICATION : Preference will be given to a candidate with CIC (Craft Instructor Certificate) in Fitter trade.
3. SPACE NORMS : 130Sq.m
4. POWER NORMS : 20 KW
5. TOOLS, EQUIPMENT & GENERAL MACHINERY : (AS PER ANNEXURE-II)

### **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 are for a particular trade (MACHINIST) comprising of four semesters and not for single semester.

## **12. ASSESSMENT STANDARD**

### **12.1 Assessment guideline:**

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 assessment. Due consideration to be given while assessing for team work, 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 to be considered while assessing competency.

Assessment will be evidence based comprising the following:

- i) Job carried out in labs/workshop
- ii) Record book/ daily diary
- iii) Answer sheet of assessment
- iv) Viva-voce
- v) Progress chart
- vi) Attendance and punctuality
- vii) Assignment
- viii) Project work

Evidence of internal assessment to be preserved until forthcoming semester examination 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 which 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 above 75%- 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 which 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 ASSESSMENTS (FORMATIVE ASSESSMENT)

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 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, simulate part programme 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 shaping, slotting and set up different work and tool holding devices required to accomplish tasks with required alignment.	
13.	Produce finished components on a shaping, slotting machine and check for accuracy without any assistance.	
<b>Sub-Total of Internal assessment for Semester- I</b>		100
14.	Understand and explain the constructional features and working principles of planning, lathe machine and set up different work and tool holding devices required to accomplish tasks on these machines with required alignment.	
15.	Produce finished components on a planning and lathe machine and check for accuracy without any assistance.	

16.	Set up different work and tool holding devices required to accomplish tasks on a milling machine with required alignment.	
17.	Demonstrate practical skills in aligning/truing the work pieces and cutting tools for different turning operations.	
	<b>Sub-Total of Internal assessment for Semester- II</b>	100
18.	Produce different forms of threads viz., “V”, Square and Acme thread applying basic methods, tools, materials and information.	
19.	Work out and apply cutting parameters for different turning, drilling & milling operations with different work and tool material for producing quality output.	
20.	Grind Form tool and parallel & stepped using grinding machine with accuracy using appropriate tools & materials and with required quality.	
21.	Manufacture different components viz., V-block, Key-way, concave & convex surface, horizontal, angular, vertical, male-female T-slot & dovetail, multiple jobs at a time by determining use of shaping /and slotting /and planing machine.	
22.	Demonstrate practical skills involved in different operation viz., step milling, straddle milling, square & hexagonal milling, T-slot & dovetail milling using milling machine to produce different components with clear choice of procedures in familiar context.	
23.	Demonstrate practical skills to ream the drilled hole using radial drill machine as per drawing.	
	<b>Sub-Total of Internal assessment for Semester- III</b>	100
24.	Make different components viz., spur gear, helical, Bevel, worm & worm wheel, rack & pinion as per drawing by setting the milling machine.	
25.	Cut different components viz., end mill/drum cam, face cam, plate cam using milling machine and by applying quality concept.	
26.	Manufacture different components viz., spline (external), straight fluted reamer, cylindrical cutter, slab milling cutter, twist drill using milling machine with clear choice of procedures in familiar context.	
27.	Manufacture and assemble tongue and groove by performing different milling operations.	
28.	Set and operate CNC Vertical Machining Centre (3 – axes) to produce components as per drawing by preparing part programmes & applying range of cognitive and practical skills.	
	<b>Sub-Total of Internal assessment for Semester- IV</b>	100
	<b>Total of Internal assessment</b>	400

**NOTE: THE GENERIC OUTCOME TO BE ASSESSED ALONGWITH SPECIFIC OUTCOME.**

### 12.3 FINAL ASSESSMENT- ALL INDIA TRADE TEST (SUMMATIVE ASSESSMENT)

- a) There will be a single objective type Examination paper for the subjects Engineering drawing and Workshop Calculation & Science.
- b) There will be a single objective type Examination paper for the subjects Trade Theory and Employability Skills.
- c) The two objective type Examination papers as mentioned above will be conducted by National Council for Vocational Training (NCVT), whereas examination for the subject Trade Practical will be conducted by the State Government. 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>
<b>a)</b>	Practical	<b>300</b>
<b>b)</b>	Trade Theory	<b>200</b> Objective type Written test of 200 marks (Trade Theory 150 marks & Employability Skills 50 marks)
<b>c)</b>	Employability Skills	
<b>d)</b>	Work shop Calculation and Science.	<b>100</b> Objective Type Written test of 100 marks (Engineering Drawing 50 marks & Work shop Calculation and Science 50 marks)
<b>e)</b>	Engineering Drawing	
<b>f)</b>	Internal assessment	<b>100</b>
<b>TOTAL:</b>		<b>700</b>

### 13. LIST OF TRADE COMMITTEE MEMBERS

Sl. No.	Name & Designation Sh/Mr./Ms.	Organization	Mentor Council Designation
<b>Members of Sector Mentor council</b>			
1.	A. D. Shahane, Vice-President, (Corporate Trg.)	Larsen &Tourbo 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

<b>Mentor</b>			
<b>21.</b>	Sunil Kumar Gupta (Director)	DGET HQ, New Delhi.	Mentor
<b>Members of Core Group</b>			
<b>22.</b>	N. Nath. (ADT)	CSTARI, Kolkata	Co-ordinator
<b>23.</b>	H.Charles (TO)	NIMI, Chennai.	Member
<b>24.</b>	Sukhdev Singh (JDT)	ATI Kanpur	Team Leader
<b>25.</b>	Ravi Pandey (V.I)	ATI Kanpur	Member
<b>26.</b>	A.K. Nasakar (T.O)	ATI Kolkata	Member
<b>27.</b>	Samir Sarkar (T.O)	ATI Kolkata	Member
<b>28.</b>	J. Ram Eswara Rao (T.O)	RDAT Hyderabad	Member
<b>29.</b>	T.G. Kadam (T.O)	ATI Mumbai	Member
<b>30.</b>	K. Mahendar (DDT)	ATI Chennai	Member
<b>31.</b>	Shrikant S Sonnavane (T.O)	ATI Mumbai	Member
<b>32.</b>	K. Nagasrinivas(DDT)	ATI Hyderabad	Member
<b>33.</b>	G.N. Eswarappa (DDT)	FTI Bangalore	Member
<b>34.</b>	G. Govindan, Sr. Draughtsman	ATI Chennai	Member
<b>35.</b>	M.N.Renukaradhya, Dy.Director/Principal Grade I.,	Govt. ITI, Tumkur Road, Banglore, Karnataka	Member
<b>36.</b>	B.V.Venkatesh Reddy. JTO	Govt. ITI, Tumkur Road, Banglore, Karnataka	Member
<b>37.</b>	N.M.Kajale, Principal,	Govt. ITI Velhe, Distt: Pune, Maharashtra	Member
<b>38.</b>	SubrataPolley, Instructor	ITI Howrah Homes, West Bengal	Member
<b>39.</b>	VINOD KUMAR.R Sr.Instructor	Govt.ITIDhanuvachapuram Trivandrum, Dist., Kerala	Member
<b>40.</b>	M. Anbalagan, B.E., Assistant Training Officer	Govt. ITI Coimbatore, Tamil Nadu	Member
<b>41.</b>	K. Lakshmi Narayanan, T.O.	DET, Tamil Nadu	Member
<b>42.</b>	L. K. Mukherjee, DDT	CSTARI, Kolkata	Member
<b>43.</b>	R. N. Manna, TO	CSTARI, Kolkata	Member
<b>Other industry representatives</b>			
<b>44.</b>	VenugopalParvatikar	Skill Sonics, Bangalore	Member
<b>45.</b>	VenkataDasari	Skill Sonics, Bangalore	Member
<b>46.</b>	Srihari, D	CADEM Tech. Pvt. Ltd., Bengaluru	Member
<b>47.</b>	Dasarathi.G.V.	CADEM Tech. Pvt. Ltd., Bengaluru	Member
<b>48.</b>	L.R.S.Mani	Ohm Shakti Industries, Bengaluru	Member



## Annexure - I

### TRADE: MACHINIST

#### 14. LIST OF TOOLS & EQUIPMENTS FOR 12 TRAINEES+1

##### A : TRAINEES TOOL KIT:-

Sl. No.	Description	Qty.
1	Steel rule 30 cm graduated both in English & Metric units	13 nos.
2	Outside spring caliper 150 mm	8 nos.
3	Inside spring caliper 150 mm	8 nos.
4	Hermaphrodite caliper 150 mm	8 nos.
5	Divider spring 150 mm	8 nos.
6	Centre Punch 100 mm	8 nos.
7	Hammer B.P. 0.5 kg.	13 nos.
8	Cold chisel flat 25 x 200 mm	13 nos.
9	File flat bastard 300 mm	13 nos.
10	File flat 2 <sup>nd</sup> cut 250 mmt	13 nos.
11	File flat smooth 200 mm	13 nos.
12	Engineers screw driver	13 nos.
13	Combination Plier 150 mm	13 nos.
14	Safety glasses	13 nos.

**B: Tools, Instruments and General Shop Out fits**

<b>Sl. No.</b>	<b>Description</b>	<b>Quantity</b>
15	Surface plate 400 mm x 400mm grade	1 no.
16	Table for surface plate 900 x 900 x 1200 mm	1 no.
17	Marking off table 1200 x 1200 x 900 mm high	1 no.
18	Scribing block universal 300 mm	2 nos.
19	V- Block 100/7 – 80 – A	2 nos.
20	Try square 300 mm	2 nos.
21	Outside spring caliper 200 mm	2 nos.
22	Divider spring 200 mm	2 nos.
23	Inside spring caliper 200 mm	2 no.
24	Straight edge steel 1 meter	1 no.
25	Straight edge steel 500 mm	1 no.
26	Steel tape 2 meter in case	1 no
27	Steel rule 60 cm graduated both in English & Metric units	2 nos.
28	Sprit level 2V 250, 05 meter	1no
29	Hammer B.P. 800 gms. With handle	4 nos.
30	Screw driver, heavy duty 300 mm with handle	4 nos.
31	Hammer lead 1 kg.	2 nos.
32	Spindle blade screw driver 100 mm	4 nos.
33	Allen Hexagonal keys 2.5 to 12	2 sets
34	Spanner D.E. series 2 (set of 7 pieces)	6 sets
35	Adjustable spanner 300 mm	2 nos.
36	Reduction sleeve Morse 1-1, 3-1, 4-1, 4-2, 5-1, 5-2, 6-1,	2 nos. each
37	Angle plate size 200 x 100 x 200 mm	2 nos.
38	Angle plate adjustable 250 x 150 x 175 mm	2 nos.

39	Solid parallels in pairs (different sizes) in Metric	12 pairs (assorted)
40	Oil Can pressure feed 500 mg.	6nos
41	Oil stone 150 x 50 x 25 mm	2nos
42	Number drills H.S.S. (parallel shank)	1set
43	Twist drills 3 mm to 13 mm in step of 0.5 mm (parallel shank)	2set
44	Drill Chuck 0.20 with taper shank	1no
45	Centre drill A 1 to 5	2set
46	Grinding wheel dresser (diamond)	1no
47	Grinding wheel dresser Huntington type	2 nos.
48	Clamps C 100 mm	2nos
49	Clamps C 200 mm	2nos
50	Tap and Die set in box metric pitch (6 mm to 12 mm)	1set
51	Drill H.S.S. taper shank (6 mm to 12 mm in step of 0.5 mm)	2set
52	File flat 2 <sup>nd</sup> cut 250 mm	4nos
53	File flat smooth 200 mm	4nos
54	File Half round 2 <sup>nd</sup> cut 250 mm	4nos
55	File triangular smooth 200 mm	4nos
56	Needle file set	1no.
57	File square 2 <sup>nd</sup> cut 250 mm	4nos
58	Reamer 6 mm to 25 mm by 1 mm	1set
59	Reamer adjustable 10 mm to 15 mm by 75 mm	1set
60	Tool bits H.S.S. 6 mm square	1 Dozen
61	Tool bits H.S.S. 10 mm square	1 Dozen
62	Tool bits holder (Armstrong) L.H	4nos
63	Tool bits holder (Armstrong) R.H.	4nos
64	Assorted tools and bit holders for lathe, shaper, slotter & planner in different shapes and sizes	As required

65	Hacksaw frame adjustable 250-300 mm with blades	2nos
66	Table chuck 75 mm jaw swivel base	1no
67	Machine vice 200 mm swivel base	4nos
68	Machine vice 160 mm swivel base	2nos
69	Hand vice 50 mm jaw	2nos
70	Radius turning attachment	1no
71	Angle turning attachment	1no
72	Compound angle vice (standard sine)	1no
73	Universal vice 150 mm	1no
74	Universal table angle plate	1no
75	Shaper tool holder turret type	2nos
76	Base chuck for slotter	1no
77	shaper indexing center	1no
78	Knurling tools (set of 3) straight and diamond	1each
79	Plier cutting 200 mm	2nos
80	Carbide tipped tools of different sizes and shapes (throw away tips)	2sets
81	Hand hammer 1 kg. With handle	2nos

### C: Milling Cutters

Sl No.	Name & Description of Cutters	Quantity
1	Cylindrical cutter 63 x 90 bore dia	3nos
2	Cylindrical cutter 80 x 90 bore dia.	3 nos
3	Side and face cutter dia 80 x 8	2 nos
4	Side and face cutter dia 160 x 10	3 nos
5	Side and face cutter dia 100 x 12	2 nos
6	Side and face cutter dia 160 x 16	2 nos
7	Side and face cutter dia 200 x 20	3 nos
8	Side and face cutter dia 100 x 10	2 nos
9	Equal angle cutter 45 <sup>0</sup> /100	2 nos
10	Equal angle cutter 60 <sup>0</sup> /100	2 nos
11	Equal angle cutter 90 <sup>0</sup> /100	2 nos
12	Double angle unequal cutter 50 x 12 x 55 <sup>0</sup>	2 nos
13	Double angle unequal cutter 50 x 12 x 60 <sup>0</sup>	2 nos
14	Double angle unequal cutter 50 x 12 x 70 <sup>0</sup>	2 nos
15	Double angle unequal cutter 50 x 12 x 75 <sup>0</sup>	1 no
16	Single angle cutter 63 x 18 x 45 <sup>0</sup> RH	1 no
17	Single angle cutter 63 x 18 x 45 <sup>0</sup> LH	1 no
18	Single angle cutter 63 x 18 x 60 <sup>0</sup> RH	1 no
19	Single angle cutter 63 x 18 x 60 <sup>0</sup> LH	1 no
20	Slitting Saw cutter Ø 75 x 3 X Ø 27 mm	2 nos.
21	Slitting Saw cutter Ø 100 x 6 X Ø 27 mm	2 nos.
22	Shell End Mill Ø 50 x 36 x Ø 22 (preferably inserted tip type)	2 nos.
23	Shell End Mill Ø 75 mm x 50 x Ø 22 (preferably inserted tip type)	2 nos.
24	Parallel shank end mills Ø6, Ø10 and Ø 16 are (double fluted), Ø 20 mm & Ø 25mm (four fluted)	4 nos. each

25	'T' slot cutter with parallel shank- Ø 17.5 x 8 mm width x dia. of shank 8 mm	2 nos.
26	Concave Milling cutter Ø 63 x 6 radius x Ø 27 mm	1 nos.
27	Convex Milling cutter Ø 63 x 6 radius x Ø 27 mm	1 nos.
28	Disc type form milling cutter (involute form -2 module, 20° pressure angle)	1 set

#### D: MEASURING INSTRUMENTS

Sl. No.	Name & Description of Instruments	Quantity
1	Micrometer outside 0-25 mm	4 nos
2	Micrometer outside 25-50 mm	2 no
3	Micrometer outside 50-75 mm	1 no
4	Micrometer depth gauge 0-200 mm	1no
5	Digital micrometer 0-25 mm	1 no
6	Direct reading vernier caliper 0- 300 (direct reading with dial)	1no
7	Digital vernier caliper 0- 300 mm	1 no
8	Vernier height gauge 250 mm	1 no
9	Vernier gear tooth caliper	1no
10	Combination set with 300 mm rule	2 sets
11	Vernier bevel protractor with 150 m blade	1 no
12	Bevel gauge 200 mm	1 no
13	Telescopic gauge 13 mm to 300 mm	1set
14	Sine Bar 200 mm	1 no
15	Dial test indicator with magnetic gauge type 1 grade A with magnetic base	1 no
16	Center gauge 60 <sup>0</sup>	1 no
17	Slip gauge set (normal set) metric (for the whole institute)	1 set
18	Screw pitch for metric pitches (25-6 mm)	2 sets
19	Radius gauge metric set (1-6 mm)	1 set

20	Limit plug gauges 5 mm to 25 mm by 2.5 mm	1 set
21	Ring gauges 5 mm to 25 mm by 2.5 mm (GO & NO GO)	1 set
22	Taper gauge M.T. No. 1, 2, 3, 4 & 5	1 set
23	Feeler gauge	1 no
24	Planer gauge standard size	1 no
25	Magnifying glass 75 mm	2nos

### E: FURNITURE

Sl. No.	Name & Description	Quantity
1	Steel lockers for 12 trainees	1no
2	Steel chair for Instructor	1 no
3	Steel table for Instructor	1 no
4	Work bench for Fitters with 2 vices of 100 mm jaw	1no
5	Steel cup board 180 x 90 x 45 mm	1 no
6	Steel cup board 120 x 60 x 45 cm	1no
7	Black board with easel	1 no
8	First Aid Box	1 no

### F : General Machinery Shop outfit

Sl. No.	Name & Description of Machine	Quantity
1	Shaping machine 450 mm stroke (motorized) with all attachments	2 nos.
2	Shaping machine 315 mm stroke (hydraulic) with all attachments	1 no

3	Double column planer 1500 x 1000 x 1000 (motorized) with all attachments	1 no
4	Slotter 180 mm stroke (motorized) with all attachments	1 no
5	SS and SC centre lathe (all geared) with specification as:  Centre height 150 mm and centre distance 1000 mm along with 4 jaw chuck, Taper turning attachment, steadies, auto feed system, safety guard, motorized coolant system, with lighting arrangement and set of lathe tools.	3 nos.
6	Tool and cutter grinder 250 mm to admit 450 mm between center-fully motorized work head supplied with tool rest of different types table clamps and other attachments.	1 no
7	Drilling machine pillar 20 mm capacity with drill chuck & key.	1 no
8	Radial drill 1200 mm area motorized with tapping attachment	1 no
9	Silicon carbide grinder for carbide tipped tools	1 no.
10	Double ended Pedestal Grinder with 178 mm wheels(one fine and one rough wheel)	1 no.
11	Universal Milling machine with minimum specification as:  Table Length x width 1200 x 300 mm having motorized up & down movement along with auto feed arrangement and with following attachments such as:  a. Vertical head b. Slotting attachment c. Rack cutting attachment d. Rotary table e. Dividing head f. Adaptors, arbors and collects etc. for holding straight shank drills and cutters from 3 mm to 25 mm.	2 nos.
12	Horizontal Milling Machine with minimum specification as:  Table Length x width 1200 x 300 mm having motorized up & down movement along with auto feed arrangement and 150mm Universal vice.	1 no
13	Vertical Milling Machine with minimum specification as:  Table Length x width 1200 x 300 mm having motorized up & down movement along with auto feed arrangement along with 150mm universal vice.	1 no
14	Surface Grinding Machine with minimum specification as:  Grinding machine plain surface, wheel dia. 175 mm (or near) with	1 no





**GUIDELINES FOR INSTRUCTORS AND PAPER SETTERS**

1. All the 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.