

MACHINIST

COMPETENCY BASED CURRICULUM

(Duration: 2 Yrs.)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL- 5



SECTOR – PRODUCTION & MANUFACTURING



GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

MACHINIST

(Revised in 2018)

APPRENTICESHIP TRAINING SCHEME (ATS)



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Developed By

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1.1 Apprenticeship Training Scheme under Apprentice Act 1961

The Apprentices Act, 1961 was enacted with the objective of regulating the programme of training of apprentices in the industry by utilizing the facilities available therein for imparting on-the-job training. The Act makes it obligatory for employers in specified industries to engage apprentices in designated trades to impart Apprenticeship Training on the job in industry to school leavers and person having National Trade Certificate (ITI pass-outs) issued by National Council for Vocational Training (NCVT) to develop skilled manpower for the industry. There are four categories of apprentices namely; **trade apprentice, graduate, technician and technician (vocational) apprentices.**

Qualifications and period of apprenticeship training of **trade apprentices** vary from trade to trade. The apprenticeship training for trade apprentices consists of basic training followed by practical training. At the end of the training, the apprentices are required to appear in a trade test conducted by NCVT and those successful in the trade tests are awarded the National Apprenticeship Certificate.

The period of apprenticeship training for graduate (engineers), technician (diploma holders and technician (vocational) apprentices is one year. Certificates are awarded on completion of training by the Department of Education, Ministry of Human Resource Development.

1.2 Changes in Industrial Scenario

Recently we have seen huge changes in the Indian industry. The Indian Industry registered an impressive growth during the last decade and half. The number of industries in India have increased manifold in the last fifteen years especially in services and manufacturing sectors. It has been realized that India would become a prosperous and a modern state by raising skill levels, including by engaging a larger proportion of apprentices, will be critical to success; as will stronger collaboration between industry and the trainees to ensure the supply of skilled workforce and drive development through employment. Various initiatives to build up an adequate infrastructure for rapid industrialization and improve the industrial scenario in India have been taken.

1.3 Reformation

The Apprentices Act, 1961 has been amended and brought into effect from 22nd December, 2014 to make it more responsive to industry and youth. Key amendments are as given below:

- Prescription of number of apprentices to be engaged at establishment level instead of trade-wise.
- Establishment can also engage apprentices in optional trades which are not designated, with the discretion of entry level qualification and syllabus.
- Scope has been extended also to non-engineering occupations.
- Establishments have been permitted to outsource basic training in an institute of their choice.
- The burden of compliance on industry has been reduced significantly.



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2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under aegis of National Council of Vocational Training (NCVT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programmes of NCVT for propagating vocational training.

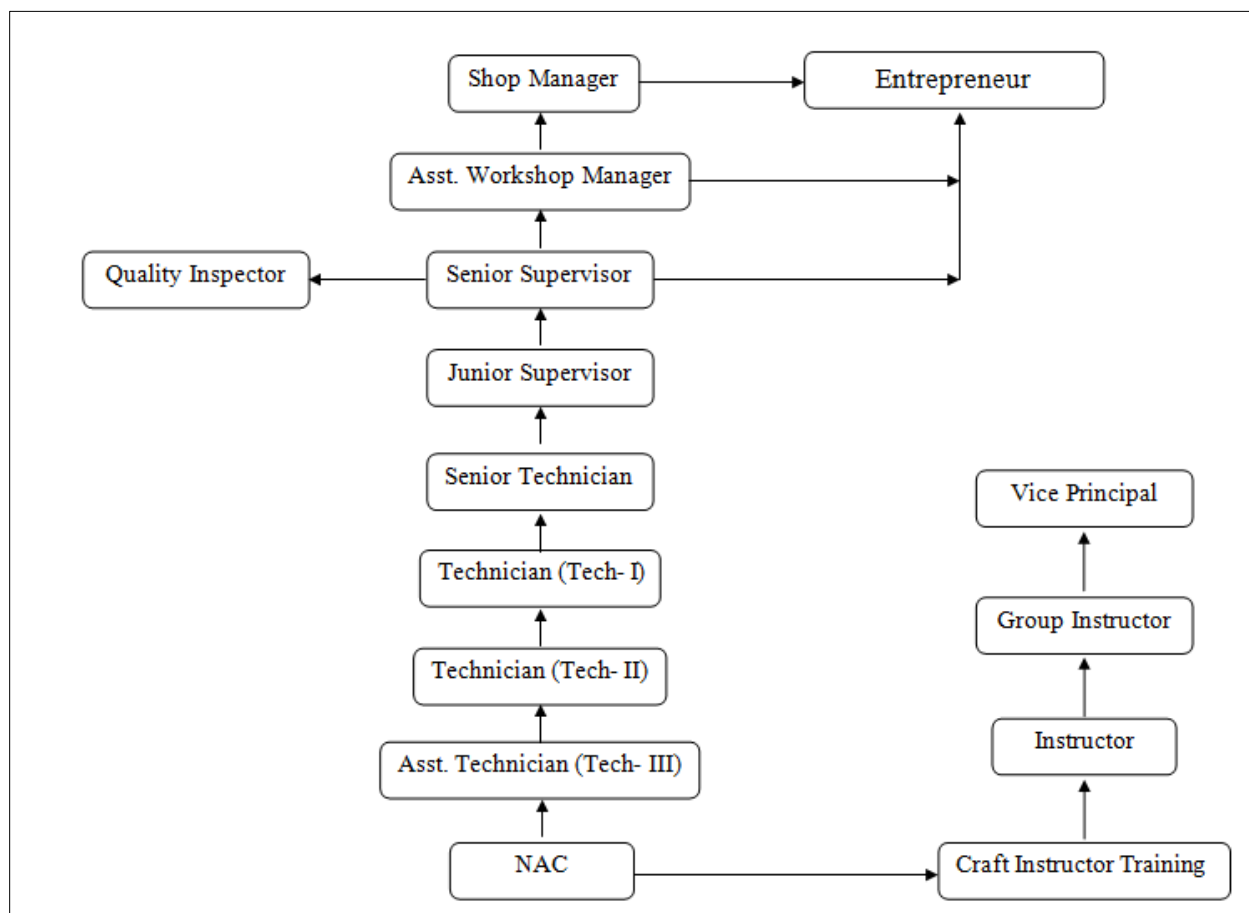
Machinist trade under ATS is one of the most popular courses delivered nationwide through different industries. The course is of two years (02 Blocks) duration. It mainly consists of Domain area and Core area. In the Domain area Trade Theory & Practical impart professional - skills and knowledge, while Core area - Workshop Calculation and science, Engineering Drawing and Employability Skills imparts requisite core skills & knowledge and life skills. After passing out the training programme, the trainee is being awarded National Apprenticeship Certificate (NAC) by NCVT having worldwide recognition.

Broadly candidates need to demonstrate that they are able to:

- Read & interpret technical parameters/documents, plan and organize work processes, identify necessary materials, tools and equipments;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional skill, knowledge, core skills & employability skills while performing jobs and solve problem during execution.
- Identify machines, their parts and operate various machines relevant to trade like lathe, milling, shaping, drilling, CNC machine etc..
- Produce part programming, setting of tools on CNC and other machines; prepare tools as per machining operation through grinding wherever applicable.
- Check the job as per drawing for quality aspects, identify and rectify errors in job or manufacturing method.
- Document the technical parameters related to the task undertaken.
- Perform preventive maintenance of relevant machines, identify simple problems and keep them in working condition.

2.2 CAREER PROGRESSION PATHWAYS:

- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Indicative pathways for vertical mobility.



2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two years (*Basic Training and On-Job Training*): -

Total training duration details: -

Time (in months)	1-3	4-12	13-15	16-24
Basic Training	Block– I	-----	Block – II	-----
Practical Training (On - job training)	----	Block – I	-----	Block – II

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A. Basic Training

For 02 yrs. course (Engg.) :-(**Total 06 months:** 03 months in 1styr. + 03 months in 2nd yr.)

For 01 yr. course (Engg.) :-(**Total 03 months:** 03 months in 1styr.)

Sl. No.	Course Element	Total Notional Training Hours	
		For 02 Yrs. course	For 01 Yr. course
1.	Professional Skill (Trade Practical)	550	275
2.	Professional Knowledge (Trade Theory)	240	120
3.	Workshop Calculation & Science	40	20
4.	Engineering Drawing	60	30
5.	Employability Skills	110	55
	Total (Including internal assessment)	1000	500

B. On-Job Training:-

For 02 yrs. Course (Engg.) :-(**Total 18 months:** 09 months in 1styr. + 09 months in 2nd yr.)

Notional Training Hours for On-Job Training: 3120 Hrs.

For 01 yr. course (Engg.) :-(**Total 12 months**)

Notional Training Hours for On-Job Training: 2080 Hrs.

C. Total training hours:-

Duration	Basic Training	On-Job Training	Total
For 02 yrs. course (Engg.)	1000 hrs.	3120 hrs.	4120 hrs.
For 01 yr. course (Engg.)	500 hrs.	2080 hrs.	2580 hrs.

2.4 ASSESSMENT & CERTIFICATION:

The trainee will be tested for his skill, knowledge and attitude during the period of course and at the end of the training programme as notified by Govt of India from time to time. The Employability skills will be tested in first two semesters only.

a) The **Internal assessment** during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline (section-2.4.2). The marks of internal assessment will be as per the template (Annexure – II).

b) The final assessment will be in the form of summative assessment method. The All India Trade Test for awarding NAC will be conducted by NCVT on completion of course as per guideline of Govt of India. The pattern and marking structure is being notified by govt of India from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check individual trainee's profile as detailed in assessment guideline (section-2.4.2) before giving marks for practical examination.**

2.4.1 PASS REGULATION

The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects 40%. The candidate pass in each subject conducted under all India trade test.

2.4.2 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 should be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scrap/wastage as per procedure, behavioral attitude, sensitivity to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work

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Evidences of internal assessments are to be preserved until forthcoming semester examination for audit and verification by examination body. The following marking pattern to be adopted while assessing:

Performance Level	Evidence
(a) Weigh tage in the range of 60 -75% to be allotted during assessment	
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.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • Below 70% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b)Weight age in the range of above75% - 90% to be allotted during assessment	
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.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A good level of neatness and consistency in the finish • Little support in completing the project/job
(c) Weight age in the range of above 90% to be allotted during assessment	
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.	• High skill levels in the use of hand tools, machine tools and workshop equipment • Above 80% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

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.

Perform TPM (Total Production Management), TQM (Total Quality Management) and record keeping system.

Reference NCO:

NCO-2015: 7223.0500

NCO-2015: 7223.0601

NCO-2015: 7223.0800

NCO-2015: 7223.1100

NCO-2015: 7223.1201

NCO-2015: 7223.1300

NCO-2015: 7223.1500

NCO-2015: 7223.1600

NSQF level for Machinist trade under ATS: **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:

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

5. GENERAL INFORMATION

Name of the Trade	MACHINIST
NCO-2015	7223.0500, 7223.0601, 7223.0800, 7223.1100, 7223.1201, 7223.1300, 7223.1500, 7223.1600
NSQF Level	Level – 5
Duration of Apprenticeship Training (Basic Training + On-Job Training)	Two years (02 Blocks each of one year duration).
Duration of Basic Training	a) Block –I : 3 months b) Block – II : 3 months Total duration of Basic Training: 6 months
Duration of On-Job Training	a) Block–I: 9 months b) Block–II : 9 months Total duration of Practical Training: 18 months
Entry Qualification	Passed 10 th Class with Science and Mathematics under 10+2 system of Education or its equivalent
Selection of Apprentices	The apprentices will be selected as per Apprenticeship Act amended time to time.
Instructors Qualification for Basic Training	As per ITI instructors qualifications as amended time to time for the specific trade.
Infrastructure for Basic Training	As per related trades of ITI
Examination	The internal examination/ assessment will be held on completion of each block. Final examination for all subjects will be held at the end of course and same will be conducted by NCVT.
Rebate to Ex-ITI Trainees	01 year
CTS trades eligible for Machinist Apprenticeship	Machinist

Note:

- Industry may impart training as per above time schedule for different block, however this is not fixed. The industry may adjust the duration of training considering the fact that all the components under the syllabus must be covered. However the flexibility should be given keeping in view that no safety aspects is compromised.
- For imparting Basic Training the industry to tie-up with ITIs having such specific trade and affiliated to NCVT.

6.1 GENERIC LEARNING OUTCOME

The following are minimum broad Common Occupational Skills/ Generic Learning Outcome after completion of the Machinist course of 02 years duration under ATS.

Block I & II:-

1. Recognize & comply safe working practices, environment regulation and housekeeping.
2. Understand and explain different mathematical calculation & science in the field of study including basic electrical. *[Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, Power transmission, Pressure]*
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Electrical & electronic symbol]*
4. Select and ascertain measuring instrument and measure dimension of components and record data.
5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.
6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.
8. Plan and organize the work related to the occupation.

6.2 SPECIFIC LEARNING OUTCOME

BLOCK – I (09 months)

1. Safety and best practices/Basic Industrial Culture through tools like 5S, KAIZEN, LEAN, CONCEPT etc.
2. Prepare different types of documentation as per industrial need by different methods of recording information such as Route Card, Hydro test report, Job Card, MR Slip.
3. Perform marking out the components for filing, drilling, and allied operations such as milling & turning.
4. Plan and organize the work for different types of fitting operations and check for work result.
5. Blueprint reading of technical documents - part, assembly drawings.
6. Produce finished components by performing different shaping & slotting operation and check for accuracy without any assistance.
7. Produce finished components by performing different planing operation and check for accuracy without any assistance. (Optional)
8. Produce finished components by performing different lathe operations and check for accuracy without any assistance.
9. Produce finished components to perform different milling operations and check for accuracy without any assistance.
10. Perform preventive maintenance of lathe, shaping, slotting, planing, and milling machines.

B. BLOCK – II (09 months)

11. Process planning - machining sequence, cutting tools selection, cutting parameters, work holding devices.
12. Produce different forms of threads viz., "V", Square and Acme thread applying basic methods, machine tools, materials and information.
13. Work out and apply cutting parameters for different turning, drilling & milling operations with different work and tool material for producing quality output.
14. Grind Form tool and parallel & stepped using grinding machine with accuracy using appropriate tools & materials and with required quality.
15. 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.

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16. Produce different components by performing different operation viz., step milling, straddle milling, square & hexagonal milling, T-slot & dovetail milling using milling machine with clear choice of procedures.
17. Demonstrate practical skills to ream the drilled hole using radial drill machine.
18. Make different components viz., spur gear, helical, Bevel, worm & worm wheel, rack & pinion by setting the milling machine.
19. Produce different components viz., end mill/drum cam, face cam, plate cam using milling machine and by applying quality concept.
20. Manufacture different components viz., spline (external), straight fluted reamer, cylindrical cutter, slab milling cutter, twist drill using milling machine with clear choice of procedures.
21. CNC part programming, operations and machine settings virtually and practically.
22. Set and operate CNC Vertical Machining Centre (3 – axes) to produce components by preparing part programmes.
23. Preventive maintenance of CNC machines.
24. Set and operate surface & cylindrical grinder to produce components and check the job accuracy without anybody help.
25. Perform TPM (Total Productive Maintenance), TQM (Total Quality Management) and record keeping system.

NOTE: Learning outcomes are reflection of total competencies of a trainee and assessment will be carried out as per assessment criteria.

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7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING OUTCOME	
LEARNING OUTCOMES	ASSESSMENT CRITERIA
1. Recognize & comply safe working practices, environment regulation and housekeeping.	1. 1. Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
	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/unsalvageable 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 Protective Equipment (PPE) and use the same as per related working environment.
	1. 10. Identify basic first aid and use them under different circumstances.
	1. 11. Identify different fire extinguisher and use the same as per requirement.
	1. 12. Identify environmental pollution & contribute to avoidance of same.
	1. 13. Take opportunities to use energy and materials in an environmentally friendly manner
	1. 14. Avoid waste and dispose waste as per procedure
	1. 15. Recognize different components of 5S and apply the same in the working environment.
2. Understand, explain different mathematical calculation & science in the	2.1 Explain concept of basic science related to the field such as Material science, Mass, weight, density, speed, velocity, heat & temperature, force, motion, pressure,

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field of study including basic electrical and	heat treatment.
apply in day to day work. <i>[Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, Power transmission, Pressure]</i>	2.2 Measure dimensions as per drawing
	2.3 Use scale/ tapes to measure for fitting to specification.
	2.4 Comply given tolerance.
	2.5 Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.
	2.6 Ensure dimensional accuracy of assembly by using different instruments/gauges.
	2.7 Explain basic electricity, insulation & earthing.
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. <i>[Different engineering drawing-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol]</i>	3. 1. Read & interpret the information on drawings and apply in executing practical work.
	3. 2. Read & analyse the specification to ascertain the material requirement, tools, and machining /assembly /maintenance parameters.
	3. 3. Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
4. Select and ascertain measuring instrument and measure dimension of components and record data.	4.1 Select appropriate measuring instruments such as micrometers, vernier calipers, dial gauge, bevel protector and height gauge (as per tool list).
	4.2 Ascertain the functionality & correctness of the instrument.
	4.3 Measure dimension of the components & record data to analyse the with given drawing/measurement.
5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity &	5.1 Explain the concept of productivity and quality tools and apply during execution of job.
	5.2 Understand the basic concept of labour welfare legislation and adhere to responsibilities and remain sensitive towards such laws.

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quality.	5.3 Knows benefits guaranteed under various acts
6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	6.1 Explain the concept of energy conservation, global warming, pollution and utilize the available resources optimally & remain sensitive to avoid environment pollution.
	6.2 Dispose waste following standard procedure.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	7. 1. Explain personnel finance and entrepreneurship.
	7. 2. Explain role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme.
	7. 3. Prepare Project report to become an entrepreneur for submission to financial institutions.
8. Plan and organize the work related to the occupation.	8. 1. Use documents, drawings and recognize hazards in the work site.
	8. 2. Plan workplace/ assembly location with due consideration to operational stipulation
	8. 3. Communicate effectively with others and plan project tasks
	8. 4. Assign roles and responsibilities of the co-trainees for execution of the task effectively and monitor the same.
SPECIFIC OUTCOME	
<u>Block-I & II (Section:10)</u>	
<i>Assessment Criteria i.e. the standard of performance, for each specific learning outcome mentioned under block – I & block – II(section: 10) must ensure that the trainee achieves well developed skill with clear choice of procedure in familiar context. Assessment criteria should broadly cover the aspect of Planning (Identify, ascertain, estimate etc.); Execution (perform, illustration, demonstration etc. by applying 1) a range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information 2) Knowledge of facts, principles, processes, and general concepts, in a field of work or study 3)Desired Mathematical Skills and some skill of collecting and organizing information, communication) and Checking/ Testing to ensure functionality during the assessment of each outcome. The assessments parameters must also ascertain that the candidate is responsible for own work and learning and some responsibility for other's work and learning.</i>	

BASIC TRAINING (Block – I)**Duration: (03) Three Months**

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1.	Safety: - its importance, classification, personal, general, workshop and job safety. Occupational health and safety. Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution & personal safety message. Preventive measures for electrical accidents & steps to be taken in such accidents. Importance of housekeeping & good shop floor practices. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Fire& safety: Use of Fire extinguishers.	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 Institute system including stores procedures. Introduction of First aid. Safety attitude development of the trainee by educating him to use Personal Protective Equipment (PPE). Response to emergencies eg; power failure, fire, and system failure. Accidents- Definition types and causes. First-Aid, nature and causes of injury and utilization of first-aid. Introduction to 5S concept & its application. Fire: - Types, causes and prevention methods. Fire Extinguisher, its types. Global warming its causes and remedies. Industrial Waste its types, sources and waste Management.

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2	Identification of tools & equipments as per desired specifications for marking & sawing(Hand tools , Fitting tools & Measuring tools) Selection of material as per application Visual inspection of raw material for rusting, scaling, corrosion etc. Uses of marking tools, Punch, Try square & basic measuring tools, caliper, steel rule. Marking out lines, gripping suitably in vice jaws, hacksawing to given dimensions, sawing different types of metals of different sections. Chipping flat surfaces and grinding various angles to chisels, filing flat surface. Grooving with Hammer and chisel. Filing Flat surfaces, Tee shape job, flat type polygon, checking with steel rule and Try square. Marking and Drilling holes on flat pieces. Tapping as per simple drawing. Fitting male and female square piece to close limit. Application of vernier caliper in making job.	Hand tools and its importance, steel rule, Try square, chisel, surface gauge and care & maintenance, Hacksaw frame, blades. Classification and types of chisels, files & uses, vices - its constructions and uses. Hammers and its types. Related safety. Marking block, Steel rule, and calipers- different types and uses. Hacksaw blade, Hacksaw frame and its types. Drill bits- parts, Types & uses. Introduction to Hand Taps & Dies and their types, applications, care and maintenance. Familiar with tap and drill size, Thread Terminology. Use of vernier caliper and its parts, construction, principle & reading, use & care. Heat treatment process Annealing, Normalising, Tempering, Hardening, case hardening and its importance.
3.	Introduction to Shaping machine and its construction. Setting of strokes, tools, job on table. Safety points to be observed while working on a shaper. Setting of vice, setting of block on vice checking accuracy. Machining of Rectangular, Hexagonal block, steps, with the use of Basic tools as per sketch checking with caliper & steel rule, angle protractor.	Outside micrometer, its types and construction, parts, reading use, care and maintenance. Study about Depth gauge, micrometers and dial test indicator - their parts and construction. Introduction of shaper, types, classification, General principles of power transmission on shaping mechanism. Shaping parts, construction use of parts, quick return mechanism ratio etc. Various tools of shaping machine and their angles and importance of angles.

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4	Shaping “V” blocks with slides, measurement of ‘V’ groove with vernier bevel protractor, measurement of slots by vernier caliper with 0.02 mm accuracy. Shaping Tee slots, shaping angular surfaces. Cutting of external keyway on shaper.	Various methods of holding jobs, use of clamps, nuts & bolts V- blocks, angle plates shaping operations, their importance. Tool head - its parts and application, function of each part of tool head. Shaping tools and types. Speed, feed, depth of cut.
5.	General introduction to slotting. Safety points to be observed while working on a slotter. Slotting a rectangular job checking and measuring with gauges & precision measuring instruments.	Slotter-principle, construction, details, driving mechanism, quick return motion and speed ratio. Safety precaution comparative study with a shaping machine. Classification of slotting machine. Job holding devices-vice, clamps, V-block, parallel block etc. Slotting tools different types of work tool angles comparison of tool shape with that of shaper.
6.	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. Introduction to coolant & lubricant-difference between them, types and uses of each. Use of circular marks on the table for slotting curves. Introduction to Planing M/c. parts, types, constructions, details of Driving mechanism of planer, quick return motion etc.
8.	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. Parallel turning between centers, parting off, chamfering using roughing, finishing and parting off tools.	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. Lathe tools their angles & uses. Driving mechanism, speed and feed mechanism & lathe accessories.
9.	Holding the job in three jaw chuck truing, centering facing. Step turning	Chucks-different types of job holding devices on lathe and advantages of each

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	undercutting, knurling drilling and boring. 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.	type. Mounting and dismounting of chucks. Taper introduction, types and uses. Calculations of tapers. Measurement of taper by sine bar and slip gauges. Different thread forms their related dimensions and calculations screw cutting in a lathe.
10.	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. Sequence of milling six faces of a solid block. Checking the accuracy with the help of try-square scribing block and vernier height gauge. Step milling using side and face cutter checking with micrometer.	Milling machine importance of milling machine, types and specification of milling machine, driving and feed mechanism of milling machine. Classification & different types of milling cutters & their use. Parts and nomenclature. 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.
11.	Straddle and gang milling operations including up-milling and down milling. Milling concave and convex surfaces. Introduction to indexing head types, setting and aligning of indexing head with reference to job on milling machine. Milling square and hexagonal job by simple indexing method.	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. Indexing-introduction & types. Indexing head-constructural details, function of indexing plates and the sector arms. Calculation for various types of indexing.

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12.	Milling dovetail and 'T'slots both male & female matching each other. Milling of spur gear. 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.	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. Selection of gear cutter type and form & various methods of checking gear and its parts. 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.
13.	Revision & Internal Assessment	

NOTE: -

More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of related industry operations may be shown to the trainees to give a feel of Industry and their future assignment.

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BASIC TRAINING (Block – II)**Duration: (03) Three Months**

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1	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. Cutting V thread external and internal in a lathe. Checking up with screw pitch gauge. Cutting square thread external & internal on a lathe. Cutting square threads (right hand only) on a lathe-checking with thread gauge-grinding of tool and setting in correct position.	Turning of taper by taper turning attachment advantages and disadvantages taper calculations. 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. Difference between single and multi-start threads-their uses merits and demerits. Broach - its types and uses. Square thread its form and calculation of depth, core dia, pitch dia. Acme thread its forms use and calculations.
2.	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.	Square threads-its forms and calculations of depth, core dia, pitch dia, Acme threads-its forms, use and calculations. Face plate- its construction safety precaution in holding jobs on face plate. 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. Various material for single point cutting tools, tipped tools, their brazing and grinding process. Tool angles and their effect on cutting various materials.

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3.	Shaping cross dovetails mating jobs male and female. Grinding of form tools.	Cutting speed, feed, depth of cut for slotting, shaping and time calculation. Checking of dovetail grooves with vernier caliper and roller. Their calculations and use of sine bar, slip gauge and dial test indicator. Properties of metals general idea of physical, mechanical properties of metals, colour, weight, hardness toughness, malleability, ductility their effect on machine ability. Use of radius gauges and template. Introduction to jigs and fixtures. Types and uses.
4.	Machining of internal spline and external spline on slotter uses to match each other.	Interchangeability – Limit, Fit, Tolerances and allowances. Introduction and their indexing process on a slotter by its rotary table graduations. Form tool for slotting machines. Calculation for spur gear in relation to graduation of circular table.
5.	Cutting external and internal sprocket teeth on slotting machine, use of rotary table.	Calculation for cutting sprocket. Tool setting for dovetail use of relevant tool and their grinding process. Alignment of long jobs with precision instruments. 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.

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6.	Boring a cast block on a vertical milling machine, measurement of bore size. Demonstration of marking system of Grinding wheels. Surface grinding practices.	Vertical milling machines its parts, construction, method of boring in a vertical milling. Difference between horizontal and vertical milling machine. Elements of milling cutter Rake angle, primary, secondary and clearance angles, lead etc. 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.
7.	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, guide ways, LM guides, console, electrical, coolant system, hydraulic system, chip conveyor. Working of parts explained using multimedia CNC simulator. Parts shown on machine. CNC part programming with simple exercises and various programming codes. Practice on CNC machine simulator.	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 teachware. Parts shown on machine. Programming – G code & M code, 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 and depth of cut. Process planning, tool selection and cutting parameters selection. Explained using multimedia CNC teachware and CNC machine simulator.

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8.	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 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.	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 teachware. Surface finish. Surface roughness related BIS symbols
9.	Make operation sequence for different operations (milling , drilling ,shaping, slotting) 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. TPM (Total Production Management), TQM (Total Quality Management). Spiral introduction, type and elements. Difference between helix & spiral. Difference between R.H. and L.H. helix.
10.	Milling gears by differential indexing, Measuring the teeth with a vernier gear tooth caliper.	Spiral-lead, helix angle and calculation. Cam Introduction development and use. 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. Cam-lobe, lead setting of dividing head, Calculation. Vernier gear tooth caliper, its construction and application in checking gear tooth.

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11.	Milling spline (external) Milling straight fluted Reamer. Milling a helical groove in a vertical milling machine.	Introduction to broaching methods of milling splines. Its calculations and selection of cutters. 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. Cam-types, application in modern m/c. tools, its special advantages, manufacturing process, calculation for milling a drum cam. 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.
12.	Milling a rack. Cutting worm and worm wheel on a milling machine, gashing and finishing.	Introduction to rack, its use & application. Rack cutting attachment, calculation for linear pitch, circular pitch, Gear ratio, Indexing movement, etc. Introduction, geometry and use of worm and worm wheel.
13.	Revision & Internal Assessment	

NOTE: -

- *More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of related industry operations may be shown to the trainees to give a feel of Industry and their future assignment.*

9. SYLLABUS - CORE SKILLS

9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERING DRAWING

Block – I		
Sl. No.	Workshop Calculation and Science (Duration: - 20 hrs.)	Engineering Drawing (Duration : - 30 hrs.)
1.	Units & Measurements- FPS, CGS, MKS/SI unit, unit of length, Mass and time. Fundamentals and derived units Conversion of units and applied problems.	Engineering Drawing: Introduction and its importance Different types of standards used in engineering drawing. Drawing Instruments: their uses 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.
2.	Material Science : properties -Physical & Mechanical, Types -Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals.	Lines : types and applications in Drawing as per BIS SP:46-2003 Drawing geometrical object using all types of lines. Drawing of Geometrical Figures: Angle, Triangle, Square, Rectangle and Circle. Letters: - Lettering styles, Single stroke letters and numbers as per IS standard. Lettering practice
3.	Mass .Weight and Density : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density,	Dimensioning- Types of dimension, elements of dimensions, Methods of indicating Values, Arrangement, Alignment and indication of dimensions. Scales:- Types use and construction. Representative factor of scale.
4.	Speed and Velocity: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation. Average Velocity, Acceleration & Retardation. Related problems. Circular Motion: Relation between circular motion and Linear motion,	Method of presentation of Engineering Drawing - Pictorial View - Orthogonal View - Isometric view

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	Centrifugal force, Centripetal force	
5.	Ratio & Proportion : Simple calculation on related problems. Percentage: Introduction, Simple calculation.	Constructions: - Draw proportionate free hand sketches of plane figures. Sketch horizontal, vertical and inclined line by free hand, Draw circles by free hand using square and radial line method, Draw arcs and ellipse by free hand
6.	Work, Power and Energy: 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. Meaning of H.P., I.H.P., B.H.P., and F.H.P. and CC and Torque.	Projections: Concept of axes plane and quadrant. Orthographic projections Method of first angle and third angle projections (definition and difference) Symbol of 1 st angle and 3 rd angle projection as per IS specification. Free hand Drawing of Orthographic projection from isometric/3D view of geometrical blocks

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Block – II		
Sl. No.	Workshop Calculation and Science (Duration: - 20 hrs.)	Engineering Drawing (Duration : - 30 hrs.)
1.	Algebra: Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	Screw :- Its Types and Sizes, Screw thread, their standard forms as per BIS, external and internal thread.
2.	Heat & Temperature: 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.	Rivets and Joints:- Prepare a drawing sheet on rivets nomenclature and Joints.
3.	Mensuration: Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle, Volume of solids - cube, cuboid, cylinder and Sphere. Surface area of solids -cube, cuboid, cylinder and Sphere. Volume of cut-out solids: hollow cylinders, frustum of cone, block section. Volume of simple solid blocks.	Free hand Sketches for simple pipe line with general fittings.
4.	Basic Electricity: Introduction, use of electricity, how electricity is produced, Types 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. Concept of earthing.	Reading of drawing. Simple exercises related to missing lines, dimensions. How to make queries.
5.	Simple machines Transmission of power: - Transmission of power by belt, pulleys & gear drive. Heat treatment process: - Heat treatment and advantages. Annealing, Normalizing, Hardening, Tempering.	Simple exercises related to trade related symbols. Basic electrical and electronic symbols
6.	Trigonometry: Trigonometrical ratios, measurement of angles. Trigonometric tables. Finding the value of unknown sides and angles of a triangle by Trigonometrical method. Finding height and distance by trigonometry. Application of trigonometry in shop	Free hand sketch of trade related components / parts /cutting tool indicating angles.

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	problems. (viz. taper angle calculation). Calculate the area of triangle by using trigonometry and application of Pythagoras theorem.	
7.	Concept of pressure - Definition:- Force, Pressure, and their units, atmospheric pressure, gauges used for measuring pressure, problems. Introduction to pneumatics & hydraulics systems.	



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9.2 EMPLOYABILITY SKILLS

(DURATION: - 110 HRS.)

Block – I (Duration – 55 hrs.)	
1. English Literacy Duration : 20 Hrs. Marks : 09	
Pronunciation	Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)
Functional Grammar	Transformation of sentences, Voice change, Change of tense, Spellings.
Reading	Reading and understanding simple sentences about self, work and environment
Writing	Construction of simple sentences Writing simple English
Speaking / Spoken English	Speaking with preparation on self, on family, on friends/ classmates, on know, 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.
2. I.T. Literacy Duration : 20 Hrs. Marks : 09	
Basics of Computer	Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.
Computer Operating System	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.
Word processing and Worksheet	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.
Computer Networking and Internet	Basic of computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks), 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. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.
3. Communication Skills Duration : 15 Hrs. Marks : 07	

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Introduction to Communication Skills	Communication and its importance Principles of Effective communication Types of communication - verbal, non verbal, written, email, talking on phone. Non verbal communication -characteristics, components-Para-language Body language Barriers to communication and dealing with barriers. Handling nervousness/ discomfort.
Listening Skills	Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening. Triple- A Listening - Attitude, Attention & Adjustment. Active Listening Skills.
Motivational Training	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.
Facing Interviews	Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview.
Behavioral Skills	Problem Solving Confidence Building Attitude
Block – II	
Duration – 55 hrs.	
4. Entrepreneurship Skills	
Duration : 15 Hrs. Marks : 06	
Concept of Entrepreneurship	Entrepreneur - Entrepreneurship - Enterprises:-Conceptual issue Entrepreneurship vs. management, Entrepreneurial motivation. Performance & Record, Role & Function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, The process of setting up a business.
Project Preparation & Marketing analysis	Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of PLC, Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.
Institutions Support	Preparation of Project. Role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme.
Investment Procurement	Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.
5. Productivity	

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Duration : 10 Hrs.		Marks : 05
Benefits	Personal / Workman - Incentive, Production linked Bonus, Improvement in living standard.	
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.	
6. Occupational Safety, Health and Environment Education		
Duration : 15 Hrs.		Marks : 06
Safety & Health	Introduction to Occupational Safety and Health importance of safety and health at workplace.	
Occupational Hazards	Basic Hazards, Chemical Hazards, Vibroacoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.	
Accident & safety	Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.	
First Aid	Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person.	
Basic Provisions	Idea of basic provision legislation of India. safety, health, welfare under legislative of India.	
Ecosystem	Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.	
Pollution	Pollution and pollutants including liquid, gaseous, solid and hazardous waste.	
Energy Conservation	Conservation of Energy, re-use and recycle.	
Global warming	Global warming, climate change and Ozone layer depletion.	
Ground Water	Hydrological cycle, ground and surface water, Conservation and Harvesting of water.	
Environment	Right attitude towards environment, Maintenance of in-house environment.	
7. Labour Welfare Legislation		
Duration : 05 Hrs.		Marks : 03
Welfare Acts	Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.	
8. Quality Tools		
Duration : 10 Hrs.		Marks : 05
Quality Consciousness	Meaning of quality, Quality characteristic.	

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Quality Circles	Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to starting Quality Circles, Steps for continuation Quality Circles.
Quality Management System	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.
House Keeping	Purpose of House-keeping, Practice of good Housekeeping.
Quality Tools	Basic quality tools with a few examples.



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10. DETAILS OF COMPETENCIES (ON-JOB TRAINING)

BROAD LEARNING TO BE COVERED IN INDUSTRY FOR MACHINIST TRADE:

1. Understand how to perform best practices basic Industrial Culture with safety using various tools like 5S, Kaizen etc.)
2. Record keeping and documentation related to various shop floor practices.
3. Understand blue prints of drawings and choose proper machining process, tool, equipments.
4. Manufacture of components using different metal removing methods and perform different Machining operations as per drawings using available machine, tool and equipments.
5. Manufacture of machine parts by coping from available parts.
6. Grind the cutting tools as per requirements of the relevant operations.
7. Manufacture of different components as per requirement and check dimensions.
8. Identify various parts of CNC machines, produce basic part programming and understand tool setting parameters theoretically.
9. Carry out basic preventive maintenance of various machines and tools.

Note: Actual training will depend on the existing facilities available in the establishments.

The **competencies/ specific outcomes** on completion of On-Job Training are detailed below: -

Block – I (09 months)

1. Safety and best practices/Basic Industrial Culture (5S, KAIZEN, LEAN, CONCEPT etc.)
2. Prepare different types of documentation as per industrial need by different methods of recording information such as Route Card, Hydro test report, Job Card, MR Slip.
3. Perform marking out the components for filing, drilling, and operations such as milling & turning.
4. Plan and organize the work for different types of fitting operations and check for work result.
5. Blueprint reading of technical documents - part, assembly drawings.
6. Produce finished components by performing different shaping & slotting operation and check for accuracy without any assistance.
7. Produce finished components by performing different planing operation and check for accuracy without any assistance. (Optional)
8. Produce finished components by performing different lathe operations and check for accuracy without any assistance.
9. Produce finished components to perform different milling operations and check for accuracy without any assistance.

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10. Perform preventive maintenance of lathe, shaping, slotting, planning, and milling machines.

Block – II (09 months)

11. Process planning - machining sequence, cutting tools selection, cutting parameters, work holding devices.
12. Produce different forms of threads viz., “V”, Square and Acme thread applying basic methods, machine tools, materials and information.
13. Work out and apply cutting parameters for different turning, drilling & milling operations with different work and tool material for producing quality output.
14. Grind Form tool and parallel & stepped using grinding machine with accuracy using appropriate tools & materials and with required quality.
15. 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.
16. Produce different components by performing different operation viz., step milling, straddle milling, square & hexagonal milling, T-slot & dovetail milling using milling machine with clear choice of procedures.
17. Demonstrate practical skills to ream the drilled hole using radial drill machine.
18. Make different components viz., spur gear, helical, Bevel, worm & worm wheel, rack & pinion by setting the milling machine.
19. Produce different components viz., end mill/drum cam, face cam, plate cam using milling machine and by applying quality concept.
20. Manufacture different components viz., spline (external), straight fluted reamer, cylindrical cutter, slab milling cutter, twist drill using milling machine with clear choice of procedures.
21. CNC part programming, operations and machine settings virtually and practically.
22. Set and operate CNC Vertical Machining Centre (3 – axes) to produce components by preparing part programmes.
23. Preventive maintenance of CNC machines.
24. Set and operate surface & cylindrical grinder to produce components and check the job accuracy without anybody help.
25. Perform TPM (Total Productive Maintenance), TQM (Total Quality Management) and record keeping system.

Note:

1. Industry must ensure that above mentioned competencies are achieved by the trainees during their on job training.
2. In addition to above competencies/ outcomes industry may impart additional training relevant to the specific industry.

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

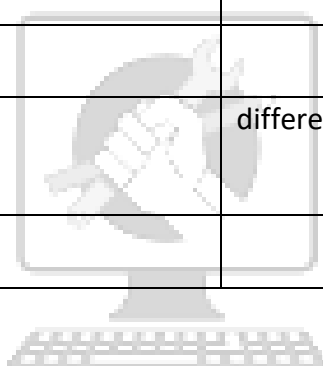
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LIST OF TOOLS AND EQUIPMENT for Basic Training (For 20 Apprentices)			
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-18 is required additionally)			
Sl. no.	Name of the Tool & Equipments	Specification	Quantity
1	Steel rule	30 cm graduated both in English & Metric units	16 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	150 mm	8 nos.
7	B.P. Hammer	0.5 kg.	16 nos.
8	Cold chisel flat	25 x 200 mm	16 nos.
9	File flat bastard	300 mm	16 nos.
10	File flat 2 nd cut	250 mm	16 nos.
11	File flat smooth	200 mm	16 nos.
12	Engineers screw driver		16 nos.
13	Combination Pliers	150 mm	16 nos.
14	Safety glasses		16 nos.

B : INSTRUMENTS & GENERAL SHOP OUTFIT			
Sl. no.	Name of the Tool & Equipments	Specification	Quantity
1.	Surface plate	400 mm x 400mm grade	1 no.
2.	Table for surface plate	900 x 900 x 1200 mm	1 no.
3.	Marking off table	1200 x 1200 x 900 mm high	1 no.
4.	Scribing block universal	300 mm	2 nos.
5.	V- Block	100/7 – 80 – A	2 nos.
6.	Try square	300 mm	2 nos.
7.	Outside spring caliper	200 mm	2 nos.
8.	Divider spring	200 mm	2 nos.
9.	Inside spring caliper	200 mm	2 no.
10.	Straight edge steel	1 meter	1 no.
11.	Straight edge steel	500 mm	1 no.
12.	Steel tape	2 meter in case	1 no
13.	Steel rule	60 cm graduated both in English & Metric units	2 nos.
14.	Sprit level	2V 250, 05 meter	1no
15.	B.P. Hammer	800 gms. With handle	4 nos.
16.	Screw driver, heavy duty	300 mm with handle	4 nos.
17.	Hammer lead	1 kg.	2 nos.
18.	Spindle blade screw driver	100 mm	4 nos.
19.	Allen Hexagonal keys	2.5 to 12	2 sets
20.	Spanner	D.E. series 2 (set of 7 pieces)	6 sets
21.	Adjustable spanner	300 mm	2 nos.

B : INSTRUMENTS & GENERAL SHOP OUTFIT			
Sl. no.	Name of the Tool & Equipments	Specification	Quantity
22.	Reduction sleeve	Morse Taper 1-1, 3-1, 4-1, 4-2, 5-1, 5-2, 6-1	2 nos. each
23.	Angle plate size	200 x 100 x 200 mm	2 nos.
24.	Angle plate adjustable	250 x 150 x 175 mm	2 nos.
25.	Solid parallels	in pairs (different sizes) in Metric	12 pairs (assorted)
26.	Oil Can pressure feed	500 mg.	6nos
27.	Oil stone	150 x 50 x 25 mm	2nos
28.	Number drills	H.S.S. (parallel shank)	1set
29.	Twist drills	3 mm to 13 mm in step of 0.5 mm (parallel shank)	2set
30.	Drill Chuck	0.20 with taper shank	1no
31.	Centre drill	A 1 to 5	2set
32.	Grinding wheel dresser	Diamond	1no
33.	Grinding wheel dresser	Huntington type	2 nos.
34.	Clamps	C type 100 mm	2nos
35.	Clamps	C type 200 mm	2nos
36.	Tap and Die set in box	metric pitch (6 mm to 12 mm)	1set
37.	Drill	H.S.S. taper shank (6 mm to 12 mm in step of 0.5 mm)	2set
38.	File	flat 2 nd cut 250 mm	4nos
39.	File	flat smooth 200 mm	4nos

B : INSTRUMENTS & GENERAL SHOP OUTFIT			
Sl. no.	Name of the Tool & Equipments	Specification	Quantity
40.	File	Half round 2 nd cut 250 mm	4nos
41.	File	triangular smooth 200 mm	4nos
42.	Needle file	Set	1no.
43.	File	square 2 nd cut 250 mm	4nos
44.	Reamer	6 mm to 25 mm by 1 mm	1set
45.	Reamer adjustable	10 mm to 15 mm by 75 mm	1set
46.	Tool bits	H.S.S. 6 mm square	1 Dozen
47.	Tool bits	H.S.S. 10 mm square	1 Dozen
48.	Tool bits holder	Armstrong L.H.	4nos
49.	Tool bits holder	Armstrong R.H.	4nos
50.	Assorted tools and bit holders for lathe, shaper, slotter & planner	different shapes and sizes	As required
51.	Hacksaw frame	adjustable 250-300 mm with blades	2nos
52.	Table chuck	75 mm jaw swivel base	1no
53.	Machine vice	200 mm swivel base	4nos
54.	Machine vice 160 mm swivel base	160 mm swivel base	2nos
55.	Hand vice	50 mm jaw	2nos
56.	Radius turning attachment		1no
57.	Angle turning attachment		1no
58.	Compound angle vice	standard size	1no
59.	Universal vice	150 mm	1no

B : INSTRUMENTS & GENERAL SHOP OUTFIT			
Sl. no.	Name of the Tool & Equipments	Specification	Quantity
60.	Universal table angle plate		1no
61.	Shaper tool holder	turret type	2nos
62.	Base chuck for slotter		1no
63.	shaper indexing center		1no
64.	Knurling tools	set of 3 straight and diamond	1each
65.	Plier cutting	200 mm	2nos
66.	Carbide tipped tools	different sizes and shapes (throw away tips)	2sets
67.	Hand hammers	1 kg. With handle	2nos



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C: MILLING CUTTERS			
Sl. no.	Name of the Tool & Equipments	Specification	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°/100	2 nos.
10	Equal angle cutter	60°/100	2 nos.
11	Equal angle cutter	90°/100	2 nos.
12	Double angle unequal cutter	50 x 12 x 55°	2 nos.
13	Double angle unequal cutter	50 x 12 x 60°	2 nos.
14	Double angle unequal cutter	50 x 12 x 70°	2 nos.
15	Double angle unequal cutter	50 x 12 x 75°	1 no
16	Single angle cutter	63 x 18 x 45° RH	1 no
17	Single angle cutter	63 x 18 x 45° LH	1 no
18	Single angle cutter	63 x 18 x 60° RH	1 no
19	Single angle cutter	63 x 18 x 60° 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.

C: MILLING CUTTERS			
Sl. no.	Name of the Tool & Equipments	Specification	Quantity
22	Shell End Mill	$\varnothing 50 \times 36 \times \varnothing 22$ (preferably inserted tip type)	2 nos.
23	Shell End Mill	$\varnothing 75 \text{ mm} \times 50 \times \varnothing 22$ (preferably inserted tip type)	2 nos.
24	Parallel shank end mills	$\varnothing 6$, $\varnothing 10$ and $\varnothing 16$ are (double fluted), $\varnothing 20 \text{ mm}$ & $\varnothing 25 \text{ mm}$ (four fluted)	4 nos. each
25	'T' slot cutter with parallel shank	$\varnothing 17.5 \times 8 \text{ mm}$ width x dia. of shank 8 mm	2 nos.
26	Concave Milling cutter	$\varnothing 63 \times 6 \text{ radius} \times \varnothing 27 \text{ mm}$	1 nos.
27	Convex Milling cutter	$\varnothing 63 \times 6 \text{ radius} \times \varnothing 27 \text{ mm}$	1 nos.
28	Disc type form milling cutter	involute form -2 module, 20° pressure angle	1 set

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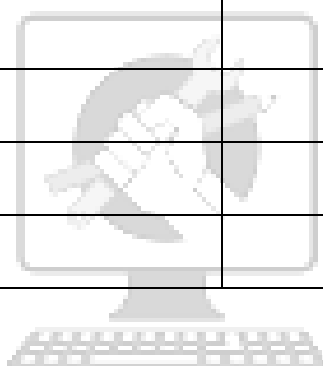
D: MEASURING INSTRUMENTS			
Sl. no.	Name of the Tool & Equipments	Specification	Quantity
1	Micrometer outside	0-25 mm	4 nos
2	Micrometer outside	25-50 mm	2 no
3	Micrometer outside	50-75 mm	1 no
4	Micrometer depth gauge	0-200 mm	1no
5	Digital micrometer	0-25 mm	1 no
6	Direct reading vernier caliper	0- 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	300 mm rule	2 sets
11	Vernier bevel protractor	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	magnetic gauge type 1 grade A with magnetic base	1 no
16	Center gauge	60°	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 m by 2.5 mm (GO &	1 set

D: MEASURING INSTRUMENTS			
Sl. no.	Name of the Tool & Equipments	Specification	Quantity
		NO GO)	
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



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E: FURNITURE			
Sl. no.	Name of the Tool & Equipments	Specification	Quantity
1	Steel lockers for	<i>For 16 trainees</i>	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



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F : General Machinery Shop outfit			
Sl. no.	Name of the Tool & Equipments	Specification	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	1no
4	Slotter	180 mm stroke (motorized) with all attachments	1no
5	SS and SC centre lathe (all geared) with	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	1no
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	with minimum specification as: Table Length x width 1200 x 300 mm having motorized up & down movement along with auto feed arrangement and with	2 nos.

F : General Machinery Shop outfit			
Sl. no.	Name of the Tool & Equipments	Specification	Quantity
		following attachments such as: a. Vertical head b. Slotting attachment c. Rack cutting attachment d. Rotary table e. Dividing head Adaptors, arbors and collects etc. for holding straight shank drills and cutters from 3 mm to 25 mm.	
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	1no
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 reciprocating table having longitudinal table traverse 200 mm (or near) fully automatic and fitted with adjustable traverse stops, machine to be fully motorized and fitted with ace guards and pumps, tank and pump fittings and also to be supplied with magnetic chuck 250 x 112 mm.	1 no

F : General Machinery Shop outfit			
Sl. no.	Name of the Tool & Equipments	Specification	Quantity
		Diamond tool holder, set of spanners, grease gun, oil-can and spare grinding wheel for general purpose grinding.	
15	Cylindrical grinder	Max. grinding length 300 mm Height of centre 130 mm Max. distance between centers 340 mm	1 no
16	CNC Vertical Machining Centre with minimum specification as:	Table size: 500x250mm Travel X-axis x Y-axis x Z-axis: 300 x 250 x 250mm Auto Tool Changer: 8 nos. Spindle power: 3.7kW (continuous rating) with popular control system like Fanuc/Siemens along with motorized coolant system.	1 No.
17	a) Multimedia teach ware/courseware for CNC technology and interactive CNC part programming software for turning & milling with virtual machine operation and simulation using popular operation control system such as Fanuc, Siemens, etc. (Web-based or licensed based) (10 trainees + 1 faculty) b) Desktop with MS-Windows-7 or latest to run above software, networked on LAN.		a) 11 users b) 11 nos.
18	CNC milling tools assorted such as adapter to suit above machine to		2 sets along

F : General Machinery Shop outfit			
Sl. no.	Name of the Tool & Equipments	Specification	Quantity
	accommodate face cutter, shell end mill cutter, taper shank and parallel shank drills/cutters.		with cutters & inserts.
19	CNC hole machining tools assorted such as adapter to suit above machine to accommodate different boring bars.		2 sets along with cutters
20	LCD projector / large screen TV		1 no.

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: MACHINIST

LIST OF TOOLS & EQUIPMENTS FOR -16 APPRENTICES

1) **Space Norms** : 45 Sq. m. (For Engineering Drawing)

2) **Infrastructure:**

A : TRAINEES TOOL KIT:-			
Sl. No.	Name of the items	Specification	Quantity
1.	Draughtsman drawing instrument box		16 set
2.	Set square celluloid 45° (250 X 1.5 mm)		16 set
3.	Set square celluloid 30°-60° (250 X 1.5 mm)		16 set
4.	Mini drafter		16 set
5.	Drawing board (700mm x 500 mm) IS: 1444		16 set
B : Furniture Required			
Sl. No.	Name of the items	Specification	Quantity
1	Drawing Board		16
2	Models : Solid & cut section		as required
3	Drawing Table for trainees		as required

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4	Stool for trainees		as required
5	Cupboard (big)		01
6	White Board (size: 8ft. x 4ft.)		01
7	Trainer's Table		01
8	Trainer's Chair		01

TOOLS & EQUIPMENTS FOR EMPLOYABILITY SKILLS		
Sl. No.	Name of the Equipment	Quantity
1.	Computer (PC) with latest configurations and Internet connection with standard operating system and standard word processor and worksheet software	10 Nos.
2.	UPS - 500VA	10 Nos.
3.	Scanner cum Printer	1 No.
4.	Computer Tables	10 Nos.
5.	Computer Chairs	16 Nos.
6.	LCD Projector	1 No.
7.	White Board 1200mm x 900mm	1 No.
Note: - Above Tools & Equipments not required, if Computer LAB is available in the institute.		

ANNEXURE-II

FORMAT FOR INTERNAL ASSESSMENT

Name & Address of the Assessor :				Year of Enrollment :									
Name & Address of ITI (Govt./Pvt.) :				Date of Assessment :									
Name & Address of the Industry :				Assessment location: Industry / ITI									
Trade Name :		Semester:		Duration of the Trade/course:									
Learning Outcome:													
Sl. No	Maximum Marks (Total 100 Marks)	15	5	10	5	10	10	5	10	15	15	Total internal assessment Marks	Result (Y/N)
	Candidate Name	Father's/Mother's Name	Safety consciousness	Workplace hygiene	Attendance/Punctuality	Ability to follow Manuals/ Written instructions	Application of Knowledge	Skills to handle tools & equipment	Economical use of materials	Speed in doing work	Quality in workmanship	VIVA	
1													
2													