



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

COMPETENCY BASED CURRICULUM

TURNER

(Duration: Two Years)

**CRAFTSMEN TRAINING SCHEME (CTS)
NSQF LEVEL- 5**



SECTOR – PRODUCTION & MANUFACTURING

TURNER

(Revised in 2017)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 5

Skill India

कौशल भारत - कुशल भारत

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

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1. COURSE INFORMATION

During the 02 years duration a candidate is trained on subjects Professional Skill, Professional Knowledge, Engineering Drawing, Workshop Science & Calculation and Employability Skills. In addition to this a candidate is entrusted to make/do project work and Extra Curricular Activities to build up confidence. The practical skills are imparted in simple to complex manner & simultaneously theory subject is taught in the same fashion to apply cognitive knowledge while executing task. The practical part starts with basic fitting & turning and executes complex turning operation both in conventional lathe and CNC turn centre at the end of the course. The broad components covered under Professional Skill subject are as below:

Semester-I: The practical part starts with basic fitting & different turning including setting of different shaped job on different chucks. The different turning operations – Plain, Facing, Drilling, Boring (counter and stepped) Grooving, Parallel turning, Stepped turning, Parting, Chamfering, U-cut, Reaming, Internal recess & Knurling. The skills on grinding of different cutting tools viz., V tool, side cutting, parting and thread cutting (both LH & RH) are also imparted. During this period the testing alignment of lathe by checking different parameters viz., axial slip of main spindle, true running of head stock, parallelism of main spindle and alignment of both the centres are also covered. The observation of all safety aspects is mandatory during execution any task. The safety aspects covers components like OSH&E, PPE, Fire extinguisher, First Aid and in addition 5S being taught.

Semester-II: This section covers setting of different components (Form tool, Compound slide, Tail stock offset, taper turning attachment) & parameters (feed, speed, depth of cut) of lathe for taper/ angular turning of jobs. Different boring operations (plain, stepped and eccentric) are also undertaken to gain the skill in producing components involving such operations. Different thread cutting (BSW, Metric, Square, ACME, Buttress) by setting machining parameters are being taught in the practical. The use different accessories of lathe (Driving Plate, Steady rest, dog carrier and different centres) are also part of the practical training. During this period the basic maintenance and preventive maintenance of lathe and grinding machine are also covered.

Semester-III: On achieving above mentioned skill sets the candidate is engaged in producing different precision of engineering component with an appropriate accuracy ($\pm 0.02\text{mm}$). The machining of different irregular shaped job using different lathe accessories and also producing different utility items viz., Crank Shaft (single throw), Stub arbor, etc. are covered to enhance their competency and perform the job as per practical requirement. The machining of different components along with assembly of such components (male & female) by performing different turning activities is also covered. The accuracy achieved is of an accuracy of $\pm 0.02\text{ mm}$ outside and $\pm 0.05\text{mm}$ for inside turning.

Semester-IV: A dedicated time of 13 weeks devoted for CNC operations which involve setting both job and tools and operating the CNC turn centre to produce components as per drawing by preparing part programmes. The candidate gets enough training both on multi-media based CNC simulated and on actual intermediate production based CNC machine. The candidate is also imparted training on process plan to produce components by performing special operation on lathe viz., worm shaft cutting and also producing different engineering components viz., drill chuck, collet chuck, screw jack, box nut etc., to develop competency in producing components which is tangible and significant in work and industry ready for executing such work as per demand.

Professional Knowledge subject is simultaneously taught in the same fashion to apply cognitive knowledge while executing task. In addition components like cutting tools and its specification, method of brazing and soldering, calculation involving gear ratio and gearing, and tool life, lubrication and functions, jigs and fixtures, interchangeability, quality control procedure and technical English are also covered under theory part.

Total three projects need to be completed by the candidates in a group. In addition to above components the core skills components viz., Workshop calculation & science, Engineering drawing, employability skills are also covered. These core skills are essential skills which are necessary to perform the job in any given situation.



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2. TRAINING SYSTEM

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.

Turner trade under CTS is one of the most popular courses delivered nationwide through network of ITIs. The course is of two years (04 semester) 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 skill & knowledge and life skills. After passing out the training programme, the trainee is being awarded National Trade Certificate (NTC) by NCVT having worldwide recognition.

Candidates need broadly to demonstrate that they are able to:

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

2.2 CAREER PROGRESSION PATHWAYS:

- Can appear in 10+2 examination through National Institute of Open Schooling (NIOS) for acquiring higher secondary certificate and can go further for General/ Technical education.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.

2.3 COURSE STRUCTURE:

The training duration of course in hours during a period of two years (04 semesters) is as follows -

Sl. No.	Course Element	Notional Training Hours
1	Professional Skill (Trade Practical)	2209
2	Professional Knowledge (Trade Theory)	510
3	Workshop Calculation & Science	170
4	Engineering Drawing	255
5	Employability Skills	110
6	Library & Extracurricular activities	146
7	Project work	240
8	Revision & Examination	520
	Total	4160

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. 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 NTC will be conducted by NCVT at the end of each semester 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 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%. For the purposes of determining the overall result, 25% weightage is applied to the result of each semester examination.

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 scarp/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

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) Weightage 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.	<ul style="list-style-type: none"> • Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • Below 70% tolerance dimension achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b) Weightage in the range of above75% - 90% to be allotted during assessment	
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.	<ul style="list-style-type: none"> • 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

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 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.



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Brief description of Job roles:

Turner: Lathe Operator makes metal articles to required specifications using lathe and cutting tools. Studies drawings and other specifications of parts to be made. Selects metal, holds it in chuck, fixture on lathe as required, centres it by manipulating chuck jaws or otherwise using dial indicator or marking block and securely tightens it in position. Selects correct cutting tool, grinds it if necessary and holds it tight in tool post at correct height. Sets feed and speed and starts machine. Manipulates hand wheels or starts automatic controls to guide cutting tool into or along metal. Controls flow of coolant (cutting lubricant) on edge of tool. Arranges gears in machine to obtain required pitch for screw cutting. Calculates tapers and sets machine for taper turning, controls lathe during operation by means of hand wheels and levers and frequently checks progress of cutting with measuring instruments such as calipers and rule, micrometers, etc. Stops machine, removes completed part and checks it further with instruments to ensure accuracy. Repeats operations if necessary. Cleans and oils machine. Demonstrate the setting & operation of CNC turning machine and produce components as per drawing by preparing part programmes. May be designated as Turner according to nature of work done. May improvise devices and make simple adjustments to machine. May recondition lathe tools.

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.

May be designated as TURNER according to nature of work done

Reference NCO:

i) NCO-2015:7223.0601

4. NSQF LEVEL COMPLIANCE

NSQF level for Turner 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 Turner trade under CTS 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	TURNER
NCO - 2015	7223.0601
NSQF Level	Level – 5
Duration of Craftsmen Training	Two years (Four semesters each of six months duration).
Entry Qualification	Passed 10 th Class with Science and Mathematics under 10+2 system of Education or its equivalent
Unit Strength (No. Of Student)	12 (Max. supernumeraries seats: 4)
Space Norms	110 Sq.m
Power Norms	18.5 KW
Instructors Qualification for	
1. Turner Trade	<p>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 10th Class Pass + NTC/NAC in the Trade of “Turner” With 3 years post qualification experience in the relevant field.</p> <p>Desirable: - Preference will be given to a candidate with CIC (Craft Instructor Certificate) in Turner trade.</p> <p><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.</i></p>
2. Workshop Calculation & Science	<p>Degree in Engineering with one year experience. OR Diploma in Engineering with two years experience. Desirable: Craft Instructor Certificate in RoD & A course under NCVT.</p>
3. Engineering Drawing	<p>Degree in Engineering with one year experience. OR Diploma in Engineering with two years experience. OR NTC / NAC in the Draughtsman (Mechanical) with three years experience.</p>

	Desirable: Craft Instructor Certificate in RoD & A course under NCVT.					
4. Employability Skill	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 DGT institutes. AND Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above. OR Existing Social Studies Instructors duly trained in Employability Skills from DGT institutes					
List of Tools and Equipment	As per Annexure – I					
Distribution of training on Hourly basis: (Indicative only)						
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

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6. LEARNING/ ASSESSABLE OUTCOME

6.1 GENERIC LEARNING OUTCOME

The following are minimum broad Common Occupational Skills/ Generic Learning Outcome after completion of the Turner course of 02 years duration:

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, graph, Statistics, Centre of gravity, 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, Estimation of material, 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

Semester – I

9. Plan and organize the work to make job as per specification applying different types of basic fitting operations & check for dimensional accuracy. [*Basic Fitting Operation – Marking, Hack sawing, filing, drilling, tapping etc.*]
10. Set different shaped jobs on different chuck and demonstrate conventional lathe machine operation observing standard operation practice. [*Different chucks: - 3 jaws & 4 jaws, different shaped jobs: - round, hexagonal, square*]
11. Prepare different cutting tool to produce jobs to appropriate accuracy by performing different turning operations. [*Different cutting tool – V tool, side cutting, parting, thread cutting (both LH & RH), Appropriate accuracy: - $\pm 0.06\text{mm}$, Different turning operation – Plain, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U-cut, Reaming, internal recess, knurling.*]
12. Test the alignment of lathe by checking different parameters and adjust the tool post. [*Different parameters – Axial slip of main spindle, true running of head stock, parallelism of main spindle, alignment of both the centres.*]

Semester – II

13. Set different components of machine & parameters to produce taper/ angular components and ensure proper assembly of the components. [*Different component of machine: - Form tool, Compound slide, tail stock offset, taper turning attachment. Different machine parameters- Feed, speed, depth of cut.*]
14. Set the different machining parameter & tools to prepare job by performing different boring operations. [*Different machine parameter- Feed, speed & depth of cut; Different boring operation – Plain, stepped & eccentric*]
15. Set the different machining parameters to produce different threaded components applying method/ technique and test for proper assembly of the components. [*Different thread: - BSW, Metric, Square, ACME, Buttress.*]
16. Set the different machining parameter & lathe accessories to produce components applying techniques and rules and check the accuracy. [*Different machining parameters: - Speed, feed & depth of cut; Different lathe accessories: - Driving Plate, Steady rest, dog carrier and different centres.*]
17. Plan and perform basic maintenance of lathe & grinding machine and examine their functionality.

Semester – III

18. Plan & set the machine parameter to produce precision engineering component to appropriate accuracy by performing different turning operation. [*Appropriate accuracy - $\pm 0.02\text{mm}$ / (MT - 3) (proof turning); Different turning operation – Plain turning, taper turning, boring threading, knurling, grooving, chamfering etc.*]
19. Set & Produce components on irregular shaped job using different lathe accessories. [*Different Lathe accessories: - Face plate, angle plate*]
20. Plan and set the machine using lathe attachment to produce different utility component/ item as per drawing. [*Different utility component/ item – Crank shaft (single throw), stub arbour with accessories etc.*]
21. Set the machining parameters and produce & assemble components by performing different boring operations with an appropriate accuracy. [*Different boring operation – eccentric boring, stepped boring; appropriate accuracy - $\pm 0.05\text{mm}$*]
22. Calculate to set machine setting to produce different complex threaded component and check for functionality. [*Different complex threaded component- Half nut, multi start threads (BSW, Metric & Square)*]

Semester – IV

23. Set (both job and tool) CNC turn centre and produce components as per drawing by preparing part programme.
24. Manufacture and assemble components to produce utility items by performing different operations & observing principle of interchangeability and check functionality. [*Utility item: - screw jack/ vice spindle/ Box nut, Marking block, drill chuck, collet chuck etc.; different operations: - threading (Square, BSW, ACME, Metric), Thread on taper, different boring (Plain, stepped)*]
25. Make a process plan to produce components by performing special operations on lathe and check for accuracy. [*Accuracy - $\pm 0.02\text{mm}$ or proof machining & $\pm 0.05\text{mm}$ bore; Special operation – Worm shaft cutting (shaft) boring, threading etc.*]

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

7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING/ ASSESSABLE OUTCOME	
LEARNING/ ASSESSABLE OUTCOME	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 Productive Equipment (PPE) and use the same as per related working environment.
	1. 10. Identify basic first aid and use them under different circumstances.
	1. 11. Identify different fire extinguisher and use the same as per requirement.
	1. 12. Identify environmental pollution & contribute to 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 field of study including basic electrical and	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, heat treatment, centre of gravity, friction.

<p>apply in day to day work. [Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure]</p>	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.
<p>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, Estimation of material, Electrical & electronic symbol]</p>	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.
<p>4. Select and ascertain measuring instrument and measure dimension of components and record data.</p>	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.
<p>5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.</p>	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.
	5.3 Knows benefits guaranteed under various acts
<p>6. Explain energy conservation, global warming and pollution</p>	6.1 Explain the concept of energy conservation, global warming, pollution and utilize the available recourses

and contribute in day to day work by optimally using 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>Semester-I</u>	
LEARNING/ ASSESSABLE OUTCOMES	ASSESSMENT CRITERIA
9. Plan and organize the work to make job as per specification applying different types of basic fitting operations & check for dimensional accuracy. <i>[Basic Fitting Operation – Marking, Hack sawing, filing, drilling, tapping etc.]</i>	9. 1 Plan & Identify tools, instruments and equipments for marking and make this available for use in a timely manner.
	9. 2 Select raw material and visual inspect for defects.
	9. 3 Mark as per specification applying desired mathematical calculation and observing standard procedure.
	9. 4 Measure all dimensions in accordance with standard specifications and tolerances.
	9. 5 Identify Hand Tools for different fitting operations and make these available for use in a timely manner.
	9. 6 Prepare the job for Hacksawing, chiselling, filing, drilling, tapping, grinding.
	9. 7 Perform basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job.
	9. 8 Observe safety procedure during above operation as per standard norms and company guidelines.

	9.9 Check for dimensional accuracy as per standard procedure.
	9.10 Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
10. Set different shaped jobs on different chuck and demonstrate conventional lathe machine operation observing standard operation practice. <i>[Different chucks: - 3 jaws & 4 jaws, different shaped jobs: - round, hexagonal, square]</i>	10.1 Identify and acquaint with lathe machine operation with its components.
	10.2 Identify different work holding devices and acquaint with functional application of each device.
	10.3 Mount the appropriate work holding device and check for its functional usage to perform turning operations.
	10.4 Set the job on chuck as per shape.
	10.5 Set the lathe on appropriate speed & feed.
	10.6 Operate the lathe to demonstrate lathe operation, observing standard operating practice.
	10.7 Observe safety procedure during above operation as per standard norms and company guidelines.
11. Prepare different cutting tool to produce jobs to appropriate accuracy by performing different turning operations. <i>[Different cutting tool – V tool, side cutting, parting, thread cutting (both LH & RH), Appropriate accuracy: - $\pm 0.06\text{mm}$, Different turning operation – Plain, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U -cut, Reaming, internal recess, knurling.]</i>	11.1 Identify cutting tool materials used on lathe machine as per the specification and their application.
	11.2 Plan and Grind cutting tools
	11.3 Measure the tool angles with gauge and Bevel protractor as per tool signature.
	11.4 Mount the job and set machine parameter.
	11.5 Perform turning operations viz., facing, Parallel Turning, Step Turning, chamfering, grooving, U -cut, parting, drilling, boring (counter & stepped), Reaming, internal recess and knurling to make component as per specification.
	11.6 Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement.
	11.7 Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
12. Test the alignment of lathe by checking different parameters and adjust the tool post. <i>[Different parameters – Axial slip of main spindle, true running of head stock, parallelism of main spindle, alignment of both the centres.]</i>	12.1. Plan for testing alignment of lathe
	12.2. Select appropriate items and tools for testing the alignment.
	12.3. Demonstrate possible solutions and agree tasks within the team.
	12.4. Perform testing of alignment and adjust the tool post as per instruction of machine manual/ standard testing procedure.
	12.5. Check for desired functionality.
	12.6. Record the different parameters in a standard format.

Semester-II	
LEARNING/ ASSESSABLE OUTCOMES	ASSESSMENT CRITERIA
13. Set different components of machine & parameters to produce taper/ angular components and ensure proper assembly of the components. <i>[Different component of machine: - Form tool, Compound slide, tail stock offset, taper turning attachment. Different machine parameters- Feed, speed, depth of cut.]</i>	13. 1. Plan and select appropriate method to produce taper/ angular components.
	13. 2. Evaluate angles to set up the tool and machine component for machining.
	13. 3. Demonstrate possible solutions and agree tasks within the team.
	13. 4. Produce taper/ angular components as per standard operating procedure.
	13. 5. Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement.
	13. 6. Assemble the components to ascertain functionality.
14. Set the different machining parameter & tools to prepare job by performing different boring operations. <i>[Different machine parameter- Feed, speed & depth of cut; Different boring operation – Plain, stepped & eccentric]</i>	14.1 Plan for different boring (Plain, stepped & eccentric), Select appropriate tools and counter balance while holding the work piece as per requirement.
	14.2 Set the different machining parameters as per requirement.
	14.3 Demonstrate possible solutions within the team.
	14.4 Set job and produce component following the standard operating procedure.
	14.5 Measure with instruments/gauges as per drawing.
	14.6 Comply with safety rules when performing the above operations.
	14.7 Avoid wastage, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
15. Set the different machining parameters to produce different threaded components applying method/ technique and test for proper assembly of the components. <i>[Different thread: - BSW, Metric, Square, ACME, Buttress.]</i>	15. 1. Plan and select appropriate method to produce threaded components.
	15. 2. Plan and prepare thread cutting tool in compliance to standard thread parameters.
	15. 3. Produce components as per drawing.
	15. 4. Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement and suit to male /female part.
	15. 5. Test the proper assembly of the threaded components.
16. Set the different machining parameter & lathe accessories to produce	16. 1. Identify different lathe accessories of lathe machine as per functional application.
	16. 2. Mount appropriate lathe accessories to set up a job for

components applying techniques and rules and check the accuracy. [Different machining parameters: - Speed, feed & depth of cut; Different lathe accessories: - Driving Plate, Steady rest, dog carrier and different centres.]	machining.
	16. 3. Observe safety/ precaution during mounting the accessories.
	16. 4. Check for the alignment of accessories to machine as per standard procedure.
	16. 5. Set the machining parameter and produce the component applying technique/ machine.
	16. 6. Check the accuracy of the component using instruments.
17. Plan and perform basic maintenance of lathe & grinding machine and examine their functionality.	17. 1. Plan for periodic and preventive maintenance of lathe/ grinding machine.
	17. 2. Select appropriate items and tools for maintenance.
	17. 3. Demonstrate possible solutions and agree tasks within the team.
	17. 4. Perform maintenance as per schedule of machine manual.
	17. 5. Check for desired functionality.
Semester - III	
LEARNING/ ASSESSABLE OUTCOMES	ASSESSMENT CRITERIA
18. Plan & set the machine parameter to produce precision engineering component to appropriate accuracy by performing different turning operation. [Appropriate accuracy - $\pm 0.02\text{mm}$ / (MT - 3) (proof turning); Different turning operation – Plain turning, taper turning, boring threading, knurling, grooving, chamfering etc.]	18. 1. Plan and select appropriate method to produce components.
	18. 2. Grind form cutting tool.
	18. 3. Set the machine parameters.
	18. 4. Produce components by performing different turning operations as per standard operating procedure and as per drawing.
	18. 5. Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
19. Set & Produce components on irregular shaped job using different lathe accessories. [Different Lathe accessories: - Face plate, angle plate]	19. 1. Plan and select appropriate method to produce irregular shaped components with internal taper turning.
	19. 2. Work out different parameters to set up the tool for machining.
	19. 3. Set the lathe accessories and mount the job.
	19. 4. Produce components as per standard operating procedure by using appropriate tools.
	19. 5. Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
20. Plan and set the machine using lathe attachment to	20. 1. Select appropriate tools and plan for turning and counter balance while holding the work piece as per requirement.

produce different utility component/ item as per drawing. <i>[Different utility component/ item – Crank shaft (single throw), stub arbour with accessories etc.]</i>	20. 2. Comply with safety rules when performing the above operations.
	20. 3. Demonstrate possible solutions within the team.
	20. 4. Set the lathe attachment as per requirement and produce component observing standard operating procedure.
	20. 5. Measure with instruments/gauges as per drawing.
21. Set the machining parameters and produce & assemble components by performing different boring operations with an appropriate accuracy. <i>[Different boring operation – eccentric boring, stepped boring; appropriate accuracy - $\pm 0.05\text{mm}$]</i>	21. 1. Plan for different boring (Plain, stepped & eccentric) and counter balance while holding the work piece as per requirement and select appropriate tools.
	21. 2. Set the different machining parameters as per requirement.
	21. 3. Demonstrate possible solutions within the team.
	21. 4. Set job and produce component following the standard operating procedure.
	21. 5. Measure with instruments/gauges as per drawing.
	21. 6. Comply with safety rules when performing the above operations.
	21. 7. Avoid wastage, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
22. Calculate to set machine setting to produce different complex threaded component and check for functionality. <i>[Different complex threaded component- Half nut, multi start threads (BSW, Metric & Square)]</i>	22. 1. Plan and select appropriate method to produce components with multi start threading.
	22. 2. Prepare appropriate tool for generating required thread form.
	22. 3. Calculate and set machine
	22. 4. Mount the job and turn multi start thread (male and female).
	22. 5. Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
	22. 6. Match the male & female component for checking for functionality
Semester - IV	
LEARNING/ ASSESSABLE OUTCOMES	ASSESSMENT CRITERIA
23. Set (both job and tool) CNC turn centre and produce components as per drawing by preparing part programme.	23. 1. Plan and prepare part programme as per drawing, simulate for it's correctness with appropriate software.
	23. 2. Prepare tooling layout and select tools as required
	23. 3. Demonstrate possible solution within the team.
	23. 4. Set selected tools on to the machine
	23. 5. Test/Dry run the part programme on the machine
	23. 6. Set up the job and machine the component as per standard operating procedure involving parallel, step, taper, drilling, boring, radius, grooving and threading operations, etc.
	23. 7. Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
	23. 8. Observe safety/ precaution during machining.

	23. 9. Avoid wastage, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
24. Manufacture and assemble components to produce utility items by performing different operations & observing principle of interchangeability and check functionality. [<i>Utility item: - screw jack/ vice spindle/ Box nut, Marking block, drill chuck, collet chuck etc.; different operations: - threading (Square, BSW, ACME, Metric), Thread on taper, different boring (Plain, stepped)</i>]	24. 1. Plan and select tools and materials for the part components and make this available for use in a timely manner.
	24. 2. Produce part components as per drawing
	24. 3. Check for accuracy of all the part components and suitability to the higher assembly.
	24. 4. Assemble all the part components as per the guide lines given in the drawing.
	24. 5. Check for functionality of the screw jack, vice spindle/ Box nut, marking block, drill chuck, collet chuck etc., as per standard operating procedure.
	24. 6. Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
25. Make a process plan to produce components by performing special operations on lathe and check for accuracy. [<i>Accuracy - $\pm 0.02\text{mm}$ or proof machining & $\pm 0.05\text{mm}$ bore; Special operation – Worm shaft cutting (shaft) boring, threading etc.]</i>]	25. 1. Plan and select appropriate method to produce components with worm gear cutting.
	25. 2. Prepare appropriate tool for producing required worm shaft.
	25. 3. Set the job and turn worm shaft, match for accurate fitting with female gauge.
	25. 4. Check accuracy/ correctness of job using appropriate gauge and measuring instruments.

First Semester
Duration: Six Month

Week No.	Ref. Learning Outcome	Professional Skills with Indicative hrs.	Professional Knowledge
1.	Recognize & comply safe working practices, environment regulation and housekeeping.	<ol style="list-style-type: none"> 1. Importance of trade training, List of tools & Machinery used in the trade.(1 hrs.) 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). (5 hrs.) 3. First Aid Method and basic training.(2 hrs.) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (2 hrs.) 5. Hazard identification and avoidance. (2 hrs.) 6. Safety signs for Danger, Warning, caution & personal safety message.(1 hrs.) 7. Preventive measures for electrical accidents & steps to be taken in such accidents.(2 hrs.) 8. Use of Fire extinguishers.(7 hrs.) 9. Practice and understand precautions to be followed while working in fitting jobs. (2 hrs.) 10. Safe use of tools and equipments used in the trade. (1 hrs.) 	<p>All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures.</p> <p>Soft Skills: its importance and Job area after completion of training.</p> <p>Importance of safety and general precautions observed in the in the industry/shop floor.</p> <p>Introduction of First aid. Operation of electrical mains. Introduction of PPEs.</p> <p>Response to emergencies e.g.; power failure, fire, and system failure.</p> <p>Importance of housekeeping & good shop floor practices. Introduction to 5S concept & its application.</p> <p>Occupational Safety & Health: Health, Safety and Environment guidelines, legislations & regulations as applicable.</p>
2.	Plan and organize the work to make job as per specification applying different types of basic fitting operations & check for dimensional accuracy. [<i>Basic Fitting Operation – Marking, Hack sawing, filing,</i>	<ol style="list-style-type: none"> 11. Identification of tools & equipments as per desired specifications for marking & sawing (Hand tools, Fitting tools & Measuring tools) (2 hrs.) 12. Selection of material as per application Visual inspection of raw material for rusting, scaling, corrosion etc. (1 hrs.) 13. Marking out lines, gripping suitably in vice jaws, hack sawing to given dimensions, sawing 	<p>Measurement, line standard and end standard, steel rule-different types, graduation and limitation. Hammer and chisel-materials, types and uses. Prick punch and scriber.</p>

	<i>drilling, tapping etc.]</i>	different types of metals of different sections. (16 hrs.) 14. Practice on hammering, marking out, chipping, chisel grinding. (6 hrs.)	
3-4	-do-	15. Filing practice on plain surfaces, right angle by filing. (45 hrs.) 16. Use of calipers and scale measurement. (5 hrs.)	Vice – types and uses, Files-different types of uses, cut, grade, shape, materials etc. Try square-different types, parts, material used etc. Calipers-types and uses (firm joint).
5.	-do-	17. Filing at right angle, marking & hack sawing. (25 hrs.)	Vee – block, scribing block, straight edge and its uses. Hacksaw-their types & uses.
6	-do-	18. Marking operation on flat & round job. (10 hrs.) 19. Drilling operation: Drill on flat, square bar and round bar of different material (Sensitive drill machine). (15 hrs.)	Center punch- materials, construction & material uses. Drill machine-different parts. Hacksaw blades- sizes, different Parts. Hacksaw blades-sizes, different pitch for different materials. Nomenclature of drill.
7.	-do-	20. Different threading (BSW, BSP, BA, Metric, UNC, UNF) with the help of taps and dies both external & internal (including pipes) using collet chuck. (19 hrs.) 21. Extraction of broken tap. (6 hrs.)	Surface plate its necessity and use. Tap - different types (Taper 2 nd and bottoming) care while tapping. Dies different types and uses. Calculation involved to find Out drill size (Metric and Inch).
8.	Set different shaped jobs on different chuck and demonstrate conventional lathe machine operation observing standard operation practice. [Different chucks: - 3 jaws & 4 jaws, different shaped jobs: - round, hexagonal, square]	22. Identify & function of different parts of lathe. Practice on operation of lathe (dry/idle run). (20 hrs.) 23. Setting lathe on different speed and feed. (5 hrs.)	Getting to know the lathe with its main components, lever positions and various lubrication points as well. Definition of machine & machine tool and its classification. History and gradual development of lathe.

9.	-do-	<p>24. Mounting of chuck on machine spindle and unloading –3-jaw chuck & 4-jaw chuck. (15 hrs.)</p> <p>25. Setting practice on round & square/ hexagonal bar. (3 hrs.)</p> <p>26. Dismantling and assembling of 3 jaw and 4 jaw chucks. (7 hrs.)</p>	Classification of lathe in Function and construction of different parts of Lathe.
10-11	<p>Prepare different cutting tool to produce jobs to appropriate accuracy by performing different turning operations.</p> <p><i>[Different cutting tool – V tool, side cutting, parting, thread cutting (both LH & RH), Appropriate accuracy: - $\pm 0.06\text{mm}$, Different turning operation – Plain, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U -cut, Reaming, internal recess, knurling.</i></p>	<p>27. Turning of round stock and square/hexagonal as per availability on 4-jaw independent chuck. (30 hrs.)</p> <p>28. Turning of round stock on 3-jaw self centering chuck. (20 hrs.)</p> 	<p>Types of lathe drivers, merit and demerit. Description in details-head stock-cone pulley type- all geared type-construction & function. Tumbler gear set.</p> <p>Reducing speed-necessary & uses. Back Gear Unit –its construction use.</p>
12	-do-	<p>29. Grinding of R.H. and L.H., V-tool, side cutting tools, parting tool. (15 hrs.)</p> <p>30. Checking of angles with angle gauge / bevel protractor. (1 hrs.)</p> <p>31. Grinding of “V” tools for threading of Metric 60 degree threads. (9 hrs.)</p>	Lathe cutting tool-different types, shapes and different angles (clearances and rake), specification of lathe tools
13-14	-do-	<p>32. Facing operation to correct length (15 hrs.)</p> <p>33. Centre drilling and drilling operation to required size. (10 hrs.)</p>	<p>Combination drill- appropriate selection of size from chart of combination drill. Drill, chuck- its uses.</p> <p>Lathe accessories, chuck independent,</p>

		34. Make square block by turning using 4-jaw chuck and perform drilling, boring and grooving operation.(25 hrs.)	self centering, collet, magnetic etc., its function, construction and uses.
15-16	-do-	35. Parallel turning, step turning, parting, grooving, chamfering practice. (48 hrs.) 36. Measurement with scale and outside caliper to ± 0.5 mm. accuracy. (2 hrs.)	Vernier caliper-its construction, principle graduation and reading, least count etc. Digital vernier caliper. Outside micrometer –different parts, principle, graduation, reading, construction. Digital micrometer. Cutting speed, feed depth of cut, calculation involved-speed feed R.P.M. etc. recommended for different materials.
17	-do-	37. Step turning within ± 0.06 mm with different shoulder, U/cut on outside diameter. (15 hrs.) 38. Drilling on Lathe-step drilling, drill grinding practice. (10 hrs.)	Different types of micrometer, Outside micrometer. Vernier scale graduation and reading. Sources of error with micrometer & how to avoid them. Use of digital measuring instruments.
18-19	-do-	39. Boring practice-Plain. counter & step, internal recessing. (20 hrs.) 40. Reaming in lathe using solid and adjustable reamer. (15 hrs.) 41. Make bore by trepanning (10 hrs.) 42. Drill grinding. (5 hrs.)	Drills-different parts, types, size etc., different cutting angles, cutting speed for different material. Boring tool. Counter - sinking and Counter boring. Letter and number drill, core drill etc. Reamers-types and uses. Lubricant and coolant-types, necessity, system of distribution, selection of coolant for different material: Handling and care.
20-21	-do-	43. Turning practice-between centres on mandrel (Gear blanks). (20 hrs.) 44. Fitting of dissimilar materials- M.S. in brass, aluminium, in cast iron etc. (20 hrs.) 45. Knurling practice in lathe (Diamond, straight, helical & square). (10 hrs.)	Knurling meaning, necessity, types, grade, cutting speed for knurling. Lathe mandrel-different types and their uses. Concept of interchangeability, Limit, Fit and tolerance as per BIS: 919-unilateral and bilateral system of limit, Fits-different types, symbols for holes and shafts. Hole basis & shaft basis etc. Representation of Tolerance in drawing.


22.	Test the alignment of lathe by checking different parameters and adjust the tool post. [<i>Different parameters – Axial slip of main spindle, true running of head stock, parallelism of main spindle, alignment of both the centres.</i>]	46. Checking alignment of lathe centres such as Levelling, axial slip of main spindle, true running of head stock centre, parallelism of the main spindle to saddle movement, alignment both the centres. (20 hrs.) 47. Adjustment of tool post. (3 hrs.) 48. Mounting job in between centres. (2 hrs.)	Driving plate. Face plate & fixed & traveling steadies- construction and use. Transfer caliper-its construction and uses. Lathe centers-types and their uses. Lathe carrier-function, types & uses. Mandrel – Different types and its use. Magnetic stand dial indicator, its used and care.
23-25		Revision	
26		Examination	

Note: -

1. More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of both conventional & CNC turning operation, production of different components, turning of complex job, etc., may be shown to the trainees to give a feel of Industry and their future assignment.

Skill India
कौशल भारत - कुशल भारत

Second Semester
Duration: Six Month

Week No.	Learning Outcome	Professional Skills with Indicative hrs.	Professional Knowledge
27	<p>Set different components of machine & parameters to produce taper/ angular components and ensure proper assembly of the components.</p> <p><i>[Different component of machine: - Form tool, Compound slide, tail stock offset, taper turning attachment.</i></p> <p><i>Different machine parameters- Feed, speed, depth of cut.]</i></p>	<p>49. Make taper turning by form tool and compound slide swiveling. (25 hrs.)</p> 	<p>Taper – different methods of expressing tapers, different standard tapers. Method of taper turning, important dimensions of taper. Taper turning by swiveling compound slide, its calculation.</p>
28-29	-do-	<p>50. Male and female taper turning by taper turning attachment, offsetting tail stock. (22 hrs.)</p> <p>51. Matching by Prussian Blue. (2 hrs.)</p> <p>52. Checking taper by bevel protector and sine bar. (1 hrs.)</p> <p>53. Make MT3 lathe dead centre and check with female part. (Proof machining) (25 hrs.)</p>	<p>Bevel protector & Vernier bevel protractor- its function & reading.</p> <p>Method of taper angle measurement. Sine bar-types and use. Slip gauges-types, uses and selection.</p>
30	<p>Set the different machining parameter & tools to prepare job by performing different boring operations.</p> <p><i>[Different machine parameter- Feed, speed & depth of cut; Different boring operation – Plain, stepped & eccentric]</i></p>	<p>54. Turning and boring practice on CI (preferable) or steel. (23 hrs.)</p> <p>55. Tip brazing on shank. (2 hrs.)</p>	<p>Method of brazing solder, flux used for tip tools.</p> <p>Basic process of soldering, welding and brazing.</p>

31-32	-do-	<p>56. Eccentric marking practice. (2 hrs.)</p> <p>57. Perform eccentric turning. (18 hrs.)</p> <p>58. Use of Vernier height Gauge and V-block. (1 hrs.)</p> <p>59. Perform eccentric boring. (18 hrs.)</p> <p>60. Make a simple eccentric with dia. of 22mm and throw/offset of 5mm. (11 hrs.)</p>	<p>Vernier height gauge, function, description & uses, templates-its function and construction. Screw thread-definition, purpose & it's different elements.</p> <p>Driving plate and lathe carrier and their usage. Fundamentals of thread cutting on lathe. Combination set-square head. Center head, protractor head-its function construction and uses.</p>
33-35	<p>Set the different machining parameters to produce different threaded components applying method/ technique and test for proper assembly of the components.</p> <p><i>[Different thread: - BSW, Metric, Square, ACME, Buttress.]</i></p>	<p>61. Screw thread cutting (B.S.W) external (including angular approach method) R/H & L/H, checking of thread by using screw thread gauge and thread plug gauge. (16 hrs.)</p> <p>62. Screw thread cutting (B.S.W) internal R/H & L/H, checking of thread by using screw thread gauge and thread ring gauge. (18 hrs.)</p> <p>63. Fitting of male & female threaded components (BSW) (2 hrs.)</p> <p>64. Prepare stud with nut (standard size). (14 hrs.)</p>	<p>Different types of screw thread- their forms and elements. Application of each type of thread. Drive train. Chain gear formula calculation.</p> <p>Different methods of forming threads. Calculation involved in finding core dia., gear train (simple gearing) calculation. Calculations involving driver-driven, lead screw pitch and thread to be cut.</p>
36-37	-do-	<p>65. Grinding of "V" tools for threading of Metric 60 degree threads and check with gauge. (3 hrs.)</p> <p>66. Screw thread cutting (External) metric thread- tool grinding.(15 hrs.)</p> <p>67. Screw thread (Internal) metric & threading tool grinding. (16 hrs.)</p> <p>68. Fitting of male and female thread components (Metric) (2 hrs.)</p> <p>69. Make hexagonal bolt and nut (metric) and assemble. (14 hrs.)</p>	<p>Thread chasing dial function, construction and use. Calculation involving pitch related to ISO profile. Conventional chart for different profiles, metric, B.A., With worth, pipe etc. Calculation involving gear ratios and gearing (Simple & compound gearing). Screw thread micrometer and its use.</p>
38	-do-	70. Cutting metric threads on inch lead screw and inch threads on Metric Lead Screw. (25 hrs.)	<p>Calculation involving gear ratios metric threads cutting on inch L/S Lathe and vice-versa.</p>

39	-do-	71. Practice of negative rake tool on non-ferrous metal and thread cutting along with fitting with ferrous metal. (25 hrs.)	Tool life, negative top rake-its application and performance with respect to positive top rake
40-41	-do-	72. Cutting Square thread (External) (16 hrs.) 73. Cutting Square thread (Internal). (18 hrs.) 74. Fitting of male and female Square threaded components. (2 hrs.) 75. Tool grinding for Square thread (both External & Internal). (2 hrs.) 76. Make square thread for screw jack (standard) for minimum 100mm length bar. (12 hrs.)	Calculation involving tool Thickness, core dia., pitch proportion, depth of cut etc. of sq. thread.
42-43	-do-	77. Acme threads cutting (male & female) & tool grinding. (16 hrs.) 78. Fitting of male and female threaded components (14 hrs.) 79. Cut Acme thread over 25 mm dia rod and within length of 100mm. (20 hrs.)	Calculation involved – depth, core dia., pitch proportion etc. of Acme thread. Calculation involved depth, core dia., pitch proportion, use of buttress thread.
44-45	-do-	80. Buttress threads cutting (male & female) & tool grinding. (26 hrs.) 81. Fitting of male & female threaded components. (2 hrs.) 82. Make carpentry vice lead screw (22 hrs.)	Buttress thread cutting (male & female) & tool grinding
46	Set the different machining parameter & lathe accessories to produce components applying techniques and rules and check the accuracy. <i>[Different machining parameters: - Speed, feed & depth of cut; Different lathe accessories: - Driving Plate, Steady rest, dog</i>	83. Make job using different lathe accessories viz., driving plate, steady rest, dog carrier and different centres. (15 hrs.) 84. Make test mandrel (L=200mm) and counter bore at the end. (10 hrs.)	Different lathe accessories, their use and care.

	<i>carrier and different centres.]</i>		
47	Plan and perform basic maintenance of lathe & grinding machine and examine their functionality.	85. Balancing, mounting & dressing of grinding wheel (Pedestal). (5 hrs.) 86. Periodical lubrication procedure on lathe. (10 hrs.) 87. Preventive maintenance of lathe. (10 hrs.)	Lubricant-function, types, sources of lubricant. Method of lubrication. Dial test indicator use for parallelism and concentricity etc. in respect of lathe work Grinding wheel abrasive, grit, grade, bond etc.
48-49		In-plant training / Project work 1. Drill extension socket 2. conical brush 3. V-belt pulley 4. Tail Stock Centre (MT – 3) 5. Taper ring gauge 6. Sprocket 7. Socket spanner	
50-50			Revision
52			Examination

Note: -

1. *Some of the sample project works (indicative only) are given against each semester.*
2. *Instructor may design their own project and also inputs from local industry may be taken for designing such new project.*
3. *The project should broadly covered maximum skills in the particular trade and must involve some problem solving skill. Emphasis should be on Teamwork: Knowing the power of synergy/ collaboration, Work to be assigned in a group (Group of at least 4 trainees). The group should demonstrate Planning, Execution, Contribution and application of Learning. They need to submit Project report.*
4. *If the instructor feels that for execution of specific project more time is required than he may plan accordingly to produce components/ sub-assemblies in appropriate time i.e., may be in the previous semester or during execution of normal trade practical.*
5. *More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of both conventional & CNC turning operation, production of different components, turning of complex job, etc., may be shown to the trainees to give a feel of Industry and their future assignment.*

Third Semester
Duration: Six Month

Week No.	Ref. Learning Outcome	Professional Skills with Indicative hrs.	Professional Knowledge
53	Plan & set the machine parameter to produce precision engineering component to appropriate accuracy by performing different turning operation. <i>[Appropriate accuracy - $\pm 0.02\text{mm}/(MT - 3)$ (proof turning); Different turning operation – Plain turning, taper turning, boring, threading, knurling, grooving, chamfering etc.]</i>	88. Form turning practice by hand. (8 hrs.) 89. Re-sharpening of form tools using bench grinder. (2 hrs.) 90. Tool machine handle turning by combination feed. (15 hrs.)	Form tools-function-types and uses, Template-purpose & use. Dial test indicator-construction & uses Calculation involving modified rake and clearance angles of lathe tool at above and below the center height. Subsequent effect of tool setting. Jig and fixture-definition, type and use. Chip breaker on tool-purpose and type
54-55	-do-	91. Turn Morse taper plug (different number) and check with ring gauge / suitable MT sleeve. (25 hrs.) 92. Make revolving tail stock centre-Bush type (C-40). (Proof machining) (25 hrs.)	Cutting tool material-H.C.S., HSS, Tungsten Carbide, Ceramic etc, - Constituents and their percentage. Tool life, quality of a cutting material.
56	-do-	93. Make Morse taper sleeve and check by taper plug gauge. (25 hrs.)	Checking of taper with sin bar and roller-calculation involved
57	-do-	94. Make mandrel/ plug gauge with an accuracy of $\pm 0.02\text{mm}$ using tungsten carbide tools including throw-away tips. (25 hrs.)	Cutting speed, feed, turning time, depth of cut calculation, cutting speed chart (tungsten carbide tool) etc. Basic classification of tungsten carbide tips.
58-59	Set & Produce components on irregular shaped job using different lathe accessories. <i>[Different Lathe accessories: - Face plate, angle plate]</i>	95. Setting and turning operation involving face and angle plate (25 hrs.) 96. Make angle plate using face plate. (25 hrs.)	Accessories used on face plate –their uses. Angle plate-its construction & use. Balancing-its necessity. Surface finish symbols used on working blueprints- I.S. system lapping, honing etc.

60-61	Plan and set the machine using lathe attachment to produce different utility component/ item as per drawing. <i>[Different utility component/ item – Crank shaft (single throw), stub arbour with accessories etc.]</i>	97. Holding and truing of Crankshaft – single throw (Desirable). (50 hrs.)	Preventive maintenance, its necessity, frequency of lubrication. Preventive maintenance schedule., TPM (Total Productive Maintenance), EHS (Environment, health, Safety) Marking table-construction and function. Angle plate-construction, eccentricity checking.
62	-do-	98. Turning of long shaft using steady rest (within 0.1 mm). (25 hrs.)	Roller and revolving steadies, Necessary, construction, uses etc.
63-64	-do-	99. Use of attachments on lathe for different operations. (25 hrs.) 100. Turning standard stub arbor with accessories collar, tie rod, lock nut. (25 hrs.)	Different types of attachments used in lathe. Various procedures of thread measurement thread screw pitch gauge. Screw thread micrometer, microscope etc.
65	Set the machining parameters and produce & assemble components by performing different boring operations with an appropriate accuracy. <i>[Different boring operation – eccentric boring, stepped boring; appropriate accuracy - ±0.05mm]</i>	101. Perform eccentric boring and make male & female eccentric fitting. (15 hrs.) 102. Position boring using tool maker's button. (10 hrs.)	Tool maker's button and its parts, construction and uses, telescopic gauge its construction and uses.
66	-do-	103. Boring and stepped boring (within ± 0.05 mm) (15 hrs.) 104. Cutting of helical grooves in bearing and bushes (Oil groove) (10 hrs.)	Inside micrometer principle, construction graduation, reading, use etc. (Metric & Inch.)
67-68	-do-	105. Turning & boring of split bearing – (using boring bar and fixture) (50 hrs.)	Care for holding split bearing. Fixture and its use in turning.
69	Calculate to set machine setting to produce different complex threaded component and check for functionality. <i>[Different complex threaded component- Half nut, multi start threads (BSW, Metric & Square)]</i>	106. Cutting thread of 8 and 11 TPI. (25 hrs.)	Calculation involving fractional threads. Odd & even threads.

70	-do-	107. Multi start thread cutting (B.S.W.) external & internal. (25 hrs.)	Multiple thread function, use, different between pitch & lead, formulate to find out start, pitch, lead. Gear ratio etc.
71	-do-	108. Multi start thread cutting (Metric) (External & internal). (25 hrs.)	Indexing of start - different methods tool shape for multi-start thread. Setting of a lathe calculation for required change wheel
72	-do-	109. Multi-start thread cutting, square form (Male & Female). (25 hrs.)	Calculation involving shape of tool, change wheel, core dia etc. Calculation involving shape, size pitch, core dia. Etc.
73	-do-	110. Make half nut as per standard lead screw. (25 hrs.)	Helix angle, leading angle & following angles. Thread dimensions-tool shape, gear, gear calculation, pitch, depth, lead etc.
74-75		Implant training / Project work (work in a team)	
		<ol style="list-style-type: none"> 1. Pedestal bearing 2. crank shaft 3. arbor with clamping nut 4. mandrel with jaw 5. Eccentric with connecting rod 6. Taper mandrel with sphere 7. Lever Handle 	
76-77			Revision
78			Examination

Note: -

1. Some of the sample project works (indicative only) are given against each semester.
2. Instructor may design their own project and also inputs from local industry may be taken for designing such new project.
3. The project should broadly covered maximum skills in the particular trade and must involve some problem solving skill. Emphasis should be on Teamwork: Knowing the power of synergy/ collaboration, Work to be assigned in a group (Group of at least 4 trainees). The group should demonstrate Planning, Execution, Contribution and application of Learning. They need to submit Project report.
4. If the instructor feels that for execution of specific project more time is required than he may plan accordingly to produce components/ sub-assemblies in appropriate time i.e., may be in the previous semester or during execution of normal trade practical.
5. More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of both conventional & CNC turning operation, production of different components, turning of complex job, etc., may be shown to the trainees to give a feel of Industry and their future assignment.

Fourth Semester
Duration: Six Month

Week No.	Learning Outcome	Professional Skills with Indicative hrs.	Professional Knowledge
79	Set (both job and tool) CNC turn centre and produce components as per drawing by preparing part programme.	111. Personal and CNC machine Safety: Safe handling of tools, equipment and CNC machine. (2 hrs.) 112. Identify CNC machine, CNC console. (5 hrs.) 113. Demonstration of CNC lathe machine and its parts - bed, spindle motor and drive, chuck, tailstock, turret, axes motor and ball screws, guide ways, LM guides, console, control switches, coolant system, hydraulic system, chip conveyor, steady rest. (7 hrs.) 114. Working of parts explained using Multimedia based simulator for CNC parts shown on machine. (6 hrs.) 115. Identify machine over travel limits and emergency stop. (1 hrs.)	CNC technology basics: Difference between CNC and conventional lathes. Advantages and disadvantages of CNC machines over conventional machines. Machine model, control system and specification. Axes convention of CNC machine - Machine axes identification for CNC turn centre. Importance of feedback devices for CNC control. Concept of Co-ordinate geometry, concept of machine axis.
80-82	-do-	116. Conduct a preliminary check of the readiness of the CNC turning centre viz., cleanliness of machine, referencing – zero return, functioning of lubrication, coolant level, correct working of sub-system. (2 hrs.) 117. Identification of safety switches and interlocking of DIH modes. (1 hrs.) 118. Machine starting & operating in Reference Point, JOG and Incremental Modes. (12 hrs.) 119. Check CNC part programming with simple exercises and using various programming codes and words. (12 hrs.) 120. Check the programme simulation on machine OR practice in simulation software in respective control system. (12 hrs.)	Programming – sequence, formats, different codes and words. Co-ordinate system points and simulations. Work-piece zero points and ISO/DIN G and M codes for CNC. Different types of programming techniques of CNC machine. Describe the stock removal cycle in CNC turning for OD / ID operation. L/H and R/H tool relation on speed. Describe CNC interpolation, open and close loop control systems. Co-ordinate systems and Points. Program execution in different modes like manual, single block and auto. Absolute and incremental programming. Canned cycles. Cutting parameters- cutting speed, feed rate , depth of cut, constant surface speed, limiting spindle speed, tool wear,

		<p>121. Absolute and incremental programming assignments and simulations. (12 hrs.)</p> <p>122. Linear interpolation, and Circular interpolation assignments and simulations on soft ware. (24 hrs.)</p>	<p>tool life, relative effect of each cutting parameter on tool life.</p> <p>Selection of cutting parameters from a tool manufacturer's catalog for various operations.</p> <p>Process planning & sequencing, tool layout & selection and cutting parameters selection.</p> <p>Tool path study of machining operations</p> <p>Prepare various programs as per drawing.</p>
83-85	-do-	<p>123. Perform Work and tool setting: - Job zero/work coordinate system and tool setup and live tool setup. (12 hrs.)</p> <p>124. Carryout jaw adjustment according to Diameter and tooling setup on Turret. (12 hrs.)</p> <p>125. CNC turning centre operation in various modes: JOG, EDIT, MDI, SINGLE BLOCK, AUTO. (12 hrs.)</p> <p>126. Program entry. (2 hrs.)</p> <p>127. Set the tool offsets, entry of tool nose radius and orientation. (12 hrs.)</p> <p>128. Conduct work off set measurement, Tool off set measurement and entry in CNC Control. (8 hrs.)</p> <p>129. Make Tool nose radius and tool orientation entry in CNC control. (6 hrs.)</p> <p>130. Jaw removal and mounting on CNC Lathe. (4 hrs.)</p> <p>131. Manual Data Input (MDI) and MPG mode operations and checking of zero offsets and tool offsets. (9 hrs.)</p>	<p>Tool Nose Radius Compensation (G41/42) and its importance (TNRC).</p> <p>Cutting tool materials, cutting tool geometry – insert types, holder types, insert cutting edge geometry.</p> <ul style="list-style-type: none"> - Describe Tooling system for turning - Setting work and tool offsets. - Describe the tooling systems for CNC TURNING Centers. - Cutting tool materials for CNC Turning and its applications - ISO nomenclature for turning tool holders, boring tool holders, indexable inserts. - Tool holders and inserts for radial grooving, face grooving, threading, drilling.
86-88	-do-	<p>132. Program checking in dry run, single block modes. (6 hrs.)</p> <p>133. Checking finish size by over sizing through tool offsets. (9 hrs.)</p> <p>134. Part program preparation, Simulation & Automatic Mode Execution for the exercise on Simple turning & Facing (step turning) (10 hrs.)</p> <p>135. Part program preparation,</p>	<p>Prepare various part programs as per drawing & check using CNC simulator.</p> <p>Processes and Tool selection related to grooving, drilling, boring & threading.</p>

		<p>Simulation & Automatic Mode Execution for the exercise on Turning with Radius / chamfer with TNRC. (10 hrs.)</p> <p>136. Part program preparation, Simulation & Automatic Mode Execution of CNC Machine for the exercise on Blue print programming contours with TNRC. (10 hrs.)</p> <p>137. Machining parts on CNC lathe with parallel, taper, step, radius turning, grooving & threading. (15 hrs.)</p> <p>138. Carryout Drilling /Boring cycles in CNC Turning. (15 hrs.) <i>(First 60 % of the practice is on CNC machine simulator, followed by 40 % on machine.)</i></p>	
89-91	-do-	<p>139. Geometry Wear Correction. Geometry and wear offset correction. (10 hrs.)</p> <p>140. Produce components on CNC Machine involving different turning operations viz.,</p> <ul style="list-style-type: none"> • Stock removal cycle OD • Drilling / boring cycles • Stock removal cycle ID • Carryout threading in different pitches. (18 hrs.) <p>141. Produce components by involving turning operation and part programme exercises of CNC turning viz.,</p> <ul style="list-style-type: none"> • Grooving and thread cutting OD • Grooving and thread cutting ID • Threading cycle OD • Sub programs with repetition • Using Sub Programs & Cycles in the Main Program. (18 hrs.) <p>142. Part off: Part Prog. (4 hrs.)</p> <p>143. Produce job involving profile turning, threading on taper, boring, etc. operations. (22 hrs.)</p> <p>144. Demo on M/C on bar feeding system. (simulation/ video)</p>	<ul style="list-style-type: none"> - Describe Tapping on CNC turning. - Programming for Grooving/Threading on OD/ID in CNC Turning. - Trouble shooting in CNC lathe machine - Identify Factors affecting turned part quality/ productivity. - Parting off operation explanation. - Bar feeding system through bar feeder. - Input and Output of Data. - DNC system. Interlacing with PC. - Use of CAM Programme. (Optional)

		<p>(1 hrs.)</p> <p>145. DNC system setup. (Optional)</p> <p>146. Run the machine on DNC mode.(Optional)</p> <p>147. CAM programme execution. (Optional)</p> <p>148. Data Input-Output on CNC machine. (2 hrs.)</p>	
92-93	<p>Manufacture and assemble components to produce utility items by performing different operations & observing principle of interchangeability and check functionality.</p> <p><i>[Utility item: - screw jack/ vice spindle/ Box nut, Marking block, drill chuck, collet chuck etc.; different operations: - threading (Square, BSW, ACME, Metric), Thread on taper, different boring (Plain, stepped)]</i></p>	<p>149. Thread on taper surface (Vee form). (50 hrs.)</p> 	<p>Setting of tool for taper threads- calculation of taper setting and thread depth.</p> <p>Heat treatment – meaning & procedure hardening, tempering, carbonizing etc.</p> <p>Different types of metal used in engineering application.</p>
94-95	-do-	<p>150. Manufacturing & Assembly of Screw jack/vice/Box nut by performing different lathe operation. (To use earlier produce screw jack). (50 hrs.)</p>	<p>Interchangeability meaning, procedure for adoption, quality control procedure for quality production.</p>
96	-do-	<p>151. Prepare different types of documentation as per industrial need by different methods of recording information. (4 hrs.)</p> <p>152. Turn Bevel gear blank. (21 hrs.)</p>	<p>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.</p>
97	<p>Make a process plan to produce components by performing special operations on lathe</p>	<p>153. Read a part drawing, make a process plan for turning operation and make arbor with clamping nut (hexagonal). (25 hrs.)</p>	<p>Terms used in part drawings and interpretation of drawings – tolerances, geometrical symbols - cylindricity, parallelism. etc.</p>

	and check for accuracy. [Accuracy - $\pm 0.02\text{mm}$ or proof machining & $\pm 0.05\text{mm}$ bore; Special operation – Worm shaft cutting (shaft) boring, threading etc.]		
98	-do-	154. Practice of special operations on lathes - worm gear cutting. (Shaft) (25 hrs.)	Automatic lathe-its main parts, types diff. Tools used-circular tool etc
99	-do-	155. Boring on lathe using soft jaws to make bush with collar (standard) on non ferrous metal and check with dial bore gauge to accuracy of ± 0.05 mm. (15 hrs.) 156. Make Arbor support bush. (Proof Machining) (10 hrs.)	Related theory and calculation.
100-101		In-plant training/ Project work (Any Project to be done on CNC machine) 1. Taper Sunk 2. Socket With Split Collet 3. Screw Jack 4. Spindle With Hub 5. Morse Taper Eccentric 6. Crank Shaft With Taper Sleeve	
102-103		Revision	
104		Examination	

NOTE:-

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9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERING DRAWING

First Semester		Duration: Six Month
Sl. No.	Workshop Calculation and Science	Engineering Drawing
1.	Unit: 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"> - Relationship to other technical drawing types - Conventions - Viewing of engineering drawing sheets. - Method of Folding of printed Drawing Sheet as per BIS SP:46-2003
2.	Fractions : 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"> - 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.
3.	Square Root : Square and Square Root, method of finding out square roots, Simple problem using calculator.	Lines : <ul style="list-style-type: none"> - Definition, types and applications in Drawing as per BIS SP:46-2003 - Classification of lines (Hidden, centre, construction, Extension, Dimension, Section) - Drawing lines of given length (Straight, curved) - Drawing of parallel lines, perpendicular line - Methods of Division of line segment
4.	Ratio & Proportion : Simple calculation on related problems.	Drawing of Geometrical Figures: Definition, nomenclature and practice of <ul style="list-style-type: none"> - Angle: Measurement and its types, method of bisecting. - Triangle -different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.
5.	Percentage : Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	Lettering and Numbering as per BIS SP46-2003: <ul style="list-style-type: none"> - Single Stroke, Double Stroke, inclined, Upper case and Lower case.
6.	Material Science : properties -Physical & Mechanical, Types –Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous	Dimensioning: <ul style="list-style-type: none"> - Definition, types and methods of dimensioning (functional, non-functional and auxiliary)

	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.	<ul style="list-style-type: none"> - Types of arrowhead - Leader Line with text
7.	Mass, Weight and Density : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals.	<p>Free hand drawing of</p> <ul style="list-style-type: none"> - Lines, polygons, ellipse, etc. - geometrical figures and blocks with dimension - Transferring measurement from the given object to the free hand sketches.
8.	Speed and Velocity : Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation, equations of motions, simple related problems.	<p>Sizes and Layout of Drawing Sheets</p> <ul style="list-style-type: none"> - 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.	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.	<p>Method of presentation of Engineering Drawing</p> <ul style="list-style-type: none"> - Pictorial View - Orthogonal View - Isometric view
10.		<p>Symbolic Representation (as per BIS SP:46-2003) of :</p> <ul style="list-style-type: none"> - Fastener (Rivets, Bolts and Nuts) - Bars and profile sections - Weld, brazed and soldered joints. - Electrical and electronics element - Piping joints and fittings

Second Semester		Duration: Six Month
Sl. No.	Workshop Calculation and Science	Engineering Drawing
1.	Algebra : Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	Construction of Scales and diagonal scale
2.	Mensuration : 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.	Trigonometry : Trigonometrical ratios, measurement of angles. Trigonometric tables	Dimensioning practice: <ul style="list-style-type: none"> - 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.	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.	Construction of Geometrical Drawing Figures: <ul style="list-style-type: none"> - Different Polygons and their values of included angles. Inscribed and Circumscribed polygons. - Conic Sections (Ellipse & Parabola)
5.	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.	Drawing of Solid figures (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions.
6.	Levers and Simple Machines : levers and its types. Simple Machines, Effort and Load, Mechanical Advantage, Velocity Ratio,	Free Hand sketch of hand tools and measuring tools used in respective trades.

	Efficiency of machine, Relationship between Efficiency, velocity ratio and Mechanical Advantage.	
7.	---	<p>Projections:</p> <ul style="list-style-type: none"> - Concept of axes plane and quadrant. - Orthographic projections - Method of first angle and third angle projections (definition and difference) - Symbol of 1st angle and 3rd angle projection as per IS specification.
8.	--	Drawing of Orthographic projection from isometric/3D view of blocks
9.	--	Orthographic Drawing of simple fastener (Rivet, Bolts, Nuts & Screw)
10.	--	Drawing details of two simple mating blocks and assembled view.

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

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



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Fourth Semester		Duration: Six Month
Sl. No.	Workshop Calculation and Science	Engineering Drawing
1.	<p>Graph:</p> <ul style="list-style-type: none"> - Read images, graphs, diagrams - bar chart, pie chart. - Graphs: abscissa and ordinates, graphs of straight line, related to two sets of varying quantities. 	- Free hand Details and assembly of simple bench vice.
2.	<p>Simple problem on Statistics:</p> <ul style="list-style-type: none"> - Frequency distribution table - Calculation of Mean value. - Examples on mass scale productions. -Cumulative frequency -Arithmetic mean 	- Reading of drawing. Simple exercises related to missing lines, dimensions. How to make queries.
3.	Acceptance of lot by sampling method (within specified limit size) with simple examples (not more than 20 samples).	<ul style="list-style-type: none"> - Simple exercises relating missing symbols. - Missing views
4.	<ul style="list-style-type: none"> - Friction- co-efficient of friction, application and effects of friction in Workshop practice. <p>Centre of gravity and its practical application.</p>	- Simple exercises related to missing section.
5.	<ul style="list-style-type: none"> - Magnetic substances- natural and artificial magnets. - Method of magnetization. Use of magnets. 	-Free hand sketching of different types of bearings and its conventional representation.
6.	<ul style="list-style-type: none"> - Electrical insulating materials. - Basic concept of earthing. 	<ul style="list-style-type: none"> - Free hand sketching of different gear wheels and nomenclature/ Simple duct (for RAC). Free hand sketch of Reciprocating compressor – open type (for RAC)
7.	<ul style="list-style-type: none"> - Transmission of power by belt, pulleys & gear drive. - Calculation of Transmission of power by belt pulley and gear drive. 	<ul style="list-style-type: none"> - Solution of NCVT test. - Simple exercises related to trade related symbols. - Basic electrical and electronic symbols
8.	- Heat treatment and advantages.	- Study of drawing & Estimation of materials.
9.	Concept of pressure – units of pressure, atmospheric pressure, absolute pressure, gauge pressure – gauges used for measuring pressure	- Solution of NCVT test papers.
10.	Introduction to pneumatics & hydraulics systems.	

9.2 EMPLOYABILITY SKILLS

(DURATION: - 110 HRS.)

1st Semester		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	

	<p>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>
3. Communication Skills	
Duration : 15 Hrs. Marks : 07	
Introduction to Communication Skills	<p>Communication and its importance</p> <p>Principles of Effective communication</p> <p>Types of communication - verbal, non verbal, written, email, talking on phone.</p> <p>Non verbal communication -characteristics, components-Para-language</p> <p>Body language</p> <p>Barriers to communication and dealing with barriers.</p> <p>Handling nervousness/ discomfort.</p>
Listening Skills	<p>Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening.</p> <p>Triple- A Listening - Attitude, Attention & Adjustment.</p> <p>Active Listening Skills.</p>
Motivational Training	<p>Characteristics Essential to Achieving Success.</p> <p>The Power of Positive Attitude.</p> <p>Self awareness</p> <p>Importance of Commitment</p> <p>Ethics and Values</p> <p>Ways to Motivate Oneself</p> <p>Personal Goal setting and Employability Planning.</p>
Facing Interviews	<p>Manners, Etiquettes, Dress code for an interview</p> <p>Do's & Don'ts for an interview.</p>
Behavioral Skills	<p>Problem Solving</p> <p>Confidence Building</p> <p>Attitude</p>
2nd Semester	
Duration – 55 hrs.	
4. Entrepreneurship Skills	
Duration : 15 Hrs. Marks : 06	
Concept of Entrepreneurship	<p>Entrepreneur - Entrepreneurship - Enterprises:-Conceptual issue</p> <p>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.</p>
Project Preparation & Marketing analysis	<p>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.</p>
Institutions Support	<p>Preparation of Project. Role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non</p>

	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 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.
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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Turner (CTS)			
LIST OF TOOLS AND EQUIPMENT (For batch of 12 candidates)			
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit sl. 1-10 is required additionally)			
Sl. no.	Name of the Tool & Equipments	Specification	Quantity
1	Caliper outside spring joint	150 mm	12 Nos.
2	Caliper inside spring joint	150 mm	12 Nos.
3	Caliper odd-leg firm joint	150 mm	12 Nos.
4	Steel Rule	150 mm, Graduated both in Metric and English Unit	12 Nos.
5	Scriber	150mm x 3 mm	12 Nos.
6	Hammer ball peen	250 gm with handle	12 Nos.
7	Centre punch	100 mm	12 Nos.
8	Prick punch	100 mm	12 Nos.
9	Divider spring joint	150 mm	12 Nos.
10	Safety goggles clear glass (Good quality)		12 Nos.
B. INSTRUMENTS AND GENERAL SHOP OUTFIT			
11	Surface Plate - Granite	1000 x 1000 mm with Stand and Cover	1 no.
12	Work bench	240 x 120x 90cm high	1 no.
13	Marking table (CI)	120 x 120 cm	1 no
14	Bench vice	125 mm jaw	6 nos.
15	V-Block	150X100X100 mm with Clamp (Hardened & Ground)	1 pair each
16	Universal Surface gauge	250 mm arm	2 nos.
17	Hammer ball peen	750 gm with handle	6 nos.
18	Chisel cold flat	20 x 150 mm	6 nos.
19	Hammer copper/brass	500 gm with handle	12 nos.
20	Hacksaw fixed	200 mm (Pistol grip)	6 nos.
21	File flat	300 mm rough	6 nos.
22	File flat	250 mm 2nd cut	6 nos.
23	File flat	250 mm smooth	6 nos.

24	File half round	250 mm 2nd cut	6 nos.
25	File round	250 mm smooth	6 nos
26	File half round	150 mm smooth	2 Sets
27	Knurling tool revolving head	(Rough, med, fine) diamond and straight	2 Sets
28	Combination set	300 mm (Complete Set)	6 Nos.
29	Screw Driver	10 X 200 mm	1 set
30	Spanner double ended	6 mm to 21 mm	2 Nos
31	Spanner adjustable	200 mm	---
32	Pliers flat nose	150 mm side cutting	15 nos.
33	Caliper transfer inside	150 mm	3 nos.
34	Micrometer Outside	0 to 25 mm, Least Count 0.01 mm with NABL Accredated lab. Certificate	2 sets
35	Micrometer Outside	25 to 50 mm, Least Count 0.01 mm with NABL Accredated lab. Certificate	2 nos.
36	Micrometer Outside	50to 75 mm, Least Count 0.01 mm with NABL Accredated lab. Certificate	2 sets
37	Micrometer Inside	up to 25 mm, Least Count 0.01 mm with NABL Accredated lab. Certificate	2 nos.
38	Micrometer Inside	up to 25 to 50 mm, Least Count 0.01 mm with NABL Accredated lab. Certificate	2 nos.
39	Depth Gauge Micrometer	0 to 150 mm, Least Count 0.01 mm with NABL Accredated lab. Certificate	2 nos.
40	Vernier Caliper Outside, Inside and Depth	200 mm /8 inches with metric & inch scale (L.C. = 0.02mm) with NABL Accredated lab. Certificate	6 nos.
41	Dial Vernier Caliper with metric	200 mm, Least Count 0.05 mm with NABL Accredated lab. Certificate	6 nos.
42	Vernier Bevel Protractor	300 mm blade with NABL Accredated lab. Certificate	6 nos.
43	Vernier Micrometer	0 - 25 mm o/s LC 0.001mm with NABL Accredated lab. Certificate	2 nos.
44	Vernier Micrometer	25 - 50 mm, outside Least Count 0.001mm with NABL Accredated lab. Certificate	2 sets
45	Vernier Micrometer	0 inch to 1 inch.Outside Least Count 0.001 inch with NABL Accredated lab. Certificate	2 nos.

46	Gauge Feeler	Thickness - 0.05 mm to 0.3 mm by 0.05 and 0.4 mm to 1 mm by 0.1 mm - 13 leaves	01 each
47	Gauge - Radius Set	1 mm to 25 mm by 0.5 mm	6 Nos
48	Centre Gauge	com. 60°, 55° and 29°	2 sets
49	Screw Pitch Gauge	Whitworth & Metric each (0.25 to 6mm)	2 sets
50	Drill Angle Gauge		2 sets
51	Universal Dial Test Indicator - Plunger Type	Range 0 - 10 mm, Graduation 0.01 mm complete with Clamping Devices and Magnetic Stand	2 sets
52	Vernier Height Gauge	0 - 300 mm, LC = 0.02 mm with NABL Accredated lab. Certificate	1 set
53	Try Square	150 blade	4 nos.
54	Magnifying Glass	75 mm with magnifying factor 10X	4 nos.
55	Plain Ring and Plug Gauge	(12,16,20,25,30,32,36,40,45,50 mm)	1 set each
56	Wheel Dresser Hunting on-type with star cutter		1 No.
57	Wheel Dresser Diamond	(inserted-0.75 or 1 Carat)	2 Nos.
58	Screw Thread micrometer interchangeable	(0-25 mm)	1 No
59	Morse Taper Plug & Ring Gauge	No. 0 to 7 MT	1 set
60	Sine Bar with centers	200 mm	2 Nos.
61	Slip Gauge metric set	(87 pieces in a Box) with workshop grade	2 Nos.
62	Morse Taper	Sleeves No. 0-1, 1-2, 2-3, 3-4, 4-5.	1 set
63	Drill Drift		1 Set.
64	Twist Drill	straight shank 3 to 12 mm by 1 mm	1 No.
65	Drill Twist Set	Taper Shank - 14 mm to 20 mm by 1 mm	1 set (Box)
66	Drill Chuck	12 mm cap with key	2 Sets.
67	Tap & Die	B.A. No. 0 to 10 in a box	2 Nos...
68	Tap and Die Set	Metric - 3 to 24 mm	2 Sets
69	Tap & Die	B.S.F. up to 1 inch	2 Sets.
70	Tap & Die	B.S.W. up to 1 inch	2 Sets.
71	Reamer machine	straight flute 6 to 25 mm	1 Set.
72	Reamer Adjustable	10 to 20 mm	1 set.
73	Tool Holder RH & straight for mm square tool bit		1 No.
74	Parting Tool Holder with H.S.S. blade		12 Nos.
75	Tool Bits	12 X 150 mm sq. assorted shaped	15 Nos.
76	Boring Tool holder	6 mm sq. tool bit	15 Nos.
77	Steel Rule	300 mm with Metric and Inch	15 Nos.

78	Oil Can	½ pint (pressure feed system)	06 Nos.
79	Dog Carrier	25, 50 and 75 mm	12 Nos
80	Angle Plate	Adjustable - 150 X 175 X 250 mm	02 Nos.
81	Spirit Level	0.05 mm / 200 mm	2 Nos.
82	Tool Maker's button		1 set
83	Combination Drill / Centre Drill	A3, A4 & A5	1 set
84	Oil Stone	12 mm sq. x 100 long fine	12 nos.
85	Tap Wrench (adjustable)		09 Nos.
86	Die Handle		2 Nos.
87	Tool Bit assorted sizes on holder		10 Nos.
88	Machine Vice - Swivel Base	100 mm	01 No.
89	Chalk Board on mobile stand		1 No.
90	Spare Grinding Wheel Ajax type for carbide tool		1 No.
91	Almirah	1980x 910 x 480 mm	2 No.
92	St. Locker with drawer (Pigeon holes)		.1 No.
93	Desk		1 No.
94	Stool		4 Nos.
95	Angle Gauge for tool grinding		6 Nos
96	Hand Chaser	M-12 & M-16 (External)	2 Nos.
97	Hand Chaser	M-12 & M-16 (Internal)	2 Nos.
98	Revolving Center (to suit Lathe tailstock)		6 Nos
99	Tool Cemented carbide assorted shaped (External) for steel turning	set of 12 nos.	1 No.
100	Thread Plug Gauge	M-20 & M-21	1 set
101	Thread Ring Gauge	M-20 & M-21	1 No.
102	Machine Chaser	M-12 TO M-21 (Std. Series) to suit on	1 set
103	Coventry Die head		2 Nos
104	Gauge Drill Grinding		1 No
105	Magnetic Chuck	150 mm dia.(Circular type)	1 set.
106	Lathe Mandrels (Diff. Types)		1 No.
107	Coventry Type Die Head (Self opening)		1 No
108	Collapsible Tap with attachment		2 Nos
109	Fire Extinguisher and buckets		02 nos. each
110	Bore dial gauge stems	12 to 35 mm, 35 to 65 mm., dial gauge indicator of 0.01 accuracy.	1 set each
C : MACHINERIES AND EQUIPMENTS			
1	Lathe S.S. & S.C. (All geared head stock)	150 mm center height, to admit 750	5 nos.

	with minimum specification as:	mm between centers. Machine to be motorized and supplied with coolant installation, 4-jaw Independent chuck 150 mm, 3-jaw self-centering chuck 150 mm, fixed steady, traveling steady, face plate, driving plate, 4-way tool post, quick change gear box for Metric or British threads, live and dead centers with taper attachments, Motor Capacity - 5.5 KW	
2	Lathe S.S & S.C.(all geared type) with minimum specification as:	150 mm. Center height, 1000 mm between centers, gap bed machine to be motorized and supplied with coolant installation, 4-jaw independent chuck 250 mm , 3-jaw self-centering chuck 200 mm fixed steady, face plate, driving plate, 4-way tool post, quick change gear box for Metric/British threads, live and dead centers with taper attachments, Motor Capacity -5.5 KW	1 no.
3	Lathe tool room S.S. & S.C. (all geared type) with minimum specification as:	150 mm center height, 1000 mm between centers. Machine to be motorized and supplied with coolant installation, 4-jaw independent chuck 250 mm, 3-jaw self-centering chuck 150 mm fixed steady, traveling steady, face plate, driving plate, 1-way tool post, draw in type collets set up to 25 mm, 0.5 mm, relieving attachments, Motor Capacity -5.5 KW	1 no.
4	Grinding machine pedestal type	D.E. 200 mm dia. Wheel with wheel guard and vision, Motor Capacity - 0.75 KW	1 no.
5	Drill machine pillar type-motorized	up to 12 mm. Cap, Motor Capacity - 0.75 KW	1 no.
6	Power saw machine – hydraulic feed system	400 mm. Blade size, Motor Capacity -0.75 KW	1 no.

Note: - Preferably all tools must be hardened, toughened and grounded.

D: List of additional machines, tools & equipment for CNC turn Centre:

Sl. No.	Description	Specification	Quantity
1.	CNC lathe/CNC turn Centre	[specification as per Annex-A & A (I)]	As per Annex-A & A (I)
2.	a) Simulator b) Desktop Computers	[specification as per Annex-A & A (I)]	As per Annex-A & A (I)
3.	Tool holders	[specification as per Annex-A & A (I)]	As per Annex-A & A (I)
4.	LCD projector / large screen TV		1 no.
5.	Digimatic Electronic Vernier Caliper	inch and mm 8"/200 mm. LCM 0.005"/0.001 mm	2 nos.
6.	Digimatic electronic outside Micrometer	(0 to 25 mm & 25 to 50 mm) LC 0.001 mm.	1 no. each

NOTE: -

1. No additional items are required to be provided to the batch working in the second and third shift except the items under trainee's toolkit.
2. Institute having centralized computer lab may use the existing infrastructure to impart simulation training & in that case not required to procure item no. 2b

Annexure – A

CNC Lab						
Space and Power Requirement						
1	Space Required (in Sq. Meter):	40 (For below 8(4+4) units) 65 (For above 8(4+4) units)				
2	Power Required (in KW):	6 (For below 4(2+2) units) 12.5 (For 4(2+2) & above units)				
CNC Lab Infrastructure						
S.N.	Name of Item	Category	Quantity		Unit	Remark
			4 (2+2) units & Above	Below 4 (2+2) units		
3	CNC turn Centre [specification as per Annex-A (I)]	Machine	1	NIL	Number	Refer Instructions
4	Multimedia based simulator 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) (12 trainees + 1 faculty) <i>With help of this software the trainees should be able to Write, Edit, Verify & Simulate</i>	Software	13	13	users	
5	Desktop Computers compatible to run simulation software with LAN facility	Machine	13	13	Number	
6	Printer - (Laser/ Inkjet)	Machine	1	1	Number	Optional
7	Air Conditioner - Split - 2.0 Ton	Machine	1	1	Number	Optional
8	UPS - 2 KVA	Machine	1	1	Number	Optional
Instructions						
a)	<p>For units less than 4(2+2), ITI can enter into MoU with Facilitator who will provide the Training to Trainees admitted and undergoing training in above Trades. The Facilitator should be Government ITI, Engineering/ Polytechnic College, Recognized Training Institute, Industry, Private ITI (Facilitators are arranged in descending preference order). The Facilitator should have all the above training infrastructure. (Including CNC Machines and Multimedia software for CNC). If any of the facility is not available with facilitator then the same should be provided in the ITI. The facilities of CNC should be made available to ITI trainees at the time of examination. This clause should be part of MoU to be signed. The training provider must be within the range of 15 Km or within city whichever is less.</p>					
b)	<p>NOTE: - “It is on the discretion of the ITI that it may procure CNC simulation software with extra features in addition to the specification defined against CNC simulator”.</p>					

Annexure –A (I)

Detailed specification for 2 axis CNC Lathe / Turning centre			
1	MACHINE CAPACITY	Units	Size
a	Swing over bed	mm	350 or higher
b	Turning diameter	mm	135 or higher
c	Distance between centres	mm	250 or higher
d	Maximum Turning Length	mm	200 or higher
e	Slant angle (bed or saddle)	degrees	30 to horizontal or higher
f	Cast Iron grade for bed and saddle		Grade 25 or equivalent
g	Machine weight nett	kg	1500 or higher
2	SPINDLE		
a	Spindle nose		A2-4 / A2-5
b	Bore through Spindle	mm	35 or higher
c	Maximum spindle speed	RPM	4000 or higher
d	Spindle power, continuous	kW	3.7 or higher
e	Minimum spindle speed @ full power	RPM	1200 or lower
f	Drive		AC servo spindle motor (digital)
g	Chuck size	mm	135 or higher
h	Chuck type		3-jaw hydraulic, Hydraulic Power operated
i	Spindle bearing class		P4 class
j	Front Bearing Dia. (ID)	mm	60 or higher
3	AXES		
a	X - axis Travel	mm	100 or higher
b	Z - axis Travel	mm	200 or higher
c	Programmable feed rate- X & Z	mm/min	10 - 10000
d	Minimum programmable command - X & Z	mm	0.001
e	Rapid traverse - X & Z	m/min	20 or higher
f	Type of drive - X & Z		AC servo motor
g	Motor torque - Z axis	Nm	3 or higher
h	Motor torque - X axis	Nm	3 or higher with brake
i	Ball screw - Z & X axes (diameter x pitch)	mm	25 x 10 or higher
j	Ball screw finish - Z & X axes		Hardened and Ground
k	Ball screw class- Z & X axes		Pre-loaded with C3 or better
l	Guideway type - Z & X axes		Antifriction linear motion guideway
m	Guideway size - Z & X axes	mm	25 or higher
n	Guideway precision - Z & X axes		P class
4	TURRET		
a	Bi-Directional Tool Turret		Electromechanical/Servo/Hydraulic
b	No. of Tools	Nos.	8 or higher
c	Tool shank size	mm	20 x 20 or higher
d	Maximum boring bar diameter	mm	25 or higher
5	TAIL STOCK		
a	Quill Diameter	mm	65 or higher
b	Quill Stroke	mm	70 or higher
c	Quill Taper		MT-4 or higher
d	Quill actuation		Hydraulic
e	Tail stock base travel manual	mm	150 or higher
f	Thrust (Adjustable)	Kgf	300 or higher
6	COOLANT/LUBRICATION/HYDRAULIC		
a	Coolant tank Capacity	Litres	100 or higher

b	Coolant pump motor	kW	0.37	
c	Coolant pump out put	LPM	20 or higher	
d	Lubrication type		Automatic centralized lubrication	
e	Lubrication tank capacity	Litres	3 or higher	
f	Hydraulic pump discharge	LPM	8 or higher	
g	Hydraulic tank capacity	Litres	30 or higher	
h	Hydraulic system pressure maximum	Bar	30 or higher	
7	ACCURACY as per ISO 230-2			
a	Positioning accuracy X & Z axes	mm	0.012	
b	Repeatability X & Z axes	mm	± 0.007	
c	Geometrical Alignment		ISO 13041-Part 1	
d	Accuracy of finish test piece		ISO 13041-Part 6	
8	CNC SYSTEM			
a	Control System	FANUC /Siemens		
b	System resolution	0.001 mm		
c	Motors & Drives	Compatible with CNC controllers mentioned above		
d	Tool number display	On machine operator panel		
e	Machine control panel	Feed rate, spindle speed override knob		
f	MPG (Manual pulse generator)	On machine operator panel		
g	CNC features	Graphic Simulation, Programming help, Tool Offsets, MDI, Absolute/ Incremental Positioning, Pitch error compensation		
9	POWER SOURCE			
a	Mains supply (± 10 %)	415 V, 3 Ph., 50Hz		
b	Total connected load requirement	Approx. 15 kVA		
10	STANDARD EQUIPMENT			
a	Voltage Stabilizer	15 kVA		
b	Air conditioning unit for electrical cabinet	1 No		
	Backup CD for PLC Ladder Logic	1 No		
d	Machine lighting	1 No		
e	Levelling pads and jacking screws	4 No		
f	Operation manual	1 No		
g	Maintenance manual	1 No		
h	Installation kit	1 No		
i	Maintenance tool kit	1 No		
j	6 rack trolley (Size 25"x22"x45")with lock	1 No		
k	Machine guarding with safety compliance	1 No		
11	MAKES OF CRITICAL MACHINE TOOL COMPONENTS			
a	Linear Motion Guideways	HIWIN/THK/PMI/STAR		
b	Ball Screws	HIWIN/THK/TSUBAKI/PMI/STAR/HMT/NSK		
c	Spindle Bearings	RHP/NSK/FAG/SKF/NRB		
d	Turret	PRAGATI/BARUFFALDI/SAUTER/DUPLOMATIC		
e	Hydraulic Chuck & Cylinder	GMT/KITAGAWA/AIRTECH/PRAGATI/ROHM		
f	Hydraulic Power Pack	YUKEN/FLUID/REXROTH		
g	Panel AC	WERNER FINLEY/RITTAL/LEXTECNOID		
h	Stabilizer	NEEL/SERVOMAX/CONSUL/FARMAX/EQUIVALENT		
i	Lubrication	CENLUBE/DROP/CO/EQUIVALENT		
j	Coolant Pump	RAJAMANE/GRUNDFOS		
k	Cutting tools and holders	SANDVIK/TAEGUTEC/KENNAMETAL/SECO/ISCAR/MITSUBI SHI		
12	Cutting tools & tool holders	Quantity	Inserts	Quantity

	1 year	3 years		1 year	3 years
1. External turning holder, insert type, MWLNL	2	4	WNMG	20	40
2. External turning holder, insert type, MVJNL	2	4	VNMG	10	20
3. External turning holder, insert type, PDJNR	2	4	DNMG	10	20
4. Threading Holder - External, LH	2	4	0.5 to 2	10	30
5. Threading Holder - Internal, LH	2	4	0.5 to 2	10	30
6. Grooving Holder External, LH	2	4	3 mm	10	30
7. Grooving Holder Internal, LH	2	4	3 mm	10	30
8. Parting off Holder for insert width 2 mm, LH	2	4	2 mm	10	30
9. Boring holder SCLCL for minimum bore dia. 12 mm	2	4	WCMT	20	60
10. Boring holder SCLCL for minimum bore dia. 16 mm	2	4	CCMT	20	60
11. Internal grooving holder LH, for minimum bore dia. 12 mm.	2	4	2 mm	10	30
12. Internal threading holder LH, for minimum bore dia. 12 mm	2	4	w mm	10	30
13. Insert drill 12.7 mm	2	4	Suitable e	10 sets	30 sets
14. Reducing sleeves for internal holders - Dia 12 and 16 mm	1 set	2 sets			
15. Centre drill HSS A 2.5 x 6.3	2	6			
16. Twist drill HSS straight shank, dia 6,8,10,12 mm	2 Sets	6 sets			
17. Collets suitable for the above drills	1 Set	2 sets			
18. Collet Holder	2	4			
19. Boring bar holder	3	3			

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	20 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.

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														