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

COMPETENCY BASED CURRICULUM

CNC MACHINING TECHNICIAN

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

Directorate General of Training

CNC MACHINING TECHNICIAN

(Engineering Trade)

(Revised in March 2023)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 4

Developed By
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1. COURSE INFORMATION

During the duration of this course, the students are imparted the knowledge on CNC Machining and employability skills related to the job role and trained on Skills related to CNC Machining. The students shall undertake live projects and are expected to engage in extracurricular activities so that his morale and confidence is built up. Practical skills are imparted on the Advanced CNC Machines and the theory related to this subject is taught in a way that the students are able to use their cognitive skills and use it while executing the task assigned to them.

The course is designed in such a way that the students can program and operate any Advanced CNC Turning Center, Vertical Machining Center with ATC and fourth axis. The students are given basic knowledge of TPM, and preventive maintenance. The students shall be able to perform self-inspection of the components made by them. The broad components covered under Professional Skill subject are as below: -

FIRST YEAR: Safety being the most important thing in all the industries now a day is covered in the first year to start with. The input in this trade is always the drawing, so the students are taught to read Industrial drawings, concept of GD & T and ISO Tolerances. The students are also introduced to latest trends and other advanced technologies. The students are oriented with the computer aided machining concept and given working knowledge of types of cutting tools & selection criteria. The students are also imparted the knowledge of materials used in industry and their properties & their impact on cutting tool life. The students are trained in use of different measuring instruments used in the industry and selection of appropriate measuring instrument based on the tolerance as per component drawing.

The practical training starts with the standard operating practices of the CNC Machines based on the operating manual like referencing, checking the condition of tools, spindle orientation, checking the daily check points etc. The students are taught the basic G-codes and M-codes used for programing the CNC Turning Center, making of program and running it in various modes and optimizing the program for idle movement for cycle time.

SECOND YEAR: In the second year, the students are taught the operation and programing of Vertical Machining Center with ATC and 4^{th} axis.

The practical training starts with the standard operating practices of the VMC based on the operating manual like referencing, checking the condition of tools, spindle orientation, checking the daily check points etc. The students are taught the basic G-codes and M-codes used for programing the Vertical Machining Center, making of program and running it in various modes and optimizing the program for idle movement for cycle time. Also operating and programming of 4 & 5 axis machine, tool indexing, program creation & simulation. Preventive maintenance of machines & basic trouble shooting practices.

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 Labor market. The vocational training programs are running under aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer programs under DGT for propagating vocational training.

CNC Machining Technician trade under CTS is delivered nationwide through a network of ITIs. The course is of two years' duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) imparts professional skills and knowledge, while Core area (Employability Skills) imparts requisite core skill & knowledge and life skills. After passing out of the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Trainee broadly needs 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 maintenance work.
- Self-certify the task / job with appropriate measuring tools depending on the tolerances / quality plan.
- Check the task/job for functioning, identify and rectify errors in task/job.
- Document the technical parameters related to the task undertaken.

2.2 PROGRESSION PATHWAYS

- Can join industry as CNC Machining Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship program 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.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of two years:

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
5	Employability Skills	120	60
	Total	**1200**	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

On the Job Training (OJT)/ Group Project	150	150
Optional courses (10th/ 12th class certificate along with ITI certification, or, add on short term courses)	240	240

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification or add on short term courses.

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training program through summative assessment as notified by the DGT from time to time.

a) The **Continuous Assessment** (Internal) during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain an individual trainee portfolio as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in.

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines. The pattern and marking structure is being notified by DGT from time to time. **The learning outcome and assessment criteria will be the basis for setting question papers for final assessment. The examiner during final examination will also check** the individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one-year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

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 the assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral attitude, sensitivity to the 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 some of 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
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examining body. The following marking pattern to be adopted for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • 60-70% accuracy 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) Marks in the range of 75%-90% to be allotted during assessment	
Forth is grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices	• Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracy 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) Marks in the range of more than 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% accuracy 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.

3. JOB ROLE

CNC Machining Technician Course deals with Advanced Computer operated Machines like Vertical Machining Center, Turning Center to mass produce components with very high precision and repeatability and minimizing the rejection rates to a minimum level. The basic knowledge of workshop practices is harnessed with additional knowledge of CNC. Advanced CNC Machining Technician can read the industrial drawing and notes. As a senior technician he can decide the manufacturing Process, sequence of operations, number of set up, tooling selection and programming. As a senior technician, he can confirm and perform the feasibility study for new product development & support in calculate machining cost. A senior superior sets up, program and adjusts CNC & VMC machines with optimum feed, speed & depth of cut to increasing productivity. Understanding of parameters for machines and their effectonmanufacturingcycletimeandprovidingsupporttoeachmachinist working under his guidance. He can also coordinate and manage manufacturing processes in plant. Develop budgets for machine shop and estimating up gradation costs for various processes. Keeping record of the operations of CNC Machines like cost of tools, cost of poor quality, cost of coolant, chips generation and their disposal. Also simulating machining path of VMC & Turning Centre & calculate machining cycle time and sets control parameters to regulate machines.

Plan and organize work, detect & resolve issues during operations. Assign work to junior technicians and set goals. Manage team and be sensitive to the environment, and be amenable for self-development.

Perform TPM (Total Productive Maintenance), TQM (Total Quality Management) and record keeping as per ISO requirement.

Machining Technician; is also known as Machinist or CNC Machine Operator. The role covers operations of different machine tools performed both-manually and through automatic/CNC machines/ robots. This role primarily involves all kinds of machining and in-line inspection activities for quality verification, ad hoc repair work, change of worn out parts, gauging and deburring activities.

CNC Operator-Machining Technician; sets up base level operations of different machine tools and same can be performed both manually and through automatic machines/robots. Machining Technician Level 3 is often called Assistant Machinist, Junior Machinist, Lathe Operator, Apprentice Machinist, Semi- Skilled Operator. This role primarily involves supporting the Machine Operator in all pre machining activities, machining of the actual part, ad hoc repair work like in auto service stations, gauging, and deburring and inspection activities.

CNC Operator; is responsible for maintaining and operating CNC machine. The individual monitors gauges and dials. The individual must be proficient in programming and setting CNC machinery.

CNC Operator-Vertical Machining Centre; produces components that combine a number of different features, such as flat faces, parallel faces, faces square to each other, faces at an angle, steps/shoulders, open and enclosed slots, drilled, bored and reamed holes, internal threads, and special forms. It involves continuously monitoring, inspecting the components and meeting production targets.

CNC Setter cum Operator-Turning; sets up the CNC turning machine, its work holding devices, tooling, loading the machine operating programs, conducting trial runs and correcting faults, in order to ensure that the work output is produced as per specification.

CNC Operator-Turning; removes metal from the outer diameter of a rotating cylindrical work piece. It also involves inspecting the components and continuously monitoring of the machining operations and making minor adjustments in order to ensure that the work output is to the required quality and accuracy.

CNC Programmer; produce the component program using manual data input or by use of a remote computer, saving the prepared program on the machine controller from the computer. This involves understanding the CNC machine tools used in the process, their application and programming, editing and proving process, in adequate depth to provide a sound basis for carrying out the activities.

Metal Machine Tool Setter and Operators, Other includes; all other Machine Tool Operators engaged in operating automatic, semi-automatic and simple special purpose production machines, sawing and filing by machine, grinding by hand, cutting threads in bolts and nuts etc., and may be designated as; Automatic Machine Operator if tends and feed, one or more automatic machine tools; De-Burrer if removes burrs and rough spots from metal parts or castings by use of hand files or using emery stone; Sawing Machine Operator if cuts and files various materials using electrically powered band-type sawing and filing machines; Thread Roller if tends screw making machine in which thread is formed on screws by rolling head with circular dies by action of hardened metal dies that reciprocate, rolling screw shank between their surfaces and pressing metal of screw shank into thread form; Tapping Machine Operator if cuts internal and external threads by means of tapping machine set up and adjusted by other workers or themselves; Profile Roller etc.

Machine Shop Supervisor; role covers supervision of operations for different machine tools performed both manually and through automatic/CNC machines/robots. This role primarily involves supervising all kinds of machining and in-line inspection activities for quality verification, resolving line operation issues, review of fixtures etc.

Reference NCO-2015:

a) 7223.5001 – Machining Technician/CNC Operator
b) 7223.5002 – CNC Operator – Machining Technician
c) 7223.5003 – CNC Operator – Machinist
d) 7223.5004 – CNC Operator - Vertical Machining Centre
e) 7223.6001 – CNC Setter-cum-Operator – Turning
f) 7223.6002 – CNC Operator – Turning
g) 7223.6003 – CNC Programmer
h) 7223.9900 – Metal Working Machine Tool Setters and Operators, Others
i) 7223.0502 – Machine Shop Supervisor

Reference NOS: -

i.	CSC/N9401	x.	CSC/N9556
ii.	CSC/N9402	xi.	CSC/N9557
iii.	CSC/N9407	xii.	CSC/N9558
iv.	CSC/N9550	xiii.	CSC/N9559
v.	CSC/N9551	xiv.	CSC/N9560
vi.	CSC/N9552	xv.	CSC/N9561
vii.	CSC/N9553	xvi.	CSC/N9562
viii.	CSC/N9554	xvii.	CSC/N9563
ix.	CSC/N9555	xviii.	CSC/N9564

4. GENERAL INFORMATION

Name of the Trade	**CNC MACHINING TECHNICIAN**
NCO – 2015	7223.5001, 7223.5002, 7223.5003, 7223.5004, 7223.6001, 7223.6002, 7223.6003, 7223.9900, 7223.0502
NOS Covered	CSC/N9401, CSC/N9402, CSC/N9407, CSC/N9550, CSC/N9551, CSC/N9552, CSC/N9553, CSC/N9554, CSC/N9555, CSC/N9556, CSC/N9557, CSC/N9558, CSC/N9559, CSC/N9560, CSC/N9561, CSC/N9562, CSC/N9563, CSC/N9564
NSQF Level	Level – 4
Duration of Craftsmen Training	Two years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, CP, LC, DW, AA, BLIND, LV, DEAF, HH, AUTISM, ID, SLD
Unit Strength (No. Of Student)	24 (There is no separate provision of supernumerary seats)
Space Norms	192 Sq. m.
Power Norms	50 KW
Instructors Qualification for	
1. CNC Machining Technician Trade	B. Voc/Degree in Mechanical Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Mechanical Engineering from AICTE recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/NAC passed in the Trade of "CNC MACHINING TECHNICIAN" With three years' experience in the relevant field. **<u>Essential Qualification</u>:** Relevant Regular/RPL variants of National Craft Instructor Certificate (NCIC) under DGT. ***Note: Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.***
2. Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR**

	03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering/ Draughtsman group of trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade OR Regular/RPL variants NCIC in RoDA or any of its variants under DGT
4. Employability Skill	MBA/BBA/Any Graduate/Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
5. Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

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

5.1 LEARNING OUTCOMES

FIRST YEAR:

1. Identify & comply with the safe working practices, environmental regulation and housekeeping. (NOS: CSC/N9511)
2. Perform Turning operations on simple parts. (NOS: CSC/N9513)
3. Perform milling operations on simple components. (NOS: CSC/N9407)
4. Identify customer needs & Product specification. (NOS: CSC/N9550)
5. Draw and Interpret industrial engineering drawing & its requirements. (NOS: CSC/N9551)
6. Construct the detail drawing of Machining stages. (NOS: CSC/N9556)
7. Check the quality of surface finish adhering to Surface roughness factor. (NOS: CSC/N9563)
8. Identify the measuring instruments and inspect the quality of final product. (NOS: CSC/N9563)
9. Identify the cutting tools & apply work-piece holding techniques. (NOS: CSC/N9563)
10. Apply M code & G Code used in CNC Lathe & VMC machines. (NOS: CSC/N9552)
11. Identify CNC machines over travel limits & emergency stop, machine parts, various modes in CNC machines (Jog, MDI, Edit, Auto, Single Block, MPG). (NOS: CSC/N9564)
12. Create and edit the Linear interpolation, Rapid traverse program of CNC turning center. (NOS: CSC/N9553)
13. Create Absolute & Incremental program in CNC turning center. (NOS: CSC/N9553)
14. Create and edit the Circular interpolation CW &CCW programs in turning center. (NOS: CSC/N9553)
15. Create, simulate, execute an external profile turning operation using stock removal cycles. (NOS: CSC/N9561)
16. Create, simulate, execute an external Grooving, parting -off & threading operation using Canned cycles (NOS: CSC/N9561)
17. Demonstrate Tool nose radius compensation in CNC turning program. (NOS: CSC/N9557)
18. Perform Computer aided machining & Wire-frame Geometry Creation, Surface and Solid Modeling, Dimension, Importing and Exporting of files. (NOS: CSC/N9562)
19. Create, simulate, execute an internal profile turning operation using stock removal cycles. (NOS: CSC/N9561)
20. Create, simulate, execute an internal Grooving, parting -off & threading operation using Canned cycles (NOS: CSC/N9561)
21. Verify Toolpath Generation & Programming by using Computer Aided Manufacturing Software. (NOS: CSC/N9558)

22. Explain the need of CNC turning, VMC machines & the machining component. (NOS: CSC/N9557)
23. Explain the need of advanced CNC Turning Centre. (NOS: CSC/N9554)
24. Perform operation on advanced CNC Turning Centre. (NOS: CSC/N9554)
25. Run the CNC program or subprogram. (NOS: CSC/N9555)
26. Perform Programming of CNC Turning Centre using CAM. (NOS: CSC/N9555)
27. Perform Importing & Exporting of CNC turning Program. (NOS: CSC/N9555)
28. Perform routine maintenance & basic troubleshooting of CNC turning center. (NOS: CSC/N9555)
29. Read and apply engineering drawing for different application in the field of work. (NOS: CSC/N9401)
30. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: CSC/N9402)

SECOND YEAR:

31. Operate VMC machine. (NOS: CSC/N9559)
32. Identify VMC machines over-travel limits & emergency stop, different machine parts, different mode used (Jog, MDI, Edit, Auto, Single Block, MPG) (NOS: CSC/N9564)
33. Perform VMC movements by using G code & M code using simulator and on machine (in air). (NOS: CSC/N9552)
34. Create Programming of VMC machine. (NOS: CSC/N9559)
35. Perform Importing & Exporting of VMC Program. (NOS: CSC/N9559)
36. Create Tool path using CAM software & Verify with the help of graphical icon on CNC machines. (NOS: CSC/N9558, CSC/N9559)
37. Perform routine maintenance & basic troubleshooting of CNC VMC. (NOS: CSC/N9559)
38. Explain the need of 4 Axis Machine. (NOS: CSC/N9560)
39. Perform Operating & programming of 4 Axis Machine. (NOS: CSC/N9560)
40. Read and apply engineering drawing for different application in the field of work. (NOS: CSC/N9401)
41. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: CSC/N9402)

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Identify & comply with the safe working practices, environmental regulation and housekeeping.	Demonstrate use of Personal Protective Equipment (PPE).
	Exhibit First Aid Method and basic training.
	Precautions to be followed while working.
	Demonstrate Safe use of tools and equipment used in the trade.
	Exhibit use of Fire Extinguishers in case of Fire.
2. Perform Turning operations on simple parts.	Identify the work holding devices, like three jaw and four jaw chucks and face plates.
	Component clamping and trueing.
	Performing simple metal cutting operations like OD turning, facing, taper turning, grooving etc.
	Inspect the product quality by using measuring instrument.
3. Perform milling operations on simple components.	Work piece setup on Milling Machine.
	Loading and unloading of cutting tools.
	Identify the tool life.
	Select proper G and M codes in MDI mode or make a small program for simple operation.
	Perform basic operations like step milling, slot milling, angle milling etc.
4. Identify customer needs & Product specification.	Create check List of customer needs.
	Refinement in Customer needs and create product specification.
	Develop product specification report.
5. Draw and Interpret industrial engineering drawing & its requirements.	Read & interpret engineering drawing.
	Create a checklist of dimensions & customer specific requirements.
	Ascertain types of operations to be done.
6. Construct the detail drawing of Machining stages.	Create machining set up stage detail drawing.
	Prepare process flow diagram of machining operation.
	Check process flow diagram of machining operation for its correctness.
7. Check the quality of surface finish adhering to Surface roughness factor.	Understanding of different surface roughness symbols.
	Identifying the machining process with help of surface finish symbol.
	Decide speed / feed required for required surface finish

8. Identify the measuring instruments and inspect the quality of final product.	Select appropriate measuring instrument.
	Create product quality inspection report.
	Prepare check sheet / report to confirming product quality before dispatch.
9. Identify the cutting tools & apply work-piece holding techniques.	Identify cutting tools& its Holders.
	Select and hold appropriate cutting tool.
	Use jigs & fixture for work piece holding using basic engineering principles.
10. Apply M code & G Code used in CNC & VMC machines.	Identify the G code & list out the machine movement.
	Identify M code & list out the machine movement.
	Understand safe starting codes.
	Create simple turning programme using G code & M code.
11. Identify CNC machines over travel limits & emergency stop, machine parts, various modes in CNC machines (Jog, MDI, Edit, Auto, Single Block, MPG).	Set tool offset with the help of jog mode.
	Set the maximum bed travel limit with the help of jog mode.
	Create a program and run with multiple functional option.
	Edit a created program.
12. Create and edit the Linear interpolation, Rapid traverse program of CNC turning center.	Create and run program with G00 and dry run the machine
	Create and run program with G01 and dry run the machine
13. Create Absolute & Incremental program in CNC turning center	Perform absolute & incremental programming.
	Test the programme
14. Create and edit the Circular interpolation CW & CCW programs in turning center.	Create and run MDI program with G02 and dry run the machine.
	Create and run MDI program with G03 and dry run the machine.
	Create and run circular interpolation by R.
	Create and run circular interpolation by I, J, K method.
15. Create, simulate, execute an external profile turning operation using stock removal cycles	Plan to create external profile turning.
	Simulate external profile turning operation.
	Perform different types of turning operation.
	Execute profile turning using stock removal cycle
16. Create, simulate, execute an	Plan to create external grooving.
	Simulate external grooving and parting off.

external Grooving, parting -off & threading operation using Canned cycles	Perform different types of threading operation.
	Execute Grooving, parting -off & threading operation using Canned cycles
17. Demonstrate Tool nose radius compensation in CNC turning program.	Create and run MDI program to verify with G40 & run with single block mode option.
	Create and run MDI program to verify with G41 & run with single block mode option.
	Create and run MDI program to verify with G42 & run with single block mode option.
18. Perform Computer aided machining & Wire-frame Geometry Creation, Surface and Solid Modeling, Dimension, Importing and Exporting of files.	List out the benefits of computer aided machining/ manufacturing technologies.
	Create a model using geometric creation tool.
	Importing & exporting of sample library files.
19. Create, simulate, execute an internal profile turning operation using stock removal cycles	Plan to create internal profile turning.
	Simulate internal profile turning operation.
	Perform different types of turning operation.
	Execute profile turning using stock removal cycle
20. Create, simulate, execute an internal Grooving, parting -off & threading operation using Canned cycles	Plan to create internal grooving.
	Simulate internal grooving and parting off.
	Perform different types of threading operation.
	Execute Grooving, parting -off & threading operation using Canned cycles
21. Verify Toolpath Generation & Programming by using Computer Aided Manufacturing Software.	Generate Toolpath using CAM software.
	Verification Programming by using simulator
	Generated NC program and transfer to machine by using transfer media.
	Export the generated NC program for machining process
22. Explain the need of CNC turning, VMC machines & the machining component.	Identify the manufacturing process for CNC turning or Milling operation.
	Understand the number of components to be machined.
	Selection of machining process to meet design shape intent.
	Mount fixture and set its work coordinates.
23. Explain the need of advanced CNC Turning Centre.	Identifying the CNC turning center features & its components.
	Set the program and fixture for mass production.
	Select the cutting tools & holders for simple step turning CNC Turning operation.
24. Perform operation on advanced	Start the machine by following standard operating procedure

CNC Turning Centre.	of Machine.
	Referencing of machine axis.
	Referencing of tool holder/ turret.
	Identify the wear out cutting tools & replace the cutting tool.
	Resetting the tool wear offset value.
25. Run the CNC program or subprogram.	Select the program & run sub program from the main program by controlling speed & feed.
	Call sub program in main program.
	Explain codes for entering in sub program and going back to main program.
26. Perform Programming of advanced CNC Turning Centre using CAM.	Identify and select tooling as per machining material.
	Create a program& dry run the same physical verification of program.
	Create& edit in the existing program.
27. Perform Importing & Exporting of CNC turning Program.	Import external CNC program.
	Export CNC program through machine.
28. Perform routine maintenance & basic troubleshooting of CNC turning center.	Check & top up lubrication oil.
	Verify the clamp-declamp of spindle tool.
	Verifying machining center height.
29. Read and apply engineering drawing for different application in the field of work.	Read & interpret the information on drawings and apply in executing practical work.
	Read & analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
30. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	Solve different mathematical problems
	Explain concept of basic science related to the field of study
SECOND YEAR	
31. Operate advanced VMC machine.	Start the machine by following standard operating procedure of machine.
	Referencing of machine axes.
	Referencing of tool holder/ turret.

	Tool wear offset.
	Identify the wear out cutting tools & replace the cutting tool.
	Resetting the tool wear offset after replacing the cutting tool.
32. Identify VMC machines over-travel limits & emergency stop, different machine parts, different mode used (Jog, MDI, Edit, Auto, Single Block, MPG).	Offset tool with the help of jog mode.
	Create a program in MDI mode.
	Create a program and run with single block option.
	Create a program and run with auto option mode.
33. Perform VMC movements by using G code & M code using simulator and on machine (in air).	Create and run MDI program with various G code for Rapid traverse & M code and verifying the movements in machine.
	Create and run MDI program with various G code for feed travel.
	Create and run the program for absolute position.
	Create and run the program for incremental position.
34. Create Programming of advanced VMC machine.	Identify and select tooling as per machining material.
	Create a program & dry run the same physical verification of program.
	Create& edit in the existing program.
35. Perform Importing & Exporting of VMC Program.	Importing of external program.
	Exporting of VMC program through machine.
	Make various folders in memory for types of jobs/ customer wise / Operator wise.
36. Create Tool path using CAM software & Verify with the help of graphical icon on CNC machines.	Create a complex machining part program with the help of Advance computing software.
	Identify the tool path by VPS graphical ICON system.
37. Perform routine maintenance & basic troubleshooting of CNC VMC.	Check & top up lubrication oil.
	Verify the clamp-de clamp arm for automatic tool changer.
	Lubricate the telescope.
	Tightening & verifying of spindle belt.
38. Explain the need of 4 Axis Machine.	Verify part drawing and identify requirement of 4th or 5th axis requirement.
	Identify the axis & define the machining operation over the particular axis by taking complex shape from mold & dies industries.
	Explain referencing of 4th axis.

39. Perform Operating & programming of 4 Axis Machine.	Referencing of 4 axis machine.
	Referencing of ATC (Automatic tool changer).
	Operating of 4 Axis machine.
	Identifying and replacing of machining cutting tool.
	Programming & set up of axis machine.
40. Read and apply engineering drawing for different application in the field of work.	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
41. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	Solve different mathematical problems
	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS FOR CNC MACHINING TECHNICIAN TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcomes**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Identify & comply with the safe working practices, environmental regulation and housekeeping.	1. Importance of safety training, List of cutting tools & Machinery used in the workshop. 2. Basic need of Personal Protective Equipment (PPE). 3. First Aid Method and basic training. 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. 5. Hazard identification and avoidance. 6. Safety signs for Danger, 7. Warning, caution & personal safety message. 8. Preventive measures for electrical accidents & steps to be taken in such accidents. 9. Identifying different types of Fire Extinguishers, and their use in case of Fire. 10. Practice and understand precautions to be followed while working in fitting jobs. 11. Safe use of tools and equipment's used in the trade.	• All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. • Soft Skills, its importance and Job area after completion of training. • Importance of safety and general precautions observed in the in the industry/shop floor. • Introduction of First aid. Operation of electrical mains and electrical safety. Introduction of PPEs. • Response to emergencies e.g.; power failure, fire, and system failure. • Importance of housekeeping & good shop floor practices. Introduction to 5S concept & its application. • Occupational Safety & Health: Health, Safety and Environment guidelines, legislations & regulations as applicable. • Basic understanding on Hot work, confined space work and material handling equipment.

Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Perform Turning operations on simple parts.	12. Demonstrate the different parts of the Lathe. 13. Demonstrate different work holding devices, accessories, tool holders & cutting tools used for different operations. 14. Hold a work piece in chuck and true it. 15. -Performing Face turning operations and measure. 16. Performing OD turning (Plain & Step) operations and measure . 17. Perform taper turning operation and measure. 18. Performing grooving operations and measure. 19. Perform threading operation -external 20. Perform knurling operation. 21. Perform drilling operation 22. Perform boring operation. 23. Perform threading operation-internal.	Fundamentals of work piece rotation. Three jaw / four jaw chucks / face plate clamping of work piece. Tool post, tail stock and its setting to adjust taper. Center height adjustment of Tool Orientation of simple turning operation. Inspection quality of product by using measuring instruments like Vernier, micrometer etc.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Perform milling operations on simple components.	24. Demonstrate the different parts of the milling machine (horizontal, vertical). 25. Demonstrate different work holding devices, accessories, tool holders & cutting tools used for different operations. 26. Work piece setup on Milling Machine, aligning the component. 27. Loading unloading of	Different types of milling machine configurations like horizontal, vertical, Knee type, universal head type etc. Different types of Tools used and the method of clamping. Fundamentals of Cutting speed, feed. Identification of worn out tools.

		cutting tool in spindle. 28. Selecting the proper feed and speeds. 29. Segregate ok and worn out cutting tools. 30. Perform basic operations like step milling, slot milling, angle milling etc.	
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Identify customer needs & Product specification.	31. Prepare check List of customer needs. 32. Refinement in customer needs & select optimum requirement. 33. Develop product specification report.	Introduction to product design and development. Customer's requirements &specification. Importance of customer relationship management.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Draw and Interpret industrial engineering drawing & its requirements.	34. Reading of industrial drawing. 35. List out the symbols used in industrial drawing. 36. Create a checklist of dimensions & customer specific requirements. 37. Apply the Geometric dimension & tolerances Symbol on drawing to intent of component in assembly of final product.	Introduction to engineering drawing. Fundamentals of limits fits & tolerances & symbols. Importance of inter change ability & ISO standards. Understand industrial Engineering special Characteristic symbol, Customer specific standards drawing and notation, geometrical dimensions & tolerances. Symbols used in Industrial machining drawing like surface finish, machining operation, surface treatment, GD&T, etc.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Construct the detail drawing of Machining stages.	38. Create the machining operation process flow diagram. 39. Create a stage drawing for step turning operation. 40. Create CNC Lathe /VMC 1st set up stage detail drawing. 41. Create 2nd Set up stage	Introduction to machining procedure from raw material to finished product. Concept of process flow of machining operation. Concept Work-piece holding. Importance of multi stage drawing.

		detail drawing for step turning.	
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Check the quality of surface finish adhering to Surface roughness factor.	42. List out the importance of surface finish 43. Identify the surface finish requirement. 44. Apply surface finish symbol on machining parameter. 45. Improve surface finish quality by using post process manufacturing operation.	Introduction to surface finish and its' Importance. International standards & symbols used to represent surface finish Concept of surface finish calculation of Ra, Rt, Rz, R3z, etc. Introduction to improve surface finish quality. Introduction of post process manufacturing operation to improve surface finish quality.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Identify the measuring instruments and inspect the quality of final product.	46. Select appropriate instrument to measure the component like Vernier caliper, micrometer. 47. Prepare quality / inspection check list for confirming the product quality. 48. Create incoming inspection report. 49. Create in process inspection report. 50. Create final pre-dispatch inspection report. 51. Before dispatch make check sheet report to confirming product quality before dispatch.	Introduction to quality of product. Concept of quality control & quality assurance of product. Introduction to inspection instruments. Importance of calibration of inspection instruments. Inspection instrument handling Standard guidelines / procedure to minimize the human error. Concept of inspection instruments Properties of gauges.
Professional Skill 53 Hrs.; Professional Knowledge 07Hrs.	Identify the cutting tools &apply work-piece holding techniques.	52. Understand how multi-point cutting tool is named. 53. Identify cutting tools & Holders. 54. Hold single point cutting tool and perform operation. 55. Add soluble cutting oil in	Understand the cutting tools, holders & its types. Nomenclature of cutting tools & its machining process parameter. Selection of cutting tools & Holders Cutting fluid & its importance Selection of cutting

		water for a proper concentration of coolant how to check coolant concentration. 56. Mount a drilling jig to hold square block to perform operation.	fluid & coolant used for machining. Concept of work piece holding devices and references. What are work-piece holding devices. Understand the Jigs & fixture.
Professional Skill 53 Hrs.; Professional Knowledge 07Hrs.	Apply M code & G Code used in CNC Lathe & VMC machines.	57. Identify the G code as per requirements 58. Identify the M code as per requirements 59. Use various cycle end codes.	Introduction to G code. Introduction to M code Concept of block number, end of block.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Identify CNC machines over travel limits & emergency stop, machine parts, various modes in CNC machines (Jog, MDI, Edit, Auto, Single Block, MPG).	60. Taking tool offset with the help of jog mode. 61. Find out the maximum bed travel limits in jog mode. 62. Create a program in MDI mode. 63. Create a program and run with single block option. 64. Search an existing program and edit on same page.	Concept of CNC turning center over travel limits. Importance Emergency stop function key. Concept of CNC turning center mode like Jog, MDI, Edit, Auto, Single Block, MPG.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Create and edit the Linear interpolation, Rapid traverse program of CNC turning center.	65. List out the importance of GOO code in program. 66. List out the importance of GO1 code in program. 67. Create and execute program to verify (G00 & G01) Linear interpolation & Rapid traverse.	Orientation of machine movement. Identify the direction of machine movement by using Jog mode. Concept of tool travel with Linear interpolation. Rapid traverse.

Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Create Absolute & Incremental program in CNC turning center.	68. Create and execute program to verify (G90) Absolute programming. 69. Create and execute program to verify (G91) Incremental programming.	Concept & impact of Absolute programming. Concept of Incremental programming in CNC turning program.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Create and edit the Circular interpolation CW & CCW programs in turning center.	70. Create and execute program to verify (G02)/(G03) Circular interpolation CW/CCW. 71. Manual generation of circular interpolation by using I,k code.	Concept of spindle set up to Circular interpolation CW& Circular interpolation CCW Concept of circular interpolation by using I, k code
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Create, simulate, execute an external profile turning operation using stock removal cycles.	72. Create, simulate, execute external profile using turning, facing & pattern repeat cycles.	Concept of stock removal cycles and purpose.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Create, simulate, execute an external Grooving, parting - off & threading operation using Canned cycles	73. Create, simulate, execute operations of external groove and parting-off using a canned cycles. 74. Create, simulate, execute external threading (Straight, taper and multi start) using a canned cycles.	Concept of grooving, parting off and threading cycles and purpose. Calculation of Threading parameters

Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Demonstrate Tool nose radius compensation in CNC turning program.	75. Create and execute program to verify (G41) Tool nose radius compensation left. 76. Create and execute program to verify (G42) Tool nose radius compensation right. 77. Create and execute program to verify (G40), tool nose radius compensation cancel.	Concept of Tool nose radius compensation. Its impact on shape of part & cutting tool life. Explain codes used for Tool nose radius compensation.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Create, simulate, execute an internal profile turning operation using stock removal cycles.	78. Create, simulate, execute internal profile using turning, facing & pattern repeat cycles.	Concept of stock removal cycles and purpose.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Create, simulate, execute an internal Grooving & threading operation using Canned cycles	79. Create, simulate, execute operations of internal groove using a canned cycles. 80. Create, simulate, execute internal threading (Straight, taper and multi start) using a canned cycles.	Concept of grooving and threading cycles and purpose. Calculation of Threading parameters
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Perform Computer aided machining & Wire-frame Geometry Creation, Surface and Solid Modeling, Dimension, Importing and Exporting of files.	81. List out the computer aided manufacturing software & its industrial application. 82. Customize the quick access tool bar. 83. Customize the ribbon. 84. Importing & exporting of sample library files. 85. Creation of 3D solid modeling geometry.	Introduction to the computer aided manufacturing software. Learn all its syntax. Open / modify a file in CAM software Concept of toolbar & ribbon Setting attribute & user interface orientation.
Professional	Verify Toolpath	86. Import the 3D model.	Import the 3D model

Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Generation & Programming by using Computer Aided Manufacturing Software.	87. List out the importance of toolpath generation. 88. Select and upload cutting tool library in CAM software. 89. Run the simulation tool on 3D model for virtual verification of tool path. 90. Generate a NC Program by using Computer Aided Manufacturing Software. 91. Export the generated NC program for machining process.	Start machine simulation in Computer Aided Manufacturing Software. Run a simulation in Computer. Aided Manufacturing Software. Generate the NC Program. Export the NC program for machining.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Explain the need of CNC turning, VMC machines & the machining component.	92. Identify the manufacturing process. 93. Select machining sequence for part program to meet design shape intent. 94. Select the machine (CNC & VMC) to achieve designed shape.	Introduction to manufacturing processes. Concept of machining a component & its process. Design concept in assembly of parts, its tolerances mentioned in drawing to perform designed task. Introduction to CNC lathe & VMC milling machine. Concept of NC machine controllers (Fanuc, Siemens, Mitsubishi, HAAS, etc.) Importance Emergency stop key on machine.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Explain the need of advanced CNC Turning Centre.	95. Identifying the CNC turning center features & its components. 96. Select the cutting tools & holders for simple step turning CNC turning operation.	Introduction to CNC turning Centre & its Coordinate System Cutting tools & holder for CNC turning center. Work-piece holding devices. Introduction Turn mill Centre/ Dual spindle / Sub Spindle.
Professional Skill 25 Hrs.; Professional Knowledge	Perform operation on advanced CNC Turning Centre.	97. Start machine by following the standard operating procedure of machine. 98. Referencing of machine	Operating of Advanced CNC Turning Centre Concept of axis & Coordinate System used in CNC turning Centre.

05 Hrs.		axes 99. Referencing of tool holder/ turret. 100. Identify the axes of machine + and – travel of axes & travel range of tool holder turret. 101. Run the program in single block set up by adjusting speed, feed & depth of cut. 102. Inspect the operating parameter defined in machining control plan. 103. Run the program in auto mode in single block. 104. Identify the wear out cutting tools & replace the cutting tool. 105. Resetting the tool wear offset.	Overview of Control Panel Key functions. Identifying & replacing of cutting tools in CNC turning Centre. Concept of tool wear & offsets used for machining Reading of machining control plan & understanding of operating parameter inspection.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Run the CNC program or subprogram.	106. Create a program using subroutine codes 107. Select the program & run sub program from the main program by controlling speed & feed.	Concept of sub programming Concept of block in CNC turning programming.
Professional Skill 110 Hrs.; Professional Knowledge 40 Hrs.	Perform Programming of CNC Turning Centre using CAM.	108. Identify and select tooling as per machining material 109. Create a simple step turning & facing program. 110. Create a complex machining part program with the help of CAM software. 111. Setup work-piece. 112. Calculate machine	Introduction to CNC Turning Centre Program using CAM. Selection of Tools depending on material to be cut. Program creation tools & techniques. Generation of complex machining part program with the help of CAM software. Tool path optimization Cycle time calculation.

		operation efficiency with the help cycle time. 113. Create a program of Grooving/Threading on OD/ID in CNC turning.	Machine offset Cutter tool nose radius Compensation. Concept of Interpolation and Canned Cycles.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Perform Importing & Exporting of CNC turning Program.	114. File/folder transfer between workstation and CNC. 115. Classification of program and creation of directory folders as per operator, job, customer etc. 116. Import and export of external CNC machining program.	Importance of program exchange between system and machine. Concept of importing & exporting of CNC program.
Professional Skill 24 Hrs.; Professional Knowledge 06 Hrs.	Perform routine maintenance & basic troubleshooting of CNC turning center.	117. Perform routine maintenance as per the OEM recommendations.	Basic maintenance of turning machine. Routine maintenance. Basic troubleshooting of CNC machine. Introduction to TPM (Total Productive Maintenance) Explain pillars of TPM and its importance in improving production.
Engineering Drawing: (30 hrs)			
Professional Knowledge ED- 30	Read and apply engineering drawing for different application in the field of work.	**<u>Engineering Drawing:</u>** Introduction to Engineering Drawing and Drawing Instruments – • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Lines- Types and applications in drawing Free hand drawing of – • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches.	

		• Free hand drawing of hand tools and measuring tools. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Lettering & Numbering – Single Stroke. Dimensioning - • Types of arrowhead • Leader line with text • Position of dimensioning (Unidirectional, Aligned) Symbolic representation – • Different symbols used in the related trades. Concept and reading of Drawing in • Concept of axes plane and quadrant • Concept of Orthographic and Isometric projections • Method of first angle and third angle projections (definition and difference) Reading of Job drawing of related trades.
Workshop Calculation & Science: (30 Hrs.)		
Professional Knowledge WCS- 30	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**<u>Workshop Calculation & Science:</u>** **Unit, Fractions** • Classification of unit system • Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units • Measurement units and conversion • Factors, HCF, LCM and problems • Fractions - Addition, substraction, multiplication & division • Decimal fractions - Addition, subtraction, multilipication & division • Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** • Square and suare root • Simple problems using calculator (Only direct problems) • Applications of pythagoras theorem and related problems • Ratio and proportion • Ratio and proportion - Direct and indirect proportions • Percentage • Percentage - Changing percentage to decimal and fraction **Material Science** • Types metals, types of ferrous and non ferrous metals • Physical and mechanical properties of metals • Introduction of iron and cast iron • Difference between iron & steel, alloy steel and carbon steel • Properties and uses of insulating materials **Mass, Weight, Volume and Density** • Mass, volume, density, weight and specific gravity

		Speed and Velocity, Work, Power and Energy • Work, power, energy, HP, IHP, BHP and efficiency (Definition only) **Heat & Temperature and Pressure** • Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals • Transmission of heat - Conduction, convection and radiation • Co-efficient of linear expansion **Basic Electricity** • Introduction and uses of electricity, molecule, atom, how electricity is produced, electric current AC,DC their comparison, voltage, resistance and their units **Mensuration** • Area and perimeter of square, rectangle and parallelogram • Area and perimeter of Triangles • Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse • Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder • Finding the lateral surface area, total surface area and capacity in litres of hexagonal, conical and cylindrical shaped vessels **Trigonometry** • Measurement of angles • Trigonometrical ratios • Trigonometrical tables
In-plant training/ Project work **Broad area:** a) Visit to CNC manufacturing industry/ nearby industry involving CNC operation for production purpose. b) Conduct preventive maintenance of workshop available CNC turning center. c) Performing job work as per industrial requirements.		

SYLLABUS FOR CNC MACHINING TECHNICIAN TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcomes**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill 45 Hrs.; Professional Knowledge 15 Hrs.	Operate VMC machine.	118. Identifying the VMC Machining features & its components. 119. Start the machine by following standard operating procedure through dialog box of machine. 120. Referencing of machine axis. 121. Referencing of tool holder/ turret. 122. Identify the axis of machine & travel range of bed table. 123. Run the program in single block set up by adjusting speed, feed & depth of cut. 124. Check all operating parameter defined in machining control plan. 125. Run the program in auto mode in single block. 126. Identify the wear out cutting tools & replace the cutting tool. 127. Resetting the tool wear offset.	Introduction to Vertical Machining Centre. Concept of axis & Coordinate System. Overview of Control Panel Key Functions. Concept of speed, feed & machining depth of cut. Identifying & replacing of cutting tools. Concept of tool wear & offsets used for machining. Reading of machining control plan & understanding of operating parameter inspection.
Professional Skill 45 Hrs.; Professional Knowledge 15 Hrs.	Identify VMC machines over-travel limits & emergency stop, different machine parts, different mode used (Jog,	128. Taking tool offset with the help of jog mode. 129. Identify the maximum bed travel limit with the help of jog mode. 130. Create a program in MDI mode.	Concept of over travel limits in VMC machines. Importance Emergency stop function key. Concept of VMC mode like Jog, MDI, Edit, Auto, Single Block, MPG.

	MDI, Edit, Auto, Single Block, MPG)	131. Create a program and run with single block option. 132. Create a program and run with auto option mode. 133. Find the existing program and edit on same page.	
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Perform VMC movements by using G code & M code using simulator and on machine (in air)	134. Create, simulate and execute program to verify (G00 & G01) Linear interpolation & Rapid traverse to verify (G90 & G91) Absolute programming & Incremental programming. 135. Create, simulate and execute program to verify (G02 & G03) Circular interpolation CW & Circular interpolation CCW. 136. Create, simulate and execute program to verify (G40, G41 & G42) cutter radius compensation.	Use of MDI function key. VMC Machine movement on various G codes & M codes.
Professional Skill 285 Hrs.; Professional Knowledge 75 Hrs.	Create Programming of VMC machine.	137. Identifying and selection of tooling as per machining material. 138. Setup the Work-piece and take work offset & tool offsets. 139. Create, simulate and Dry run the program for verifying actual tool path & foul with object for face milling. 140. Create , simulate and execute the program face milling in auto single block and auto continuous. 141. Create, Simulate & Execute Contour programming with	Introduction to VMC Machine Program. Concept of machining material & Tooling selection. Concept of G Codes and M Codes used in machine programming. Program creation tools & techniques. Cycle time calculation Machine. Work Piece Set Up and offset measurement Absolute and Incremental Positioning System. Cutter tool nose Compensation. Concept Interpolation and

		subroutine. 142. Create, Simulate & Execute Pocket Programming (Circular & Rectangular) . 143. Create, Simulate & Execute Spigot (Circular & Rectangular). 144. Create, Simulate & Execute Polygonal Milling with Polar Co-Ordinates 145. Create, Simulate & Execute Scaling, Mirroring, & Rotation 146. Create, Simulate & Execute a program using canned cycles. 147. Create a program & perform machining operation as per job card (Customer requirement).	Canned Cycles.
Professional Skill 25Hrs.; Professional Knowledge 05 Hrs.	Perform Importing & Exporting of VMC Program.	148. Importing of external VMC machining program. 149. Exporting of VMC program through machine.	Making a directory. Concept of importing & exporting of VMC program.
Profession al Skill 150 Hrs.; Professional Knowledge 30 Hrs.	Create Tool path using CAM software & Verify with the help of graphical icon on CNC machines.	150. Create, Simulate & Execute a complex machining part program	Generation of complex machining part program with the help of CAM software. Concept of Tool Path Verifications on CNC machines.

Professional Skill 70 Hrs.; Professional Knowledge 20 Hrs.	Perform routine maintenance & basic troubleshooting of CNC VMC.	151. Perform routine maintenance as per the OEM recommendations.	Basic maintenance of VMC. Routine maintenance. Basic troubleshooting of CNC machine.
Professional Skill 45 Hrs.; Professional Knowledge 15 Hrs.	Explain the need of 4 Axis Machine.	152. Identify the axis & define the machining operation over the particular axis by taking complex shape	Concept of Rotary axis.
Professional Skill 150 Hrs.; Professional Knowledge 30 Hrs.	Perform Operating & programming of 4 Axis Machine.	153. Align 4th axis on machine w. r. t. x, y and z axes. 154. Referencing of 4th axis machine. 155. Operating of 4 Axis machine. 156. 4 Axis Rotary Programming.	Introduction to indexer & its importance. Concept 4 Axis Machining (step wise and continuous). Introduction of referencing of 4th axis.
Engineering Drawing: (60 hrs)			
Professional Knowledge ED- 60	Read and apply engineering drawing for different application in the field of work.	**Engineering Drawing:** • Reading of drawing of nuts, bolt, screw thread, different types of locking devices e.g., Double nut, Castle nut, Pin, etc. • Reading of foundation drawing • Reading of Rivets and rivetted joints, welded joints • Reading of drawing of pipes and pipe joints • Reading of Job Drawing, Sectional View & Assembly view	
Workshop Calculation & Science: (30 Hrs.)			
Professional Knowledge WCS-30	Demonstrate basic mathematical concept and principles to perform practical	**Workshop Calculation & Science:** **Friction** • Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction • Friction - Lubrication	

	operations. Understand and explain basic science in the field of study.	• Friction - Co- efficient of friction, application and effects of friction in workshop practice **Centre of Gravity** • Centre of gravity - Centre of gravity and its practical application **Area of cut out regular surfaces and area of irregular surfaces** • Area of cut out regular surfaces - circle, segment and sector of circle • Related problems of area of cut out regular surfaces - circle, segment and sector of circle • Area of irregular surfaces and application related to shop problems **Elasticity** • Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus • Elasticity - Ultimate stress and working stress **Heat Treatment** • Heat treatment and advantages (Only overview required) • Heat treatment - Different heat treatment process – Hardening, tempering, annealing, normalizing and case hardening (Only overview required) **Estimation and Costing** • Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade • Estimation and costing - Problems on estimation and costing
In-plant training/ Project work **Broad area:** a) Visit to VMC manufacturing industry/nearby industry involving VM Cooperation for production. b) Conduct preventive maintenance of workshop available VMC machine. c) Performing job work as per industrial requirements.		

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs. + 60 Hrs.)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in / dgt.gov.in

ANNEXURE-I

LIST OF TOOLS AND EQUIPMENT			
CNC MACHINING TECHNICIAN (For 24 Candidates)			
Sl. No.	**Name of the Tool & Equipment's**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1.	Steel rule	300 mm & 600 mm graduated both in English & Metric units	24 Nos.
2.	Hand Gloves	_	24 Nos.
3.	Safety Shoes	_	24 Nos.
4.	Goggles	_	24 Nos.
B. GENERAL MACHINERY / SOFTWARE INSTALLATIONS			
5.	Computer Aided Manufacturing Software	3 + 1 axis milling and 2 axis lathe	24 Nos +1
6.	Vertical Machining Center with 4th axis (3 +1) (Fanuc, Siemens, Mitsubishi, Haas, Mazatrol control systems of latest version)`	Axis travel Min, X: 406 x Y: 305 x Z: 254 mm BT40 taper, belt drive 5.5/7.5 Kw, Rapid 10-30 m/min, 10-15" Color LCD Monitor, Program Memory, Ethernet, USB Port, Coolant window cleaning. IIoT Ready, spindle speed 6000 rpm, 10 station or more ATC, 1/4 hp (186 W),40-gallon (151 liter) tank; includes coolant level sensor , 4th axis servo rotary table 160 mm,	1 No.
7.	VMC Simulator	NC Controller Identical Simulator (Mill)with software	1 No.
8.	CNC Simulator	NC Controller Identical Simulator (Lathe)with software	1 No
9.	Voltage Stabilizer	40 kVA	1 No.
10.	Electrical cable	Standard	1 No.
11.	Copper Earthing Rod	Standard	1 No.
12.	Hand Tool Set	Standard	1 No.
13.	Job Clamping kit		1 Set
14.	Tooling Set BT40(face mill, collet holder, tapping attachment, edge finder, dial test indicator, set of collets ER 32)	Standard	1 Set.
15.	6"Manual Vise		1 No.
16.	First fill of oils		1 No.
17.	Tool trolley		1 No.

18.	CNC Simulation software	in-conversant with CNC machine controller	24 Nos. +1
19.	UPS	5 KVA with Battery & Trolley	1 No.
20.	Industrial Workstation	32 GB RAM, NVIDIA Qdr 4GB, Intel XeonW-2123 3.6 4C, 1TB HDD, USB Keyboard & USB Optical Mouse	24 Nos
21.	Monitor	Min 17" IPS Display, Narrow Bezel	24 Nos.
22.	Server with rack	Intel Xeon Silver 4114 2.2G (or equivalent), 10C/20T,9.6GT/s, 14M Cache, Turbo, HT (85W) DDR4-2400, 600GB x 5nos. 10KRPM SAS, 12Gbps 512n 2.5in Hot plug Hard Drive	1 No.
23.	Air Compressor	3 HP	1 No.
24.	CNC Tool room Lathe/CNC Turning Center (Fanuc, Siemens, Mitsubishi, Haas, Mazatrol control systems of latest version)	Max. Cutting dia. 406 mm Max. Cutting Length 762 mm Max. Part Swing dia. 508 mm X: 203 mm / Z: 762 mm 1,800-rpm, Spindle nose A2-5, Drive 5.5/ 7.5 kW rapid traverse rate 10-30 m/min 10" Color LCD Monitor or bigger, Program Memory, Memory Lock Key switch, Ethernet, USB Port, IIoT Ready 4 or more station automatic tool turret, 200mm dia power operated chuck, Universal Slant bed.	1 No.
25.	Cutting tools	External – turning (roughing & finishing), grooving, threading, parting, Internal - Boring (roughing & finishing), threading, grooving. Drill adaptor (ER32)	1 Set
C. TOOLS, INSTRUMENTS AND GENERAL SHOP OUT FITS			

35.	"V" block	V-Block pair 70 mm with Clamps	02 Nos.
36.	"V" block	V-Block 150 mm with clamps	02 Nos.
37.	Micrometer Outside	0-25, 25-50, 50-75 mm outside	03 Nos each
38.	Vernier Caliper	150, 300 mm	02 Nos.each
39.	Micrometer Inside	up to 20 mm	02 Nos.
40.	Try square	150mm	02 Nos.
41.	Try square	300 mm	02 Nos.
42.	Angle Plate	100 x 200 mm.	02Nos.
43.	Spirit Level	150mm metal	02Nos.
44.	File warding	150mm smooth	05 Nos.
45.	File knife edge	150mm smooth	05 Nos
46.	File cut saw	150mm smooth	05 Nos
47.	File feather edge	150mm smooth	05 Nos
48.	File triangular	150mm smooth	05 Nos
49.	File round	200mm second cut	05 Nos
50.	File square	150mm second cut	05 Nos
51.	File square	250mm second cut	05 Nos
52.	File triangular	200mm second cut.	05 Nos
53.	File flat	300 mm second cut.	05 Nos
54.	File flat	200 mm bastard	05 Nos
55.	File flat	300 mm bastard.	05 Nos
56.	File Swiss type	Needle set of 12.	05 Nos
57.	File half round	250 mm second cut.	05 Nos
58.	File half round	250 mm bastard.	05 Nos
59.	File round	300 mm bastard.	05 Nos
60.	File hand	150 mm second cut.	05 Nos
61.	Card file.	----	05 Nos
62.	Oil Stone	150 mm x 50 mm x 25 mm	05 Nos
63.	Pliers combination	150 mm	05 Nos
64.	Spanner	D.E. 6 -26 mm set of 10 pcs.	05 set
65.	Spanner adjustable	150 mm	05 Nos
66.	Box spanner	Set 6-25 mm set of 8 with Tommy bar.	05 Nos
67.	Glass magnifying	70 mm	05 Nos
68.	Clamp toolmaker	50 mm and 75 mm set of 2.	05 Nos
69.	Clamp "C"	50 mm	05 Nos
70.	Clamp "C"	100 mm	05 Nos
71.	Scraper flat	150 mm.	02 Nos

72.	Scraper triangular	150 mm	02 Nos
73.	Scraper half round	150 mm	02 Nos
74.	Chisel	cold 9 mm cross cut 9 mm diamond.	02 Nos
75.	Chisel	cold 19 mm flat	02 Nos
76.	Chisel	cold 9 mm round nose.	02 Nos
77.	Hand hammer	1 kg. with handle Ball Peen	05 Nos
78.	Hacksaw	frame fixed 300 mm.	05 Nos
79.	Mallets	----	05 Nos
80.	Hand Drilling Machine	Rated input power: 600W, Power output: 301W, Rated torque: 1.8 Nm	01 Nos
81.	Power Saw		01 Nos
82.	Pedestal Grinder		01 Nos
83.	Torque Wrench	Range: 20 to 280 Nm	01Nos
84.	Surface Plate	Cast iron 400 mm x 400 mm grade 1 with stand	01 No.
85.	Screw Pitch Gauge		01 Nos.
86.	Allen Screwdriver Wrench Tool	6Pcs T Handle Ball Ended Hex Key	02 set.
87.	Universal Quick Adjustable Multi-function Wrench Spanner	Range: 6-32mm	02 Nos.
88.	Double Ended Wrench Hex Socket Spanner	8 In 1, Range: 6-32mm	02 sets

ANNEXURE-II

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts, trainers of ITIs, NSTIs, faculties from universities and all others who contributed in creating the curriculum.

Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

List of Expert members contributed/ participated for finalizing the course curriculum of CNC Machining Technician trade.			
S No.	**Name & Designation Shri/Mr./Ms.**	**Organization**	**Remarks**
Industry Experts			
1.	Anil Kumar, Dy. Director General	RDSDE, Chennai	Member
2.	Nirmalya Nath, Dy. Director	NIMI, Chennai	Member
3.	Akhilesh Pandey, Asst. Director	CSTARI	Member
4.	Gopalakrishnan V, Manager	NIMI, Chennai	Member
5.	K V S Narayana, Training Officer	CSTARI	Member
6.	S Muthumukar, Manager (Service)	MTAB Engineer's Pvt. Ltd.	Member
7.	H K Madhu	Alined Technologies	Member
8.	Daniel Raravi	Mastercam India	Member
9.	Dr. Ishtiaq Khan	TATA Technologies	Member
10.	A Vijayaraghavan, Rtd. Employee	ATI Chennai	Member
11.	Manu Kumar H A	NSTI Chennai	Member
12.	Chandiramohan D		Member
13.	Pradeep S	TATA Technologies	Member
14.	K Naga Srinivas, Dy. Director (Retd.)	NSTI, Hyderabad	Member
15.	K Mahendar, Jt. Director (Retd.)	RDSDE	Member
16.	S Soundaravelu	SIEMENS Ltd.	Member

17.	K Srinivasa Rao	NIMI, Chennai	Member
18.	T V Rajasekar	NIMI, Chennai	Member
19.	N Manoharan	Govt. ITI	Member
20.	Anandh Kumar S	SIEMENS Ltd.	Member
21.	S Vijayakumar	Kiseki Machinery	Member
22.	Hemaprabhan N	Lakshmi Machine Works Ltd.	Member

ABBREVIATIONS:

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्