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

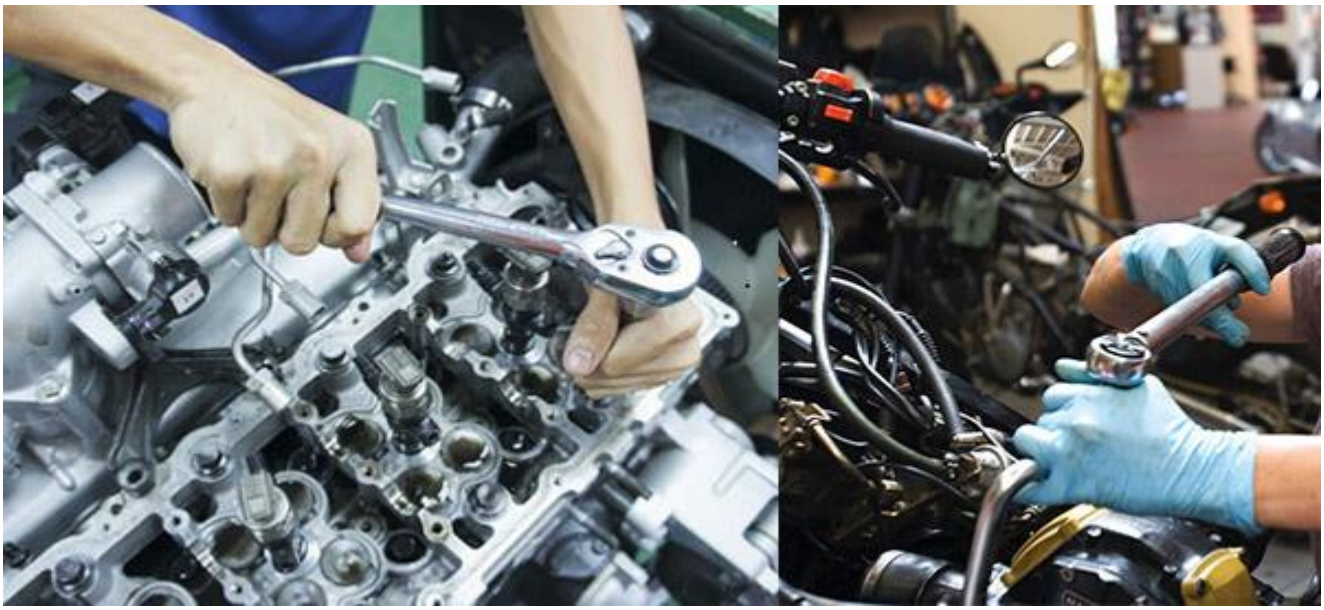
COMPETENCY BASED CURRICULUM

MECHANIC MACHINE TOOL MAINTENANCE

(Duration: Two Years)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4



SECTOR –CAPITAL GOODS AND MANUFACTURING

Directorate General of Training

MECHANIC MACHINE TOOL MAINTENANCE

(Engineering Trade)

(Revised in July 2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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CONTENTS

1. COURSE INFORMATION

During the two-year duration, a candidate is trained on subjects Professional Skill, Professional Knowledge and Employability Skills related to job role. 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 content broadly covers maintenance of different machine tools and manufacturing of components, for maintenance in conventional & CNC machines. The broad components covered under Professional Skill subject are as below:-

FIRST YEAR: In this year, the contents cover from safety aspect related to trade, basic fitting operation viz., marking, filling, sawing, chiseling, drilling tapping & grinding to an accuracy of ±0.25mm. Making different fits viz., sliding, T-fit & square fit with an accuracy ±0.2mm & angular tolerance of 1°. Also shaping and milling operation of different job and produce components by different operations.

The practical training starts with maintaining the components of power transmission elements. Followed by operation of lathe machine and making of different components. Next, practical on machine foundation and geometrical tests with preventive maintenance of machines viz., lathe, drilling, milling etc.

SECOND YEAR: In this year, welding and gas cutting of metals covered. Then practicals on total hydraulic and pneumatic system with advanced electro and pneumatic circuit making done. Followed by preventive and breakdown maintenance of milling and grinding machines.

The practical on electric, electronic and PLC system is covered. Then CNC operation including setting operation and part programming in simulator done. In addition overhauling of hydraulic press, pumps & compressor are covered. And finally fault finding & breakdown maintenance of machines viz., shaper, grinding, milling machine.

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

Mechanic Machine Tool Maintenance (MMTM) trade under CTS is one of the popular courses 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 programme, the trainee is awarded National Trade Certificate (NTC) by DGTwhich 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.
- 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

- Canjoin industry as 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 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.
- 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
3	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.

4	On the Job Training (OJT)/ Group Project	150	150

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 programme 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, DGTas 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 assessment. Due consideration should be given while assessing for teamwork, 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 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 examination 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 with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b)Marksin the range of above75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A good level of neatness and consistency in the finish • Little support in completing the project/job
(c) Marksin 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% accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

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

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

May be designated as Mechanic Machine Tool Maintenance according to nature of work done

Reference NCO-2015:

a) 8211.1000 –Erector, Machine and Equipment
b) 8211.0100 –Assembler, Workshop Machine and Equipment

Reference NOS:

a) CSC/N0304
b) CSC/N0901
c) CSC/N0305
d) CSC/N9401
e) CSC/N9402
f) CSC/N9488
g) CSC/N9489
h) CSC/N9490
i) CSC/N9491

4. GENERAL INFORMATION

Name of the Trade	**MECHANIC MACHINE TOOL MAINTENANCE**
Trade Code	DGT/1043
NCO - 2015	8211.1000, 8211.0100
NOS Covered	CSC/N0304, CSC/N0901, CSC/N0305, CSC/N 9401, CSC/N 9402, CSC/N 9488, CSC/N 9489, CSC/N 9490, CSC/N 9491
NSQF Level	Level – 4
Duration of Craftsmen Training	Two years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
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	17 KW
Instructors Qualification for	
1. Mechanic Machine Tool Maintenance 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 "Mechanic Machine Tool Maintenance" With three years' experience in the relevant field. **Essential Qualification:**

	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 Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR**

	Regular / RPL variants of NCIC in RoDA / D'man (Mech /civil) 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.

5.1LEARNING OUTCOME

FIRST YEAR:

1. Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracyfollowing safety precautions. *[Basic fitting operation – marking, Hack-sawing, Chiseling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm] NOS:*CSC/N0304
2. Make different fit of components for assembling as per required tolerance observing principle of interchange ability and check for functionality. *[Different Fit – Sliding, Angular, Step fit, Required tolerance: ±0.20 mm, angular tolerance: 1 degree] NOS:*CSC/N0304
3. Set the different parameters to produce components involving basic operations on different machine observing standard procedure and check for accuracy. *[Different machines – Shaper, Lathe & Milling, Different machining parameters – feed, speed & depth of cut.] NOS:*CSC/N0304
4. Prepare components for assembly by carrying out different Heat Treatment and surface finishing operations. *[Different Heat Treatment: - Hardening, Tempering case hardening, different surface finish- scrapping, lapping] NOS:*CSC/N0304
5. Make different fit of components for assembling as per required tolerance observing principle of interchange ability and check for functionality. [*Different Fit – square fits, T fits, hexagonal fit, dovetail fit; surface accuracy: ±0.1 mm, angular tolerance: 30 min.] NOS:*CSC/N0304
6. Dismantle, Repair and Assemble of mechanical power transmission elements in machine tools and check for functionality. *NOS:* CSC/N0901
7. Carryout preventive maintenance of lubrication & cooling system of different machines as per manufactures guidelines. *[Different machines- lathe, drilling, grinding] NOS:*CSC/N0901
8. Prepare machine foundation for erection, install different machines and carry out geometrical tests. *[Different machines – shaper, pedestal grinding] NOS:*CSC/N0304
9. Conduct preventive maintenance, perform dismantling & assembly of different components and test for accuracy to carryout advance lathe operation. *[Different components- head stock apron, saddle, tool post tail stock; Different advance lathe operation – taper turning, thread cutting] NOS:*CSC/N0901

10. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:CSC/N9402)
11. Read and apply engineering drawing for different application in the field of work. (NOS:CSC/N9401)

SECOND YEAR:

12. Make / Produce different joints by setting up of gas and arc welding machines and carry out the welding. *NOS:*CSC/N0304
13. Identify, dismantle, replace and assemble different pneumatics and hydraulics components. *[Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.]* (NOS:CSC/N9488)
14. Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect. (NOS:CSC/N9489)
15. Make pipe/tube fittings and valve connections for lubricants and coolants, test for leakages. CSC/N0901
16. Conduct preventive maintenance, perform dismantling and assembly of different components machine and test for accuracy of milling machine. *NOS:*CSC/N0901
17. Set the different grinding machine and produce component to appropriate accuracy. *[Different machine:- Surface & cylindrical grinding; appropriate accuracy ±0.02mm] NOS:*CSC/N0304
18. Conduct preventive maintenance, perform dismantling & assembly of different components of grinding machine and test for accuracy. *[Different components grinding head, lead screw, table, hydraulic cylinders] NOS:*CSC/N0901
19. Identify and explain basic functioning of different electrical equipment, sensors and apply such knowledge in industrial application including basic maintenance work. *[Different electrical & electronics equipment- DC/ AC motors, passive & active electronic components, resistor, capacitor, inductors, rectifier, diode transistor, SCRS & ICS; Different sensors – proximity & ultrasonic] NOS:CSC/N0305*
20. Programme PLC and interface with other devices to check its Applications. (NOS:CSC/N9490)
21. Prepare part programme, test on simulation software and interpret different errors. (NOS:CSC/N9491)
22. Troubleshoot & Overhaul of pumps, fans, blowers & compressors and perform preventive maintenance. *NOS:*CSC/N0901
23. Identify fault carryout maintenance work and break down of different machineries/ equipment viz., shaper, surface grinding, drilling, lathe, milling, in the shop floor, using appropriate tools & equipment to ensure its functionality. *NOS:*CSC/N0901

24. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:CSC/N9402)
25. Read and apply engineering drawing for different application in the field of work. (NOS:CSC/N9401)

6. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENT CRITERIA
FIRST YEAR	
1. Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracyfollowing safety precautions. *[Basic fitting operation – marking, Hack-sawing, Chiseling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm] NOS:*CSC/N0304	Plan & Identify tools, instruments and equipment for marking and make this available for use in a timely manner.
	Select raw material and visual inspect for defects.
	Mark as per specification applying desired mathematical calculation and observing standard procedure.
	Measure all dimensions in accordance with standard specifications and tolerances.
	Identify Hand Tools for different fitting operations and make these available for use in a timely manner.
	Prepare the job for Hacksawing, chiselling, filing, drilling, tapping, grinding.
	Perform basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job.
	Observe safety procedure during above operation as per standard norms and company guidelines.
	Check for dimensional accuracy as per standard procedure.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
2. Make different fit of components for assembling as per required tolerance observing principle of interchange ability and check for functionality. [Different Fit – Sliding, Angular, Step fit, Required tolerance: ±0.20 mm, angular tolerance: 1 degree] *NOS:*CSC/N0304	Recognize general concept of Limits, Fits and tolerance necessary for fitting applications and functional application of these parameters.
	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Set up workplace/ assembly location with due consideration to operational stipulation
	Plan work in compliance with standard safety norms and collecting desired information.
	Demonstrate possible solutions and agree tasks within the team.
	Make components according to the specification for different fit using a range of practical skills and ensuring interchange ability of

	different parts.
	Assemble components applying a range of skills to ensure proper fit.
	Check functionality of components.
3. Set the different parameters to produce components involving basic operations on different machine observing standard procedure and check for accuracy. [Different machines – Shaper, Lathe & Milling, Different machining parameters – feed, speed & depth of cut.] *NOS:*CSC/N0304	Ascertain basic working principles and safety aspect of lathe machine.
	Understand functional application of different levers, stoppers, adjustment etc.
	Identify different lubrication points and lubricants, their usage for application in lathe machine as per machine manual.
	Identify different work and tool holding devices and collect information for functional application of each device.
	Mount the work and tool holding devices with required alignment and check for its functional usage to perform lathe operations.
	Solve problem by applying basic methods, tools, materials and information during setting.
	Observe safety procedure during mounting as per standard norms.
	Produce components observing standard procedure.
	Check accuracy/ correctness of job using appropriate equipment/gauge.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
4. Prepare components for assembly by carrying out different Heat Treatment and surface finishing operations. [Different Heat Treatment: - Hardening, Tempering case hardening, different surface finish-scrapping, lapping] *NOS:*CSC/N0304	Plan & identify tools & equipment required.
	Carryout heat treatment by maintaining
	Observe safety produce during the appropriate temperature and observing standard procedure.
	Perform surface finishing operation observing standard procedure.
	Check the components for assembly.
5. Make different fit of components for	Recognize general concept of Limits, Fits and tolerance necessary for fitting applications and functional application of these

assembling as per required tolerance observing principle of interchangeability and check for functionality. [Different Fit – square fits, T fits, hexagonal fit, dovetail fit; surface accuracy: ±0.1 mm, angular tolerance: 30 min.] *NOS:*CSC/N0304	parameters.
	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Set up workplace/ assembly location with due consideration to operational stipulation
	Plan work in compliance with standard safety norms and collecting desired information.
	Demonstrate possible solutions and agree tasks within the team.
	Make components according to the specification for different fit using a range of practical skills and ensuring interchangeability of different parts.
	Assemble components applying a range of skills to ensure proper fit.
	Check functionality of components.
6. Dismantle, Repair and Assemble of mechanical power transmission elements in machine tools and check for functionality. *NOS:*CSC/N0901	Understand safety aspects while working with power transmission system.
	Explain the functions and constructional features of various mechanical power transmission elements and drives.
	Drain out lubrication oil from the power transmission system.
	Select proper tools for the required task.
	Dismantle the shaft, coupling, gears, belt, clutch, pulley, chain & sprockets. keys, bearing from the power transmission system..
	Clean and check for damage of all dismantled parts.
	Repair / replace damaged parts..
	Assemble the power transmission system in sequence.
	Fill lubrication oil and check functionality.
7. Carryout preventive maintenance of lubrication & cooling system of different machines as per manufactures guidelines. [Different machines- lathe, drilling, grinding] *NOS:*CSC/N0901	Collect relevant information from manufacturing guidelines to carryout preventive maintenance.
	Plan and select appropriate tools & raw materials to carryout preventive maintenance.
	Conduct preventive maintenance of lubrication and cooling system as per standard guidelines.
	Check the functionality of machines.
8. Prepare machine	Understand safety aspects related to the erection & installation of

foundation for erection, install different machines and carry out geometrical tests. [Different machines – shaper, pedestal grinding] *NOS:*CSC/N0304	heavy machines.
	Plan and prepare machine foundation as per drawing.
	Place the machine on the foundation for erection.
	Provide electrical power connections as per the requirement
	Level the machine and install all standard accessories and check the functional requirement.
	Conduct the geometrical test as per standards for installed machine.
	Carry out component trial machining test and check the dimensional accuracy of the component.
9. Conduct preventive maintenance, perform dismantling & assembly of different components of lathe and check accuracy by carrying out advance lathe operation. [Different components- head stock apron, saddle, tool post, tail stock; Different advance lathe operation – taper turning, thread cutting]*NOS:* CSC/N0901	Collect relevant information to conduct preventive maintenance of lathe.
	Plan and identify different tools and materials required to carry out preventive and dismantling assembling.
	Perform dismantling and assembly of different components i.e. head stock, tail stock etc as per stand procedure.
	Observe safety procedure while carrying out above task.
	Carryout advance lathe operation viz., taper turning, thread cutting to check functionality and accuracy.
10. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.(NOS:CSC/N9402)	Solve different mathematical problems
	Explain concept of basic science related to the field of study
11. Read and apply engineering drawing for different application in the field of work.(NOS:CSC/N9401)	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.
SECOND YEAR	
12. Make / Produce different joints by setting up of gas and arc welding machines and carry out the welding. *NOS:*CSC/N0304	Acquaint the safety practices related to welding.
	Plan and prepare the gas & arc welding machines to perform welding.
	Understand to set up the welding machine parameters and selection of electrode, welding torch adjustments according to the task.
	Operate the welding machine and perform different welding joints, check visually for common welding defects.
	Interpret the applications of different welding joints with respect to machine tool maintenance.
13. Identify, dismantle, replace and assemble different pneumatics and hydraulics components. [Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.] (NOS:CSC/N9488)	Select and ascertain tools for the job and make this available for use in a timely manner.
	Identify different pneumatics and hydraulics components.
	Plan to dismantle and replace pneumatics & hydraulics circuit as per drawing and collecting necessary information.
	Perform dismantling and replacing of different components with accuracy applying range of skills and standard operating procedure.
	Assemble different components.
	Check functionality of the components.
14. Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect. (NOS:CSC/N9489)	Select and ascertain tools for the job and make this available for use in a timely manner.
	Plan to construct pneumatics & hydraulics circuit as per drawing and collecting necessary information.
	Demonstrate possible solutions and agree tasks within the team for constructing circuit.
	Construct circuit of pneumatics and hydraulics observing standard procedure.
	Comply with safety rules when performing the above operations.
	Check different parameters and functionality of the system.
15. Make pipe/tube fittings and valve connections for	Acquaint the safety practices related to pipe fittings.
	Plan and perform cutting, bending, threading, ferruling on tubes.

lubricants and coolants, test for leakages. *NOS:*CSC/N0901	Dismantle and assemble of different valves and replace gaskets.
	Prepare pipe/tube joints, connect valves and check for leakages.
	Interpret the applications of different pipe/tube joints with respect to machine tool maintenance.
16. Conduct preventive maintenance, perform dismantling and assembly of different components machine and test for accuracy of milling machine. *NOS:* CSC/N0901	Collect relevant information to conduct preventive maintenance of milling.
	Plan and identify different tools and materials required to carry out preventive and dismantling assembling.
	Perform dismantling and assembly of different components of milling machine as per stand procedure.
	Observe safety procedure while carrying out above task.
	Test for accuracy of milling machine by conducting machining.
17. Set the different grinding machine and produce component to appropriate accuracy. [Different machine:-Surface & cylindrical grinding; appropriate accuracy ±0.02mm]*NOS:* CSC/N0304	Plan and identify tools and equipment to carrying grinding for using the same timely manner.
	Set the machine parameter and job observing safety.
	Grind the components using appropriate machine and observing standard procedure.
	Check the components as per defined accuracy.
18. Conduct preventive maintenance, perform dismantling & assembly of different components of grinding machine and test for accuracy. [Different components grinding head, lead screw, table, hydraulic cylinders] *NOS:*CSC/N0901	Collect relevant information to conduct preventive maintenance of grinding.
	Plan and identify different tools and materials required to carry out preventive and dismantling assembling.
	Perform dismantling and assembly of different components of grinding machine as per stand procedure.
	Observe safety procedure while carrying out above task.
	Test for accuracy of grinding machine by conducting machining.
19. Identify and explain basic functioning of different electrical equipment, sensors and apply such knowledge in industrial	Identify differnet electrical equipment viz.multi-meter, transformer, relays, solenoids, motor & generator.
	Identify different sensors viz, proximity &ultrasonic.
	Examine functioning of different electrical equipment, sensors and their utilization in industrial application.

application including basic maintenance work. [Different electrical & electronics equipment- DC/ AC motors, passive & active electronic components, resistor, capacitor, inductors, rectifier, diode transistor, SCRS & ICS; Different sensors – proximity & ultrasonic] *NOS:*CSC/NO305	Observe safety precautions during examination of electrical equipment and sensors.
20. Programme PLC and interface with other devices to check its Applications. (NOS:CSC/N9490)	Programme a PLC as per application requirement.
	Interface PLC with other devices observing standard procedure and safety.
	Check the functionality of device as per programme.
21. Prepare part programme, test on simulation software and interpret different errors. (NOS:CSC/N9491)	Plan and prepare part programme as per drawing.
	Prepare tooling layout as required.
	Demonstrate possible solution within the team.
	Test the part programme using simulation.
	Illustrate the safety/ precaution to be observed during machining.
	Interpret different messages generate against different errors.
22. Troubleshoot& Overhaul of pumps, fans, blowers & compressors and perform preventive maintenance. *NOS:*CSC/N0901	Acquaint the safety practices related to the pumps, fans, blowers & compressors.
	Understand & identify the different types of pumps, fans, blowers and compressors.
	Plan and prepare trouble shoot chart for pumps, fans, blowers & compressors and perform the task.
	Carry out the preventive maintenance of pumps, fans, blowers and compressors.
	Interpret the industrial applications of pumps, fans, blowers and compressors in different machine tools.
23. Identify fault carryout	Acquaint the safety practices related to the break down

maintenance work and break down of different machineries/ equipments viz., shaper, surface grinding, drilling, lathe, milling, in the shop floor, using appropriate tools &equipments to ensure its functionality.*NOS:* CSC/N0901	maintenance of machine tools.
	Understand & identify various machine tools under break down.
	Demonstrate the faults arised in the machine tools.
	Conduct the break down maintenance of faulty machine.
	Carry out the performance test.
24. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.(NOS:CSC/N9402)	Solve different mathematical problems
	Explain concept of basic science related to the field of study
25. Read and apply engineering drawing for different application in the field of work.(NOS:CSC/N9401)	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.

7. TRADE SYLLABUS

SYLLABUS FOR MECHANIC MACHINE TOOL MAINTENANCE TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 260Hrs; Professional Knowledge 50Hrs	Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy following safety precautions. *[Basic fitting operation – marking, Hack-sawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm]* (Mapped NOS: *NOS:*CSC/N0304)	1. Importance of trade training, List of tools & Machinery used in the trade. (1 hr) 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). (3 hrs) 3. First Aid Method and basic training.(2 hrs) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (1 hrs) 5. Hazard identification and avoidance. (2 hrs) 6. Safety signs for Danger, Warning, caution & personal safety message.(1 hr) 7. Preventive measures for electrical accidents & steps to be taken in such accidents.(2 hrs) 8. Use of Fire extinguishers.(2 hrs)	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. (04 hrs)
		9. Study the drawing to plan the job/ work. Identification of tools &equipments as per desired specifications for marking, filling & sawing. (3 hrs) 10. Visual inspection of raw material for rusting, scaling, corrosion etc.(1 hr) 11. Familiarisation of bench vice. (1 hr) 12. Filing- Flat and square (Rough finish). (8 hrs) 13. Marking with scriber and steel rule (2hrs) 14. Filing practice, surface filing, marking of straight and parallel lines with odd leg callipers and steel rule. (08 hrs)	Linear measurements- its units, steel rule dividers, callipers – types and uses, Punch – types and uses. Uses of different types of hammers. Description, use and care of marking off table. (04 hrs)
		15. Filing Channel, Parallel. (4 hrs) 16. Filing- Flat and square (Rough finish), (08 hrs) 17. Filing practice, surface filing, marking of straight and parallel lines with odd leg callipers and steel rule. (5 hrs) 18. Marking practice with dividers, odd leg callipers and steel rule (circles, ARCs, parallel lines). (5 hrs)	Bench vice construction, types, uses, care & maintenance, vice clamps, hacksaw frames and blades, specification, description, types and their uses, method of using hacksaws. Files- specifications, description, materials, grades, cuts, file elements, uses. Types of files, care and maintenance of files. Measuring standards (English, Metric Units), angular

			measurements. (04 hrs)
		19. Marking off straight lines and ARCs using scribing block and dividers. (5 hrs) 20. Chipping flat surfaces along a marked line. (05 hrs) 21. Marking, filing, filing square and check using tri-square.(05 hrs)	Marking off and layout tools, dividers, scribing block, odd leg callipers, punches- description, classification, material, care & maintenance. Try square, ordinary depth gauge, protractor- description, uses and cares. Callipers- types, material, constructional details, uses, care & maintenance of cold chisels- materials, types, cutting angles. (04hrs)
		22. Marking according to drawing for locating, position of holes, scribing lines on chalked surfaces with marking tools. (5 hrs) 23. Finding centre of round bar with the help of 'V' block and marking block. (5 hrs) 24. Prepare mushroom head and round bar and bending metal plate by hammering. (10hrs)	Marking media, Prussian blue, red lead, chalk and their special application, description. Surface plate and auxiliary marking equipment, 'V' block, angle plates, parallel block, description, types, uses, accuracy, care and maintenance. (04 hrs)
		25. Chipping flat surfaces along a marked line. (10 hrs) 26. Make a square from a round job by chipping upto 20mm length. (8hrs) 27. Slot, straight and angular chipping (5hrs) 28. Mark off and drill through holes. (5 hrs) 29. Drill and tap on M.S. flat. (8 hrs)	Drill, Tap, Die-types & application. Determination of tap drill size. Reamer- material, types (Hand and machine reamer), parts and their uses, determining hole size for reaming, Reaming procedure. (7 hrs)

		30. Cutting external thread on M.S. rod using Die.(5hrs) 31. Punch letter and number (letter punch and number punch) (5 hrs)	
		32. File steps and finish with smooth file to accuracy of ± 0.25 mm. (10 hrs) 33. File and saw on M.S. Square and pipe. (15 hrs)	Micrometer- outside and inside – principle, constructional features, parts graduation, leading, use and care. Micrometer depth gauge, parts, graduation, leading, use and care. Digital micrometer. (04 hrs)
		34. File radius along a marked line (Convex & concave) & match. (15 hrs) 35. Chip sheet metal (shearing). (5 hrs) 36. Chip step and file. (5 hrs)	Vernier calipers, principle, construction, graduations, reading, use and care. Vernier bevel protractor, construction, graduations, reading, use and care, dial Vernier Calliper, Digital verniercalliper. (04 hrs)
		37. Truing of pedestal grinding wheel. (10 hrs) 38. Grinding and re-sharpening of hand tools. (10 hrs) 39. Repair and maintenance of hand tools. (10 hrs) 40. Dressing of grinding wheel by diamond dresser tool. (15hrs)	Pedestal grinder – Introduction, care & use. Procedure of wheel mounting & wheel dressing. Related hazards, risk and precautions. (10 hrs)
		41. Counter sinking, counter boring and reaming with an accuracy ± 0.04 mm.(5 hrs) 42. Drill blind holes with an accuracy 0.04 mm.(2 hrs) 43. Form internal threads with taps to standard size (blind holes).(3 hrs)	Drilling machines-types &their application, construction of Pillar & Radial drilling machine. Countersunk, counter bore and spot facing-tools and nomenclature. Cutting Speed, feed, depth of cut and Drilling time calculations. (05hrs)

		44. Prepare studs and bolt to standard size and watch with nut. (15 hrs)	
Professional Skill 40Hrs; Professional Knowledge 08hrs	Make different fit of components for assembling as per required tolerance observing principle of interchangeability and check for functionality. *[Different Fit – Sliding, Angular, Step fit, Required tolerance: ±0.20 mm, angular tolerance: 1 degree]* (Mapped NOS: *NOS:*CSC/N0304)	45. File and make Step fit, angular fit, with surface accuracy of ±0.20 mm (Bevel gauge accuracy 1 degree). (20hrs) 46. Make simple open and sliding fits. (20hrs)	Interchangeability: Necessity in Engg, field, Limit- Definition, types, terminology of limits and fits-basic size, actual size, deviation, high and low limit, zero line, tolerance zone, allowances. Different standard systems of fits and limits. (British standard system & BIS system) (08 hrs)
Professional Skill 90Hrs; Professional Knowledge 20Hrs	Set the different parameters to produce components involving basic operations on different machine observing standard procedure and check for accuracy. [Different machines – Shaper, Lathe & Milling, Different machining parameters – feed, speed & depth of cut.] (Mapped NOS: *NOS:*CSC/N0304)	47. Perform the holding job on shaper machine vice, setting length of stroke, setting of feed in a shaper machine. (5 hrs) 48. Make a square block in shaper machine. (10 hrs) 49. Perform preventive maintenance of shaping machine. (5hrs)	**Shaper:** Introduction to Shaper machine parts & constructional details, its function and operations. Quick return mechanism of shaper. Calculation of cutting Speed, feed & depth of cut. (04 hrs)
		50. Grinding of R.H & L.H tools, V tool, parting tool, round nose tool & 'V' tools. (10 hrs) 51. Perform facing operation to correct length. (5hrs) 52. Centre drilling & drilling operations to required size. (5hrs) 53. Perform parallel turning &	Grinding wheel: Abrasive, grade structures, bond, specification, use, mounting and dressing. Selection of grinding wheels. Bench grinder parts and use. Radius/fillet gauge, feeler gauge, hole gauge, and their uses, care and maintenance. (08 hrs)

		step turning. (05hrs) 54. Perform drilling, boring, undercut, parting, grooving, chamfering operation. (10hrs)	
		55. Demonstrate working principle of milling machine. (3hrs) 56. Set arbor and cutter on arbor of milling machine. (4hrs) 57. Sequence of milling six faces of a solid block. (08hrs) 58. Perform step milling and slot milling with side & face cutter. (10hrs) 59. Make 'V' block using horizontal milling machine (accuracy ±0.02mm) (10hrs)	**Milling:** Introduction to milling machine, parts & constructional details, types. Safety precaution followed during milling operation. Milling machine attachments. Different types of milling cutters and its materials. Nomenclature of milling cutters. Milling cutter holding devices, work holding devices, Milling machine operations, Up milling and Down milling. Calculation of cutting speed, feed, machining time for milling machine. Indexing methods and its calculations. (08 hrs)
Professional Skill 65 Hrs; Professional Knowledge 15Hrs	Prepare components for assembly by carrying out different Heat Treatment and surface finishing operations. *[Different Heat Treatment: - Hardening, Tempering case hardening, different surface finish- scrapping, lapping]*	60. Hardening and tempering &Normalising. (10 hrs) 61. Case Hardening. (5 hrs) 62. Hardness Testing. (5 Hrs)	Heat Treatment: Iron Carbon Equilibrium Diagram, Time-Temperature-Transformation Curve. Annealing, Case Hardening, Tempering, Normalizing and Quenching (07 hrs)
		63. Scraping practice on flat & curved surface. (15hrs) 64. Make a plain flat surface of by scraping the high spots using Prussian blue. (20 hrs) 65. Lapping the surface with	Classification, construction, materials and functional detail of Chisels & Hammers. Chipping technique. Related hazards, risk and precautions while working. **Scrapers**: Introduction, Its

	(Mapped NOS: *NOS:*CSC/N0304)	lapping stone. (5 hrs) 66. Fixing hammer handle. (5 hrs)	types, material and use. Types of nuts, bolts, studs, locking devices for nut, wrench and spanner, pliers, screw drivers, Circlip, split pin, washers, spring washer. Concept of torque & torque wrench. Different types of rivets and their applications. Identification of different fasteners & operating them by using proper hand tool (08 hrs)
Professional Skill 85Hrs; Professional Knowledge 15Hrs	Make different fit of components for assembling as per required tolerance observing principle of interchange ability and check for functionality. *[Different Fit – square fits, T fits, hexagonal fit, dovetail fit; surface accuracy: ±0.1 mm, angular tolerance: 30 min.]* (Mapped NOS: CSC/N0304)	67. Make Male & Female 'T' fitting with an accuracy ±0.15 mm and 30 minutes. (25hrs) 68. Make male female square fit with accuracy ±0.1 mm. (20hrs)	Surface finish - importance, symbol, measuring techniques. Lapping & honing process. **Gauges:** Classification and uses of Sine bar, Slip gauge, Limit gauge, Feeler gauge, thread gauge, screw pitch gauge, taper gauge. (6 hrs)
		69. Make Male & Female Hexagon fitting with accuracy ±0.1 mm and 30 min. (20 hrs)	Tolerances & interchangeability -Definition and its necessity, basic size, actual size, limits, deviation, Tolerance, allowance, clearance, interference, Fits-definition, types, description with sketches. Method of expressing Tolerance as per BIS, Hole and Shaft basis (BIS standard). Related calculation on Limit, Fit and Tolerance. (03 hrs)
		70. Make male & female dovetail fitting scraping the surface within an accuracy ±0.1 & 30 min	**Fasteners:** Introduction to fasteners, screw threads, related terminology and specification.

		angular (20hrs)	Keys- types & use, (parallel, sunk, tangential, gib head, woodruff, key ways.) Related hazards, risk and precautions, while working. (06 hrs)
Professional Skill 130Hrs; Professional Knowledge 20Hrs	Dismantle, Repair and Assemble of mechanical power transmission elements in machine tools and check for functionality. (Mapped NOS: *NOS:*CSC/N0901)	71. Identify different components of power transmission. (5 hrs) 72. Dismantle and assemble different components of power transmission. (10 hrs) 73. Safety precautions related to power transmission. (5 hrs)	**Maintenance Practice and Mechanical Assembly** Introduction to various maintenance practices such as preventive maintenance, predictive maintenance, breakdown maintenance & reconditioning. Organization Structure for maintenance, Roles and responsibility, advantage and disadvantage of TPM. **Transmission of Power** Elements of mechanical power transmission, type of spindles and shafts (Universal spindle, Plain shaft, Hollow shaft, crank shaft, cam shaft). Positive and Non-positive drive, Friction drive, Gear drive, Belt drive, Chain drive and Rope drive. (04 hrs)
		74. Identify different types clutches in machine tools and their maintenance. (05 hrs) 75. Making key and mounting of coupling on the shaft with key. (05 hrs) 76. Identification and inspection of components of different types of brakes in machine tools.	**Clutches** Function of Clutches, its types and use in power transmission system. Function of mechanical & electromagnetic system in clutch mechanism. **Couplings:** Concept of coupling and its type viz. Rigid coupling- Muff

		(04hrs) 77. Fitting of hub and shaft with key. (05 hrs) 78. Installation of belt in transmission with adjusting the tension. (05 hrs)	coupling, Flange coupling, Flexible coupling, Pin-bush coupling, Chain coupling, Gear coupling, Spider coupling, Tyre coupling, Grid coupling, Oldham-coupling, Fluid coupling, Universal coupling and their specific applications. **Brakes**& Braking Mechanism: Types & Functions. Inspection of brakes for safe & effective working. **Belts-** Belt types (Flat and V) and specifications. Pulleys used for belt drive. Installation, Alignment of belts. Problems related to belts(Creep and slip) Belt maintenance. Sheave alignment, Chain drive- Roller chain, Silent chain, alignment of sprockets, and maintenance of chain drive. (04 hrs)
		79. Identification of various types of bearings in machine tools. (4 hrs) 80. Impression testing of split bush bearing for proper contact on journal & housing. (4 hrs) 81. Preloading of Precision angular contact bearing (4 hrs) 82. Dismantling, inspection and mounting of ball	**Bearing:** Description and function of bearing, its types - Solid Bush, Split Bush, Collar, Pivot and Plummer Block Bearing. Mounting of bearings, measurement and adjustment of clearances in bearings. Types of bearing fitting on shaft and hubs. Type of Roller contact

		bearing on shaft with press & pullers. (10hrs) 83. Dismantling & assembly of tail stock of a lathe. (10hrs) 84. Demonstrate of different types of knots and hitches used in material handling. (5 hrs) 85. Splicing of manila rope. (2 hrs) 86. Inspection of wire rope/ steel rope/belts. (2 hrs) 87. Lift an object by using slings. (2 hrs)	bearings- Ball bearings- single row & double row, Deep groove ball bearing, Angular contact, Self aligning and Thrust bearing. Roller bearing- Cylindrical, Needle roller, Taper roller, Spherical roller, self aligning and Spherical roller thrust bearing. Use of ISO bearing designation code to generate market survey and purchase. Checking and adjustment of bearing clearance. Methods of Mounting and dismounting of roller contact bearing, taper roller bearing and angular contact ball bearing. (Back-to-back, Face-to-face, tandem) Mounting-dismounting and adjustment of Taper bore bearings with adopter and withdrawal sleeve. Handling and storage of bearings. Related hazards, risk and precautions. Rigging Knowledge of different tools & tackles used in rigging. Construction and capacity of wire rope/steel rope/belts. Application of knots and hitches. Care and maintenance of all types of ropes. (6 hrs)
		88. Identification different	**Gear:**

		types of gears and gear bones used in machine tools. (5 hrs) 89. Checking of gear elements as PCD, gear tooth thickness, clearance concentricity. (08 hrs) 90. Checking of backlash and root clearance by feeler gauge, DTI & lead wire in gear meshing. (07 hrs)	Type, description and function of gears- Spur, Helical, Spiral, Bevel, Straight and Spiral bevel, Worm gears, Rack and pinion. Gear Terminology. Gear train- simple, compound, reverted and epicyclic. (03 hrs)
		91. Inspection & replacing the lubricating oil of a given gearbox.(5hrs) 92. Overhauling of gear box of lathe & milling machine. (08hrs) 93. Write a inspection report for maintenance job. (5hrs) 94. Prepare a action plan for maintenance work. (5 hrs)	Types of Gear box Gear meshing: Checking of backlash and root clearances with Feeler Gauge, Dial Test Indicator and lead wire. Impression testing of gear mesh with Prussian blue. Running maintenance Related hazards, risk and precautions. (03 hrs)
Professional Skill 65 Hrs; Professional Knowledge 15Hrs	Carryout preventive maintenance of lubrication &cooling system of different machines as per manufactures guidelines. *[Different machines- lathe, drilling, grinding]* (Mapped NOS: CSC/N0901)	95. Identification of various types of lubrication system and their components. (5hrs) 96. Cleaning of lubrication lines and oil filters. (07 hrs) 97. Fittings of different types of seals and oil rings. (07rs) 98. Preparing and fitting of gasket for different joint surface. (08hrs) 99. Preventive maintenance of lubrication system of lathe, drilling and grinding machines. (08hrs)	Lubrication and its importance, lubricating systems Concept of lubrication Types and properties of Oil and Grease. Methods of oil lubrication- Once through and centralized lubrication system. (05 hrs) Methods of grease lubrication system- grease guns, centralized lubrication system. Warning & protective devices used in centralized lubrication system (Pressure switch, temperature gauge, level

		100. Lubrication schedule- daily, weekly, monthly concept. (05 hrs)	indicator and relief valve.) Lubrication fittings. Storage and handling, Contamination control, Leakage prevention- Shaft seals, sealing devices and "O" rings. (05 hrs)
		101. Identification of components of coolant system. (5hrs) 102. Preventive maintenance of coolant system. (10hrs) 103. Breakdown maintenance of coolant system. (10hrs)	Cutting Fluids and Coolants. Essential parts of a basic coolant system used in the cutting of metals. Various types of coolants, its properties and uses ,coolantsystem type-soluble oils-soaps, sudsparaffin,soda water etc. Effect of cutting fluids in metal cutting. Difference between coolant and lubricants. (05 hrs)
Professional Skill 85Hrs; Professional Knowledge 16Hrs	Prepare machine foundation for erection, install different machines and carry out geometrical tests. *[Different machines – shaper, pedestal grinding]* (Mapped NOS: CSC/N0304)	104. Marking location, grouting and installation of foundation bolts. (10hrs) 105. Erection and installation of a small machine like shaper/ pedestal grinder machine. (10hrs)	**MACHINE FOUNDATION** Purpose & methods employed for installation & erection of precision &heavy duty machines. **Location & excavation for foundation. Different types of foundations –**structural, reinforced, wooden, isolated foundations. (04 hrs)
		106. Levelling of small machine like shaper. (10hrs) 107. Levelling of a lathe & milling machines. (10hrs)	Foundation bolt: types (rag, Lewis cotter bolt) description of each erection tools, pulley block, crow bar, spirit level, Plumb bob, wire rope, manila rope, wooden block. The use of lifting appliances, extractor presses and their use. Practical method of

			obtaining mechanical advantage. The slings and handling of heavy machinery, special precautions in the removal and replacement of heavy parts. Energy usage in relevance for Mechanical assembly. (04 hrs)
		108. Alignment of shaft with the help of feeler gauge & dial test indicator & taper gauges. (5hrs) 109. Alignment of pulley & sprocket with straight edge & thread. (5hrs) 110. Geometrical alignment test of machine as per test chart. (10hrs) 111. Dismantling, checking and assembly of various parts of drilling machine such as Motor, spindle head, gear box & arm. (10hrs) 112. Measure Current, Voltage and Resistance using Simple Ohm`s Law Circuit And Familiarizing Multi-meter. (3hrs) 113. Soldering Techniques. (3hrs) 114. Step up and step down transformers. (3hrs) 115. Working with Solenoids and Relays. (3hrs) 116. Working of Motor& Generators. (3hrs)	**Maintenance** -Total productive maintenance -Autonomous maintenance -Routine maintenance -Maintenance schedule -Retrieval of data from machine manuals Geometrical tests and inspection method with instruments. Preventive maintenance-objective and function of Preventive maintenance, section inspection. Visual and detailed, lubrication survey, system of symbol and colour coding. Revision, simple estimation of materials, use of handbooks and reference table. Possible causes for assembly failures and remedies. Hazardous waste management. **Basic Electrical:** Study of basic Electricals-Voltage –Current etc. Working Of Solenoids, Inductors, Motors, Generator Based On Electromagnetic Induction Principle. (08hrs)

Professional Skill 20Hrs; Professional Knowledge 05Hrs	Conduct preventive maintenance, perform dismantling & assembly of different components and test for accuracy to carryout advance lathe operation. *[Different components- head stock apron, saddle, tool post tail stock; Different advance lathe operation – taper turning, thread cutting]* (Mapped NOS: *NOS:*CSC/N0901)	117. Perform taper turning in the lathe by different methods. (04hrs) 118. Perform external thread cutting operation on the lathe machine. (04hrs) 119. Dismantling and assembly of head stock apron, saddle, tool post tail stock, Removing Broken Studs / Bolts of lathe machine. (08hrs) 120. Accuracy checking of lathe machine after assembly. (2hrs) 121. Perform preventive maintenance of lathe machine. (2hrs)	Safely precautions to be observed while working on a lathe, Lathe specifications, and constructional features. Lathe main parts descriptions- bed, head stock, carriage, tail stock, feeding and thread cutting mechanisms. Holding of job between centers, works with catch plate, dog, simple description of a facing and roughing tool and their applications. (05 hrs)
ENGINEERING DRAWING: (40 Hrs.)			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work. (NOS:CSC/N9401)	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 freehand sketches. • Freehand drawing of hand tools and measuring tools. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Lettering & Numbering–Single Stroke. Dimensioning • Types of arrow head • 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: (36 Hrs.)		
WCS- 36 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:CSC/N9402)	**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 Applications of pythagoras theorem and related problems Ratio and proportion Percentage Precentage - 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 Properties and uses of insulating materials **Mass, Weight, Volume and Density** Mass, volume, density, weight and specific gravity **Numerical related to L,C, O sections** **Speed and Velocity, Work, Power and Energy** Work, power, energy, HP, IHP, BHP and efficiency **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 Concept of pressure - Units of pressure **Basic Electricity** Introduction and uses of electricity Electrical power, HP, energy and units of electrical energy **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 **Levers and Simple machines** Lever & Simple machines - Lever and its types **Trigonometry** Measurement of angles Trigonometrical ratios Trigonometrical tables
In-plant training/ Project work **Broad area:** a) Manufacturing of machine spares by conventional methods of manufacturing. b) Changing of shearing pin of milling machine. c) Setting up of Lathe machine.		

SYLLABUS FOR MECHANIC MACHINE TOOL MAINTENANCE TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 40 Hrs; Professional Knowledge 10 Hrs	Make / Produce different joints by setting up of gas and arc welding machines and carry out the welding. (Mapped NOS: CSC/N0304)	122. Setting up an Arc welding machine. (5hrs) 123. Edge preparation of material for Arc welding. (5hrs) 124. Perform square lap joint, butt joint, tee joint and Pipe Joint in Arc welding. (10hrs) 125. Making straight beads in gas welding. (4hrs) 126. Perform square lap joint, but joint & tee joint in Gas welding. (08hrs) 127. Perform gas cutting of MS plate. (08hrs)	**Arc Welding:**Introduction to arc welding and its safety. Welding types, Common tools used in welding. Basic Electricity as applied to Welding Arc Length & its effects Arc Welding Machines: - advantages & disadvantages of AC & DC Arc Welding Machine. Electrodes: - Sizes & Coding. Edge Preparation: Nomenclature of butt & fillet welding. Welding Symbols & Weld defects. **Gas Welding:**Introduction to gas welding process, its classifications, accessories and its safety. **Gas Cutting:** Principle of gas cutting. Systems of Oxy-Acetylene Welding- Flashback & backfire. Types of Oxy-Acetylene flames: - Gases used in welding & Gas flame combination. Safety in gas cutting process. (10 hrs)
Professional Skill 60Hrs;	Identify, dismantle, replace and assemble	128. Demonstrate knowledge of safety procedures in	**Hydraulics & Pneumatics** Basic principles of Hydraulics

Professional Knowledge 18Hrs	different pneumatics and hydraulics components. *[Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.]* (NOS:CSC/N9488)	hydraulic systems (Demo by video). (4 hrs) 129. Identify hydraulic components – Pumps, Reservoir, Fluids, Pressure relief valve (PRV), Filters, different types of valves, actuators, and hoses. (07 hrs) 130. Inspect fluid levels, service reservoirs, clean/replace filters. (10hrs)	- Advantages & limitation of hydraulic system, hydrostatic transmission, Pascal's law, Brahma's press, pressure Temperature & flow, speed of an actuator. Control valves: Different type of control valves used in hydraulic System. Function of pressure control valve, directional control valve, check valve, flow control valve. (06 hrs)
		131. Identify pneumatic components – Compressor, pressure gauge, Filter-Regulator-Lubricator (FRL) unit, and Different types of valves and actuators. (2 hrs) 132. Dismantle, replace, and assemble FRL unit. (5 hrs) 133. Demonstrate knowledge of safety procedures in pneumatic systems and personal Protective Equipment (PPE). (2 hrs) 134. Identify the parts of a pneumatic cylinder.(1 hr) 135. Dismantle and assemble a pneumatic cylinder.(4 hrs) 136. Construct a circuit for the direction & speed control of a small-bore single-acting (s/a) pneumatic cylinder. (5 hrs)	Compressed air generation and conditioning, Air compressors, Pressure regulation, Dryers, Air receiver, Conductors and fittings, FRL unit, Applications of pneumatics, Hazards & safety precautions in pneumatic systems. Pneumatic actuators:- Types, Basic operation, Force, Stroke length, Single-acting and double-acting cylinders. Pneumatic valves:- Classification, Symbols of pneumatic components, 3/2-way valves (NO & NC types) (manually-actuated & pneumatically-actuated) & 5/2-way valves, Check valves, Flow control valves, One-way flow control valve

		137. Construct a control circuit for the control of a double acting pneumatic cylinder with momentary input signals. (5 hrs) 138. Construct a circuit for the direct & indirect control of a double acting pneumatic cylinder with a single & double solenoid valve. (08 hrs) 139. Dismantling &Assembling of solenoid valves. (07 hrs)	Pneumatic valves: Roller valve, Shuttle valve, Two-pressure valve Electro-pneumatics: Introduction, 3/2-way single solenoid valve, 5/2-way single solenoid valve, 5/2-way double solenoid valve, Control components - Pushbuttons (NO & NC type) and Electromagnetic relay unit, Logic controls (12 hrs)
Professional Skill 110Hrs; Professional Knowledge 30Hrs	Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect. (NOS:CSC/N9489)	140. Inspect hose for twist, kinks, and minimum bend radius, Inspect hose/tube fittings. (5 hrs) 141. Identify internal parts of hydraulic cylinders, pumps/motors. (10 hrs) 142. Construct a circuit for the control of a single acting hydraulic cylinder using a 3/2-way valve (Weight loaded double acting cylinder may be used as a single acting cylinder), 4/2 & 4/3 way valves. (10 hrs) 143. Perform overhauling of hydraulic pump. (10hrs) 144. Maintenance, troubleshooting, and safety aspects of pneumatic and hydraulic systems (The practical for this component may demonstrated by video).	- Symbols of hydraulic components, Hydraulic oils –function, properties, and types, Contamination in oils and its control - Hydraulic Filters – types, constructional features, and their typical installation locations, cavitations, Hazards & safety precautions in hydraulic systems - Hydraulic reservoir & accessories, Pumps, Classification – Gear/vane/ piston types, Pressure relief valves – Direct acting and pilot-operated types - Pipes, tubing, Hoses and fittings – Constructional details, Minimum bend radius, routing tips for hoses - Hydraulic cylinders –Types - Hydraulic motors –Types

		(13 hrs)	- Hydraulic valves: Classification, Directional Control valves – 2/2- and 3/2-way valves - Hydraulic valves: 4/2- and 4/3-way valves, Centre positions of 4/3-way valves - Hydraulic valves: Check valves and Pilot-operated check valves, Load holding function - Flow control valves: Types, Speed control methods – meter-in and meter-out - Preventive maintenance & troubleshooting of pneumatic & hydraulic systems, System malfunctions due to contamination, leakage, friction, improper mountings, cavitations, and proper sampling of hydraulic oils (13 hrs)
		145. Construct Electro Hydraulic circuit –Speed and Pressure control of double acting cylinder.(10 hrs) 146. Perform overhauling of pneumatic cylinders. (12hrs) 147. Perform overhauling of hydraulic actuators. (10hrs) 148. Disassembly of power pack, hydraulic pipes, ferrules, hydraulic cylinders, pistons etc.	Electro hydraulic circuit, Electrical components - Switches - Solenoid - Relay Introduction to Pneumatic actuators Pneumatic Symbols Pneumatic circuit Electrical control components - Switches - Solenoid - Relay Study & working of a hydraulic press along with its

		(10hrs) 149. Replacing &refitting of hydraulic pipes, seals etc. (10hrs) 150. Assemble the parts and testing of the power press after air bleeding. (10hrs)	components. Breakdown & preventive maintenance of a hydraulic press. Safety in use of and maintenance of hydraulic presses. Proximity Sensors Classification And Operation-Proximity Sensor-Types Of Proximity Sensor And Their Working-Industrial Application Sensors For Distance And Displacement -LVDT-Linear (17 hrs)
Professional Skill 80Hrs; Professional Knowledge 20Hrs	Make pipe/tube fittings and valve connections for lubricants and coolants, test for leakages. (Mapped NOS: CSC/N0901)	151. Flaring of pipes and pipe joints. (3 hrs) 152. Cutting & Threading of pipe length.(3 hrs) 153. Fitting of pipes as per sketch observing conditions used for pipe work. (09 hrs) 154. Bending of pipes- cold and hot.(7 hrs) 155. Fit & assemble pipes, valves and test for leakage & functionality of valves.(17 hrs) 156. Visual inspection for visual defects e.g. dents, surface finish.(3hrs)	Pipes and pipe fitting-commonly used pipes. Pipe schedule and standard sizes. Pipe bending methods. Use of bending fixture, pipe threads-Std. Pipe threads Die and Tap, pipe vices. Standard pipefitting-Methods of fitting or replacing the above fitting, repairs and erection on rainwater drainage pipes and house hold taps and pipe work. Inspection & Quality control -Visual Inspection - Basic 7 Quality tools (10 hrs)
		157. Dismantle & assembly of globe valve, gate valve, butterfly, diaphragm, direction control valve, pressure relief, non return& flow control	Pipe colour code. Safety precautions to be observed while working at pipeline. Constructional detail of different type of valve & their

		valve. (30hrs) 158. Making & replacement of gaskets, washer. (08hrs)	uses like: Gate, Globe, butterfly, Diaphragm. (10 hrs)
Professional Skill 40Hrs; Professional Knowledge 10Hrs	Conduct preventive maintenance, perform dismantling and assembly of different components machine and test for accuracy of milling machine. (Mapped NOS: CSC/N0901)	159. Dismantle and assemble of head stock, gear box lead screw, table of milling machine. (27hrs) 160. Check the accuracy of milling machine of after assembly. (08hrs) 161. Do the preventive maintenance of milling machine. (5hrs)	Breakdown maintenance and preventive maintenance of a milling machine. (10 hrs)
Professional Skill 60Hrs; Professional Knowledge 18Hrs	Set the different grinding machine and produce component to appropriate accuracy. *[Different machine:- Surface & cylindrical grinding; appropriate accuracy ±0.02mm]* (Mapped NOS: CSC/N0304)	162. Demonstrate working of grinding machine. (05 hrs) 163. Set the machine, stroke length & do wheel balancing. (10 hrs) 164. Perform grinding of parallel and perpendicular surfaces (accuracy ±0.02mm). (15 hrs) 165. Perform grinding of angular surfaces grinding (accuracy ±0.02mm). (10hrs) 166. Setting the cylindrical grinding machine for grinding internal and external surfaces. (10hrs) 167. Setting the machine for grinding taper holes. (10hrs)	**Grinding:** Grinding machine – introduction, parts & constructional details, types – surface grinding and cylindrical grinding machines. Safety precaution followed while working on grinding machines. Grinding wheels – abrasives, bond and bonding process, grit, grade, and structure of grinding wheels and its marking system. Procedure for mounting of grinding wheels, balancing of grinding wheels, dressing and truing of grinding wheels, glazing and loading in grinding wheel. (18 hrs)
Professional Skill 40Hrs; Professional	Conduct preventive maintenance, perform dismantling & assembly of	168. Dismantle and assembly of grinding head, lead screw, table, hydraulic cylinders of grinding	Preventive and breakdown maintenance of grinding machine. (10 hrs)

Knowledge 10Hrs	different components of grinding machine and test for accuracy. *[Different components grinding head, lead screw, table, hydraulic cylinders]* (Mapped NOS: CSC/N0901)	machine. (20hrs) 169. Check the accuracy of grinding machine after assembly. (10hrs) 170. Do the preventive maintenance of surface grinder and cylindrical grinding machine. (10hrs)	
Professional Skill 110Hrs; Professional Knowledge 30Hrs	Identify and explain basic functioning of different electrical equipment, sensors and apply such knowledge in industrial application including basic maintenance work. *[Different electrical & electronics equipment- DC/ AC motors, passive & active electronic components, resistor, capacitor, inductors, rectifier, diode transistor, SCRS & ICS; Different sensors – proximity & ultrasonic]* (Mapped NOS: *CSC/N0305)*	171. Behaviour of Proximity Sensors. (5hrs) 172. Behaviour of ultrasonic sensors. (5hrs) 173. Logical Operation of Sensors. (5hrs) 174. Limit & Level Control using Sensors. (5hrs) 175. Interfacing of Sensors with Electrical Actuators. (5hrs) 176. Making simple wiring circuits and measurement of current and voltage. (5hrs) 177. Testing of power supply (AC & DC).(5 hrs) 178. Demonstration of use of test lamp and megger. (5 hrs) 179. Connections of DC/AC motors and its speed control - demonstration only. (5 hrs)	Switches, Fuse And Circuit Breakers. Introduction To Sensors--Fundamental Of Sensor. Potentiometer -Ultrasonic And Optical Sensors-Industrial Application. Basic principles of DC generators and motors, Alternators and AC motors and transformers. Various types of switches, circuit breakers, fuses, lamps, proximity switches, relays and contactor in electrical circuits. Passive circuit elements – resistors, capacitors and inductors. Its identification and testing. Colour code. (12 hrs)
		180. Identification of passive & active electronic components. (8hrs) 181. Use of oscilloscope. (05hrs) 182. Demonstrate of logic	**BASIC ELECTRONICS** Introduction to electronics and its industrial applications. Introduction to digital electronics – numbers system and logic gates.

		gate operations. (5hrs) 183. Testing and measurement of resistors, capacitors, inductors using multimeter. (8hrs) 184. Perform soldering and de-soldering of components on printed circuit board. (PCB). (10hrs) 185. Study of rectifiers and testing with multimeter. (5hrs) 186. Preparing and checking of rectifier circuits. (6hrs) 187. Demonstrate of solid state devices –diode transistors. (5hrs) 188. SCRS & ICS –identification &testing. (5hrs) 189. Assembly of simple battery eliminator circuit using bright rectifier & fitter capacitor. (8hrs)	Study of electronic circuit – macro level with block diagram. (18 hrs)
Professional Skill 40Hrs; Professional Knowledge 10Hrs	Programme PLC and interface with other devices to check its Applications. (NOS:CSC/N9490)	192. Ascertain various modules, controls, and indicators of given PLC. (6 hrs) 193. Program and configure the PLC to perform a simple start/stop routine. (6 hrs) 194. Program the PLC using Timer and Counter instructions. (10 hrs) 195. Program the PLC to perform Move, Arithmetic, and Logical	**PLC:** Overview of different control systems. Introduction about PLC. Block diagram of PLC. Different types of PLC, PLC Architectures (Fixed and Modular). Selection of PLC. Advantages of PLC. Applications of PLC. Various types of modules used in PLC. Familiarization of AND, OR and NOT logics with examples. Registers Basics. Timer Functions. Counter

		operations. (3 hrs) 196. Program the PLC for performing comparator operations. (3 hrs) 197. Practice on PLC wiring. (9 hrs) 198. Program PLC for controlling analog parameter(s). (3 hrs)	Functions. Introduction and importance of Sequential Control Systems. Communication protocols used in PLC: RS-232, RS-485, Ethernet, Profibus. Different programming languages of PLC: LDR, STL,FBD, CSF. Basic ladder programming of PLC. Configuration of PLC and its modules. Wiring of PLC. (10 hrs)
Professional Skill 60Hrs; Professional Knowledge 18Hrs	Prepare part programme, test on simulation software and interpret different errors. (NOS:CSC/N9491)	199. Knowledge rules of personal and CNC machine safety, safe handling of tools, safety switches and material handling equipment using CNC didactic/simulation software and equipment. (5hrs) 200. Identify CNC lathe machine elements and their functions. (5hrs) 201. Understand the working of parts of CNC lathe, using CNC didactic/ simulation software. (05hrs) 202. Identify common tool holder and insert shapes by ISO nomenclature. (5hrs) 203. Select cutting parameters from tool manufacturer's catalogue. (2hrs) 204. Write CNC programs for	Concept of Co-ordinate geometry, concept of machine coordinate axis, axes convention on CNC lathes, work zero, machine zero. Converting part diameters and lengths into co-ordinate system points. Absolute and incremental programming. Programming – sequence, formats, different codes and words. ISO G codes and M codes for CNC turning. Describe CNC interpolation, open and close loop control systems. Co-ordinate systems and Points. Cutting tool materials, application of various materials.

		simple tool motions and parts using linear and circular interpolation; check on program verification/ simulation software. (04hrs)	Cutting tool geometry for internal and external turning, grooving, threading, face grooving, drilling. Insert holding methods for each.
		205. Write CNC part programs using canned cycles for stock removal, grooving, threading operations, with drilling and finish turning. Use TNRC commands for finish turning. Check simulation on program verification/ simulation software. (06 hrs)	Writing part programs as per drawing & checking using CNC program verification/ simulation software. Process planning, work holding, tool and cutting parameters selection according to the part geometry and dimensions.
		206. Avoiding collisions caused by program errors. Knowing causes and effects of collisions due to program errors, by making deliberate program errors and simulation on program verification/ simulation software. (6hrs)	Collisions due to program errors, effects of collisions. Costs associated with collisions – tool breakage, machine damage, injuries. Find out alarm codes and meaning of those codes. Program execution in different modes like MDI, single block and auto.
		207. Simple turning & Facing (step turning) without using canned cycles, on CNC simulator. (06 hrs)	Process planning & sequencing, tool layout & selection and cutting parameters selection.
		208. Program checking in dry run, single block modes, on CNC simulator (2hrs)	
		209. Absolute and incremental programmingassignments and simulation. (6hrs)	Work and tool offsets. Inputs value to the offset/ geometry page into machine.
		210. Checking finish size by over sizing through tool	First part checking: Program

		offsets, on CNC simulator. (2hrs) 211. Recovering from axes over travel, on CNC simulator. (1 hr) 212. Interpret different messages generated against different errors. (05hrs)	checking in single block and dry run modes – necessity and method. (18 hrs)
Professional Skill 90Hrs; Professional Knowledge 20Hrs	Troubleshoot & Overhaul of pumps, fans, blowers & compressors and perform preventive maintenance. (Mapped NOS: CSC/N0901)	213. Demonstrate various types of machine related centrifugal pump and their parts. (8hrs) 214. Overhauling of pumps with fitting of gland packing. (15hrs) 215. Priming of pump. (4hrs) 216. Testing of pump. (2hrs) 217. Perform preventive and schedule maintenance. (4hrs) 218. Trouble shooting in pump operation. (12hrs)	**Centrifugal Pump, Fan, Blower and Compressor:-** **Pump** Function of pump. Types and working principle of centrifugal pump (machine related). Constructional detail of pump Starting and stopping Pump performance and characteristics. Capitation & aeration Preventive & schedule maintenance of pumps. Gland packing changing procedure. Concept of Mechanical seal Trouble shooting in pump. (10 hrs)
		219. Identification of various types of fans, blowers and their parts. (5hrs) 220. Dismantle, inspect, repair/ replace work out part and assemble the same. (10hrs) 221. Demonstrate compressors and their parts. (8 hrs) 222. Cleaning and changing of	**Fan & Blowers:** Types and working principle Constructional detail of Fans & Blowers. Starting and stopping of Fans and Blowers Different parts of Fans & Blowers Concept of surge. Preventive & scheduled maintenance.

		filters of compressors. (8 hrs) 223. Perform schedule and preventive maintenance of blower & compressor. (6hrs) 224. Change compression ring & oil rings in a reciprocator compressor. (8 hrs)	**Compressors:** Compression theory, Types of compressors Constructional detail of compressors, working mechanism Different parts and their function. Loading unloading system Concept of air dryer. Preventive & schedule maintenance. (10 hrs)
Professional Skill 110Hrs; Professional Knowledge 30Hrs	Identify fault carryout maintenance work and break down of different machineries/ equipments viz., shaper, surface grinding, drilling, lathe, milling, in the shop floor, using appropriate tools &equipments to ensure its functionality. (Mapped NOS: CSC/N0901)	225. Demonstrate mechanical & hydraulic jack, rope puller, chain puller, chain block, and winch. (8 hrs) 226. Inspection of tools and tackles of material handling equipments. (6 hrs) 227. Shift a small machine from layout to loading centre/ different work place. (10 hrs)	Different type of jacks, chain block and pull lift. Knowledge of different types of scaffolding. Material movement by using different rigging tools and techniques. Safety appliances & precautions in rigging. Maintenance of tools and tackles. (09 hrs)
		228. Practice various belt & chain joining methods. (20 hrs) 229. Demonstrate belt conveyor system, vibratory screen & feeder. (Video demo)(6 hrs)	Bulk Material Handling (Conveyor belt, Vibratory screen, Feeders) Principle & mode of material handling. Various components used in belt conveyor system & their functions. (Pulleys, idlers, scrapers, skirts, belt, take up unit system and safety devices). Vibratory screen- working mechanism. Feeders- types, working

			mechanism. Maintenance practice-Pulley lagging, belt sway control belt joining methods. (06 hrs)
		230. Trouble shooting on machine tools such as drill, shaper, lathe & power saw machine. (15 hrs) 231. Perform overhauling of feed units of lathe milling & grinding. (15hrs) 232. Geometrical testing of machine tools. (10hrs)	Breakdown Maintenance, Preventive Maintenance, Predictive Maintenance & Concepts of TPM, OEE.(without calculations) Difference between breakdown and preventive maintenance – Its importance in productivity, types. Normal procedure followed for maintenance of machine tools on the shop floor. Accuracy testing of machine tools. Various maintenance practices. Concepts & Measurement of machine performance: MTBF, MTTR. (without calculations) (09 hrs)
		233. Preparation of check list for inspection of different machine tools. (5hrs) 234. Temperature measurement of machine tools. (5hrs) 235. Vibration measurement of machine tools. (5hrs) 236. Fault finding practice on machine tools. (05 hrs)	Inspection & Condition Monitoring. Maintenance strategy – Reactive, Preventive, Predictive and proactive. Corrective Maintenance & Plan Maintenance. Condition Base Maintenance (CBM), Reliability Centered Maintenance (RCM), Importance of inspection. Type / methods of equipment inspection. Commonly used gadgets for

			inspection. Concept of inspection check-list. Importance of condition monitoring and Various techniques used for condition monitoring. (vibration, temperature, sound and lubricant condition) Concept of Industry 4.0 **and Digital Manufacturing.** (09 hrs)
ENGINEERING DRAWING: (40 Hrs.)			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work. (NOS:CSC/N9401)	• 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 riveted joints, welded joints • Reading of drawing of pipes and pipe joints • Reading of Job Drawing, Sectional View & Assembly view	
WORKSHOP CALCULATION & SCIENCE: (36 Hrs.)			
WCS- 36 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:CSC/N9402)	**Friction** Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction Friction - Lubrication 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 Heat treatment - Different heat treatment process – Hardening, tempering, annealing, normalising and case hardening **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 CNC manufacturing industry /nearby industry involving CNC operation for production purpose(mandatory) b) Recondition electrical panel and motor of lathe/ milling and test functionality. c) Reconditioning of a lathe/ milling with testing report.		

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/ www.dgt.gov.in

ANNEXURE-I

List of Tools & Equipment			
Mechanic Machine Tool Maintenance(For batch of 24 candidates)			
S No.	**Name of the Tool & Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1.	Steel Rule	15 cm both side Graduated in Metric & English.	24+1 nos.
2.	Center punch	100 mm	24+1 nos
3.	File flat 2nd cut	250 mm	24+1 nos
4.	File flat bastard	350 mm	24+1 nos
5.	File flat smooth	200 mm	24+1 nos
6.	Hermaphrodite Caliper	150 mm	5 nos.
7.	Try Square	150 mm	5 nos.
8.	Hack Saw frame adjustable	250-300 mm with blades.	5 nos.
9.	Hammer ball peen	400 gm with handle.	5 nos.
10.	Cold Chisel	20 x200 mm	5 nos.
11.	Cross Chisel	10x150 mm	5 nos.
12.	Half Round Chisel	10x150 mm	5 nos.
13.	Diamond point Chisel	10x150 mm	5 nos.
14.	File Half round	2nd cut 250 mm	5 nos.
15.	File triangular smooth	200 mm	5 nos.
16.	File round smooth	200 mm	5 nos.
17.	File square smooth	200 mm	5 nos.
18.	Round nose pliers	200 mm	5 nos.
19.	Combination pliers	200 mm	5 nos.
20.	Scraper A	250 mm (Bearing)	5 nos.
21.	Scraper B	250 mm (Triangular)	5 nos.
22.	Scraper D	250 mm (Half Round)	5 nos.
23.	Spindle blade screw driver	100 mm	5 nos.
24.	Allen keys	2 to 16 mm (Hexagonal)	5 nos.
25.	Card file		5 nos.
26.	Screw driver set		5 nos.
B. INSTRUMENTS AND GENERAL SHOP OUTFIT			
27.	Tap and die set	M6, M8, M10, M12, M16, M20& M25 with necessary tap wrench and die holder.	1 each

28.	Spanner socket	set of 25 pieces (10 to 25, 27, 30, 32, mm = 18 pcs and assorted = 7 nos.)	1no.
29.	Hammer soft	(faced 30 mm dia.) plastic tipped.	As required
30.	Pipe wrench	450	As required
31.	Chain pipe wrench	650	As required
32.	Telescopic gauges	13 mm to 300 mm.	As required
33.	Tap Extractor		1 no.
34.	Linear Actuator (Differential and non-differential)		1 each
35.	Cut section model of Pneumatic vales		1 no.
36.	Vibrometer		As required
37.	Flow Detector		1 no.
38.	Magnetic crack detector		1 no.
39.	Engineers Stethoscope		As required
40.	Stud Extractor		1 no.
41.	Tool picker	collate type	As required
42.	Tool picker	magnetic type	As required
43.	Magnifying Glass	75 mm	1 no.
44.	Pin spanner set		1set
45.	Hand keyway breacher		As required
46.	C.I. Surface plate	400 x 400 mm with stand and cover	As required
47.	Bearing and gear tester		As required
48.	Master test bars (Different sizes)		1 no.
49.	Spirit Level	150 mm, accuracy 0.02 mm / 1000 mm	2 nos.
50.	3 Cells Torch		2 nos,
51.	Gasket Hollow punches	5, 6, 8, 10, 12, 19, 25 mm dia.	1 each
52.	Bar type Torque Wrench		1 no
53.	Cam lock type Screw Driver		1 no
54.	Flaring tools		2 no
55.	Tube Expander	up to 62 mm	2 set
56.	Circlip Pliers (inside, outside and straight)		1 each
57.	Hammer (Ball peen, cross peen, straight peen)	500 grms.	3 sets
58.	Viscometer		1 no.
59.	Vernier height gauge	300 mm	1 no.
60.	Maintenance tool kit	trolley of 1200 x 800 x1200 mm (L x W x H)	As required
61.	Steel lockers for 20 trainees		2 nos.

62.	Steel cupboard	180 cm x 60 cm x 45 cm	6 nos.
63.	Workbench	240 cm x 120 cm x 75 cm (Each bench fitted with 4 vices)	5 nos.
64.	Bench Vice	100 mm jaw	24 nos.
65.	Letter punch	5 mm set	1 set
66.	Number punch	5mm set	1 set
67.	Deep cutting hacksaw frame	300 mm	1 no.
68.	Bearing puller		1 no
69.	Bolts, nuts & studs & washer	M6-M20	4 sets
70.	Prussian Blue		2 boxes
71.	Adhesives	1) Lock tight 2) Araldite	2 each
72.	Circlip external & internal	bore size (20-40mm)	2 sets
73.	Gasket sheet material		As required
74.	Lubricants oil	servo grade	1 barrel
75.	Hydraulic fluid		1 barrel
C. PRECISION INSTRUMENTS			
76.	Vernier Bevel protractor	with 150 mm blade	1 no.
77.	Vernier caliper	200 mm with Inside and depth measurements	2 nos.
78.	Dial vernier caliper	200 mm, with 0.02 mm least count	1 no.
79.	Optical Bevel protractor		1 no.
80.	Outside micrometer	0 to 25mm	1 no.
81.	Outside micrometer	25 to 50 mm	1 no.
82.	Outside micrometer	50 to 75 mm	1 no.
83.	Combination set	300 mm blade centre head, square head and protector head.	1 no.
84.	Sine bar 200 mm		1 no.
85.	Slip Gauge Box (workshop grade) - 87 pieces per set		1 no.
86.	Inside micrometer	50 mm to 200mm, 0.01 mm least count with six extension rod.	1 no.
87.	Dial test indicator –stand)	Plunger type-Range 0-10 mm , Graduation 0.01 mm & 0.001mm Reading 0-10 with revolution counter (complete with clamping devices and magnetic Range 0-10 mm , Graduation 0.01 mm & 0.001 mm. Reading 0-10 with revolution counter (complete with clamping	1 set

		devices and magnetic stand)	
88.	Dial test indicator – Puppitast type-		1 set
89.	Feeler gauge		1 no.
90.	Radius gauge	1 to 25 mm radius	1 no.
91.	Screw pitch gauge for metric, standard & fine pitches.	BSP & BSW pitches (0.25 to 6 mm)	1 no.
92.	Center gauge	55º x 47½º	1 no.
93.	Center gauge	60º	1 no.
94.	Plug gauge	Morse taper No.1, 2, 3, 4,	1 set
95.	Ring gauge	Morse taper No.1, 2, 3, 4,	1 set
96.	Ring gauge	Ø20mm (Go and No Go)	1 no.
97.	Limit plug gauges	Ø20mm	1 no.
98.	Wire gauges		1 no.
99.	Bore gauge	dial indicator (1 mm range, 0-0.01 mm graduation)-Range of bore gauge 18-150 mm)	1 no.
100.	Straight edge	Min 500mm- Max 1000mm	1 each
101.	Bearing fitting tool		1 set
102.	Multimeter		2 Nos.
103.	Tong tester		1 No.
104.	Megger		1 No.
105.	Wire stripper cum cutter		1 No.
106.	Crimping Tool		1 No.
D. LATHE TOOL			
107.	Reduction sleeve and extension socket.		As required
108.	Centre drills	3, 4 and 5 mm (Consumable)	2 nos. each
109.	Revolving centre with arbor		As required
110.	Knurling tool with holder (straight, cross, diamond)		1 each
111.	Dog carrier		As required
112.	Oil can pressure feed		As required
113.	Tool holder (straight) to suit	6 & 8 mm sq. bit size	As required
114.	H.S.S. tool bits	6 mm, 8 mm sq. x100 mm length (consumable)	As required
115.	Carbide tip mechanically fastened tool set		1 set
E. MILLING MACHINE TOOLS			
116.	Cylindrical milling cutter	Ø 63 x 70 x Ø 27 mm	1 no.
117.	Side and face cutter	Ø 80 x 10 X Ø 27 mm	1 no

118.	Slitting Saw cutter	Ø 100 x 6 X Ø 27 mm	1 no.
119.	Slitting Saw cutter	Ø 75 x 3 X Ø 27 mm	1 no.
120.	'T' slot cutter with parallel shank-	Ø 17.5 x 8 mm width x dia. of shank 8 mm	1 no.
121.	Woodruff key seating cutters	A 13.5x3, A16x4	1 each
122.	Parallel shank	end mill Ø 5 mm, Ø 6 mm, Ø 8mm, Ø 10 mm and Ø 12 mm	1 each
123.	Scribing block universal	300mm	As required
124.	V-Block	Approx 65x65x80 mm with clamping capacity of 50 mm with clamps	1 set each
125.	D.E spanners	3-4 , 6-8, 10-12, 13-14, 15-16, 18-19, 20-22, 24-26 (8 spanners)	1 set
126.	Angle plate-adjustable	250x250x300 mm	1 no.
127.	Twist Drill	Parallel Shank Ø 4 mm to Ø 12 mm in steps of 0.5 mm	1 each
128.	Grinding wheel dresser	(diamond dresser) with holder 1.5 carat diamond	2 nos.
129.	C – clamp	50 mm & 75 mm	1 each
130.	Hand reamer	6 to 16 mm in steps of 1 mm	1 each
131.	Machine reamer	6 to 16 in steps of 1 mm	1 each
F. GENERAL MACHINERY			
132.	Lathe all gear head type	Centre height of 150 mm, Gap bed, between centers 1000 mm (with 3 jaw and 4 jaw chuck, coolant equipments)	2 nos.
133.	Universal Milling machine		1no
134.	Surface grinding machine	wheel dia 180 mm (or near) reciprocating table, longitudinal table traverse 200mm (or near) full motorized supplied with magnetic chuck 250 X120mm and necessary accessories.	1no
135.	Drilling machine	Pillar type 20mm capacity	1no
136.	Double ended Pedestal Grinder	178 mm wheels(one fine and one rough)- motorized with twist drill grinding attachment	1no
137.	Flexible Hand Grinder	100 mm dia – light duty	1no
138.	Portable Drilling machine	6 mm capacity.	1no
139.	Shaping Machine	450 mm stroke (motorized) with all attachments	1no
140.	Pipe bending machine	Manual/ Hydraulic	1no

141.	Hydraulic trainer with necessary elements for different machine circuit with all types of transparent valves and pressure gauge, reservoir etc.		1 set
142.	Pneumatic trainer with necessary elements for demonstration different machine circuit with all types of valves, pressure gauge and compressor etc.		1 set
143.	Universal Cylindrical grinder	External & Internal	1 No.
144.	Muffle Furnace (Electric)	Capacity 20kgs.	1 no.
145.	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 + 1faculty) ***With help of this software the trainees should be able to Write, Edit, Verify & Simulate***	Software	10
146.	Desktop Computers	CPU: 32/64 Bit i3/i5/i7 or latest processor, Speed: 3 GHz or Higher. RAM:-4 GB DDR-III or Higher, Wi-Fi Enabled. Network Card: Integrated Gigabit Ethernet, with USB Mouse, USB Keyboard and Monitor (Min. 17 Inch) Licensed Operating System and Antivirus compatible with trade related software	10
G. OLD MACHINES FOR JOB WORK (REPAIR & RECONDITIONING)			
147.	Old Centre lathe		1no
148.	Old Milling Machine (Universal)		1no
149.	Old Grinding Machine (Universal)		1no
150.	Old Shaping Machine		1no
151.	Old Gear Box (any type)		1no
152.	Revolving Centre		1no
153.	Old hydraulic power pack with hydraulic cylinder		1 no
154.	Old Centrifugal Pump		1 no
155.	Old Gear pump		1 no.

156.	Old Vane pump fixed and variable delivery		1each
157.	Old Piston pump (Radial& Axial)		1each
158.	Old Reciprocating Compressor		1 no.
H. WELDING WORK			
(i) GAS WELDING			
159.	Oxy-acetylene welding Cylinder Trolley		1 no.
160.	Welding hose P.V.C. flexible	Internal dia. 6 mm (Blue and red)	5m
161.	Hose coupling Nipples		2 nos.
162.	Hose Protractor		2 nos.
163.	Double stage Pressure regulator for Oxygen and Acetylene		1no. each
164.	High Pressure blow pipe with tips		1 no.
165.	Gas cutting torch with cutting tips		1 no
166.	Welding gloves pair (Leather)		1 pair
167.	Goggles	(4A) for Gas. Welding	4 nos.
168.	Spark lighter		2 nos.
169.	Spindle key		1 no.
170.	Gas Welding table with fire bricks.		1 no.
(ii) ARC WELDING			
171.	Welding Machine DC or AC,	(Single phase / 3 phase), 150 – 300 Amps capacity with all accessories	1 no.
172.	Arc welding electrode	Ø4 mild steel	3 boxes
173.	Brass brazing rod	Ø3	3 boxes
174.	Gas welding flux (Borax)		As required
175.	Gas cylinder (Acetylene & Oxygen)		2 pair
(iii) ERECTION TOOLS			
176.	Foundation bolts (different types)		1each.
177.	Plumb bob		1 no.
178.	Square Box Wrenches		1 no
179.	Square T Wrenches		1 no
180.	Engineers square	700 mm	1 no
181.	Threaded Fastener B Type		1 no
182.	Threaded Fastener C Type		1 no
183.	Threaded Fastener F Type		1 no
184.	Hoisting Equipment: chain pulley, steel slings, rope, belt, tackles		1 set

185.	Slings		2 Nos.
186.	Hydraulic trolley		1 No.
187.	Screw jack		2 Nos.
188.	Hydraulic jack		2 Nos.

NOTE:

a) 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.

b) **For units less than 8(4+4), the ITI can enter into MoU with Facilitator who will provide the CNC Training to Trainees admitted and undergoing training in above Trade.** 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 training infrastructure for providing CNC training. 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.

c) Infrastructure of Electrician trade may be utilized for imparting training on basic electrical and electronics components.

d) Infrastructure of computer lab of the institute to be utilized for imparting practical training on CNC simulation.

e) Internet facility is desired to be provided in the class room.

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