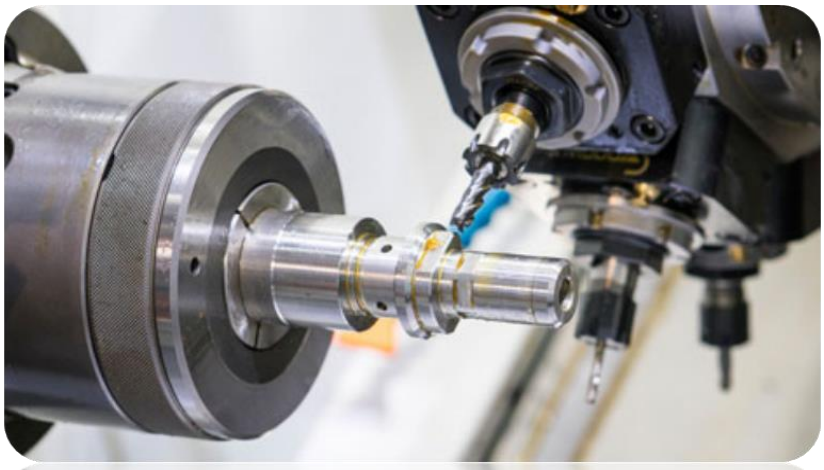
MACHINIST & OPERATOR ADVANCE MACHINE TOOL

NSQF LEVEL - 5



SECTOR- CAPITAL GOODS & MANUFACTURING

COMPETENCY BASED CURRICULUM

CRAFT INSTRUCTOR TRAINING SCHEME (CITS)

GOVERNMENT OF INDIA
Ministry of Skill Development & Entrepreneurship
Directorate General of Training
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
EN-81, Sector-V, Salt Lake City, Kolkata – 700091

MACHINIST & OPERATOR ADVANCE MACHINE TOOL

(Engineering Trade)

SECTOR- CAPITAL GOODS & MANUFACTURING

(Revised in 2023)

Version 2.0

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Developed By

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1. COURSE OVERVIEW

The Craft Instructor Training Scheme is operational since inception of the Craftsmen Training Scheme. The first Craft Instructor Training Institute was established in 1948. Subsequently, 6 more institutes namely, Central Training Institute for Instructors (now called as National Skill Training Institute (NSTI)), NSTI at Ludhiana, Kanpur, Howrah, Mumbai, Chennai and Hyderabad were established in 1960 by DGT. Since then the CITS course is successfully running in all the NSTIs across India as well as in DGT affiliated institutes viz. Institutes for Training of Trainers (IToT). This is a competency based course for instructors of one year duration. "Machinist & Operator Advance Machine Tool" CITS trade is applicable for Instructors of "Machinist" & "Operator Advanced Machine Tool Maintenance" CTS Trades.

The main objective of Craft Instructor training programme is to enable Instructors explore different aspects of the techniques in pedagogy and transferring of hands-on skills so as to develop a pool of skilled manpower for industries, also leading to their career growth & benefiting society at large. Thus promoting a holistic learning experience where trainee acquires specialized knowledge, skills & develops attitude towards learning & contributing in vocational training ecosystem.

This course also enables the instructors to develop instructional skills for mentoring the trainees, engaging all trainees in learning process and managing effective utilization of resources. It emphasizes on the importance of collaborative learning & innovative ways of doing things. All trainees will be able to understand and interpret the course content in right perspective, so that they are engaged in & empowered by their learning experiences and above all, ensure quality delivery.

2. TRAINING SYSTEM

2.1 GENERAL

CITS courses are delivered in National Skill Training Institutes (NSTIs) & DGT affiliated institutes viz., Institutes for Training of Trainers (IToT). For detailed guidelines regarding admission on CITS, instructions issued by DGT from time to time are to be observed. Further complete admission details are made available on NIMI web portal http://www.nimionlineadmission.in. The course is of one-year duration. It consists of Trade Technology (Professional skills and Professional knowledge), Training Methodology and Engineering Technology/ Soft skills. After successful completion of the training programme, the trainees appear in All India Trade Test for Craft Instructor. The successful trainee is awarded NCIC certificate by DGT.

2.2 COURSE STRUCTURE

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

S No.	Course Element	Notional Training Hours
1.	**Trade Technology**	
	Professional Skill (Trade Practical)	480
	Professional Knowledge (Trade Theory)	270
2.	**Training Methodology**	
	TM Practical	270
	TM Theory	180
	Total	**1200**

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

3	On the Job Training (OJT)/ Group Project	150
4	Optional Courses	240

CITS Trainees of optional courses of up to 240 hours in each year short term courses.

2.3 PROGRESSION PATHWAYS

- Can join as an Instructor in a vocational training Institute/ technical Institute.
- Can join as a supervisor in Industries.

2.4 ASSESSMENT & CERTIFICATION

The CITS trainee will be assessed for his/her Instructional skills, knowledge and attitude towards learning throughout the course span and also at the end of the training program.

a) The Continuous Assessment (Internal) during the period of training will be done by **Formative Assessment Method** to test competency of instructor with respect to assessment criteria set against each learning outcomes. The training institute has to maintain an individual trainee portfolio in line with assessment guidelines. 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 Method**. The All India Trade Test for awarding National Craft Instructor Certificate will be conducted by DGT at the end of the year as per the guidelines of DGT. The learning outcome and assessment criteria will be the basis for setting question papers for final assessment**.** The external 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 CRITERIA

Allotment of Marks among the subjects for Examination:
The minimum pass percent for Trade Practical, TM practical Examinations and Formative assessment is 60% & for all other subjects is 40%.There will be no Grace marks.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking the assessment. While assessing the major factors to be considered are approaches to generate solutions to specific problems by involving standard/non-standard practices.

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

Assessment will be evidence based comprising of the following:

- Demonstration of Instructional Skills (Lesson Plan, Demonstration Plan)
- Record book/daily diary
- Assessment Sheet
- Progress chart
- Video Recording
- Attendance and punctuality
- Viva-voce
- Practical work done/Models
- Assignments
- Project work

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

Performance Level	Evidence
(a) Weightage in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of an ***acceptable standard*** of crafts instructorship with ***occasional*** **guidance** and engage students by demonstrating good attributes of a trainer.	• Demonstration of ***fairly good*** skill to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field. • Average engagement of students for learning and achievement of goals while undertaking the training on specific topic. • A fairly good level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson. • Occasional support in imparting effective training.
(b) Weightage in the range of 75%-90% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of a ***reasonable standard*** of crafts instructorship with ***little*** **guidance** and engage students by demonstrating good attributes of a trainer.	• Demonstration of ***good*** skill to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field. • Above average in engagement of students for learning and achievement of goals while undertaking the training on specific topic. • A good level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson. • Little support in imparting effective training.
(c) Weightage in the range of more than 90% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of a ***high standard*** of crafts instructorship with ***minimal or no support*** and engage students by demonstrating good attributes of a trainer.	• Demonstration of ***high*** skill level to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field. • Good engagement of students for learning and achievement of goals while undertaking the training on specific topic. • A high level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson.

	• Minimal or no support in imparting effective training.

3. GENERAL INFORMATION

Name of the Trade	**MACHINIST & OPERATOR ADVANCE MACHINE TOOL - CITS**
Trade Code	**DGT/4015**
Reference NCO 2015	2356.0100, 7223.0500
NOS Covered	CSC/N9466, CSC/N9467, CSC/N9472, CSC/N9406, CSC/N9474, CSC/N9475, CSC/N9476, CSC/N9482, CSC/N9433, ASC/N9410, ASC/N9411
NSQF Level	Level-5
Duration of Craft Instructor Training	One Year
Unit Strength (No. Of Student)	25
Entry Qualification	Degree in Mechanical/Production/ Metallurgy / Mechatronics Engineering from AICTE/ UGC recognized Engineering College/ University OR 03 years Diploma in Mechanical/Production/ Metallurgy / Mechatronics Engineering after class 10th from AICTE/ recognized board of technical education. OR Ex-serviceman from Indian Armed forces with 15 years of service in related field as per equivalency through DGR OR 10th Class with 02-year NTC/NAC in Machinist trade + 01 year of relevant experience.
Minimum Age	18 years as on first day of academic session.
Space Norms	120 Sq. m
Power Norms	21 KW
Instructors Qualification for	
1. Machinist & Operator Advance Machine Tool -CITS Trade	B.Voc./Degree in Mechanical / Production Engineering from AICTE/UGC recognized University with two years experience in relevant field. OR 03 years Diploma in Mechanical / Production Engineering from AICTE/ recognized Board/ University or relevant Advanced Diploma (Vocational) from DGT with five years experience in relevant field. OR Ex-serviceman from Indian Armed forces with 15 years of service in related field as per equivalency through DGR. Candidate should undergone methods of instruction course of minimum 02 years of experience in technical training institute of Indian Armed forces

	OR NTC/ NAC passed in Machinist or Operator AMT trade with seven years experience in relevant field. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in Machinist & Operator AMT trade or in any of the variants under DGT.
2. Workshop Calculation & Science	B.Voc/Degree in any Engineering from AICTE/ UGC recognized Engineering College/ university with two years experience in relevant field. **OR** 3 years Diploma in Engineering from AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with five years experience in relevant field. **OR** NTC/ NAC in any Engineering trade with seven years experience in relevant field. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in relevant trade. **OR** 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 two years experience in relevant field. OR 03 years Diploma in Engineering from AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with five 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 seven years experience. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in relevant trade. **OR** NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
4. Training Methodology	B.Voc./Degree in any discipline from AICTE/ UGC recognized College/ university with two years experience in training/ teaching field. OR Diploma in any discipline from recognized board / University with five years experience in training/teaching field. OR NTC/ NAC passed in any trade with seven years experience in training/ teaching field. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in any of the variants under DGT / B.Ed /ToT from NITTTR or equivalent.

5. Minimum Age for Instructor	21 years

4. JOB ROLE

Brief description of job roles:

Manual Training Teacher/Craft Instructor; instructs students in ITIs/Vocational Training Institutes in respective trades as per defined job role. Imparts theoretical instructions for the use of tools & equipment of related trades and related subjects. Demonstrate process and operations related to the trade in the workshop; supervises, assesses and evaluates students in their practical work. Ensures availability & proper functioning of equipment and tools in stores.

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

Reference NCO:

2356.0100 - Manual Training Teacher/Craft Instructor
7223.0500 - Mechanist, General/Machinist

Reference NOS:

i) CSC/N9466
ii) CSC/N9467
iii) CSC/N9472
iv) CSC/N9406
v) CSC/N9474
vi) CSC/N9475
vii) CSC/N9476
viii) CSC/N9474
ix) CSC/N9482
x) CSC/N9433
xi) CSC/N9410
xii) CSC/N9411

5. LEARNING OUTCOMES

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

5.1 TRADE TECHNOLOGY

1. Demonstrate workshop safety measures and monitor job as per specification perform different types of filing jobs, pedestal grinder operations and check for dimensional accuracy by using appropriate measuring and checking instruments. (NOS: CSC/N9466)
2. Plan and manage the work to make jobs as per requirement selecting different operations ensuring accuracy by using appropriate measuring instruments [power saw machine operation, external and internal thread cutting (using tap and die), demonstrate reaming (manual/ on machine), counter-boring, counter-sinking]. (NOS: CSC/N9467)
3. Plan, organize and perform various jobs by selection of appropriate operation, tools, accessories, attachments and processes like making flat surface, angular surface, slot, formed surfaces, dovetail and T-slots etc. on shaping machine. Assess accuracy using appropriate measuring instruments. (NOS: CSC/N9472)
4. Monitor & supervise work to ensure correct functional operation, selection of appropriate tools, accessories, attachments and processes like making of flat surface, angular surface, slot, formed surfaces, dovetail and T-slots etc. on Planer machine. Check accuracy using appropriate measuring instruments. (NOS: CSC/N9472)
5. Demonstrate slotting machine parts, mechanisms & their functions. Conduct various jobs on slotting machine. Evaluate accuracy with appropriate instruments. *[Key-way cutting, regular and irregular polygon, spline cutting etc.].* (NOS: CSC/N9406)
6. Demonstrate lathe machine parts, mechanisms & their functions. Perform various jobs on lathe machine. Assess accuracy with appropriate instruments. [*Plain turning, facing, taper turning, step turning, drilling & boring, knurling, thread cutting external and internal etc.].* (NOS: CSC/N9474)
7. Demonstrate milling machine parts, mechanisms & their functions. Plan, organize and make various jobs by selection of appropriate operation, tools, accessories, attachments and processes on milling machine. Check accuracy with appropriate instruments. *[Face milling, slot milling, gang milling, angular milling, end milling and process of up & down milling etc.].* (NOS: CSC/N9474)
8. Demonstrate parts of vertical milling machine, mechanisms & their functions. Monitor selection of appropriate operation, tools, accessories, attachments and processes on vertical milling machine. Check accuracy with appropriate instruments. *[Operation: -slot milling, end milling, pocket milling, dovetail, T-slot milling and cam profile milling etc.]* (NOS: CSC/N9474)

9. Plan and perform simple repair, overhauling of different machines used in machinist section and Check for functionality. *[Cleaning, oiling, greasing, belt replacement and setting etc.].* (NOS: CSC/N9475)
10. Demonstrate various types of grinding on jobs using different types of grinding machines (surface and cylindrical grinder etc.). Explain wheel Mounting, balancing, dressing & truing and other setting for surface / cylindrical grinder. Explain Honing and lapping and its practice. Check accuracy with appropriate instruments. *[Surface grinding, angular grinding, cylindrical grinding, step and camshaft grinding etc.].* (NOS: CSC/N9476)
11. Execute and monitor operations of sharpening/ re-sharpening different cutting tools and cutters using tool and cutter grinder. Check accuracy with appropriate instruments. *[Plain milling cutter, side & face milling cutter, angular cutter, end mill etc.].* (NOS: CSC/N9476)
12. Analyze & set different machining parameters and cutters to prepare components by performing different milling operation with indexing. *[Different machining parameters – feed, speed and depth of cut. Different components – Rack, Spur Gear, External Spline, Clutch, Helical Gear, bevel gear, cam profile, worm & worm wheel].* (NOS: CSC/N9474)
13. Demonstrate operations on machines and check components and its functioning. *[Machines: - EDM, Gear Shaper, Gear Hobber, Jig Boring, Broaching and CMM].* (NOS: CSC/N9482)
14. Plan and perform setting of job and tool in CNC turning centre/ CNC machining centre. Produce components through various modes of operations, prepare/ edit part program, simulation and execution as per drawing/ requirement. *[Face milling and drilling application, tool selection and setting on machine, tool offset].* (NOS: CSC/N9433)
15. Read and apply engineering drawing for different application in the field of work. (NOS: ASC/N9410)
16. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: ASC/N9411)

6. COURSE CONTENT

SYLLABUS - MACHINIST & OPERATOR ADVANCE MACHINE TOOL (CITS)			
TRADE TECHNOLOGY			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Practical 35Hrs Theory 14Hrs	Demonstrate workshop safety measures and monitor job as per specification perform different types of filing jobs, pedestal grinder operations and check for dimensional accuracy by using appropriate measuring and checking instruments.(NOS: CSC/N9466)	**Occupational Safety & Health** **Importance of housekeeping & good shop floor practices.** 1. Follow Health, Safety and Environment guidelines, legislations & regulations as applicable. 2. Dispose as per procedure of waste materials like cotton waste, metal chips/burrs etc. Basic safety introduction, Personal protective Equipments(PPE): - 3. Ensure Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution & personal safety message. 4. Use Preventive measures for electrical accidents & steps to be taken in such accidents. 5. Use Fire extinguishers. **Technical English:** 6. Prepare different types of documentation as per industrial need by different methods of recording information. **Basic Life support training:** 7. Be able to perform DRSABCD:	Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Response to emergencies e.g.; power failure, fire, and system failure Soft Skills: its importance and Job area after completion of training. Introduction to 5S concept & its application. Importance of 5S implementation throughout CITS course-workplace cleaning, machine cleaning, signage, proper storage of equipment etc. Importance of Technical English terms used in industry -(in simple definition only)Technical forms, process charts, activity logs, in required formats of industry, estimation, cycle time, productivity reports, job cards. **Basic Life support (BLS): -** Basic Life Support (BLS) techniques for drowning, choking, electrocution, neck and spinal injury, including CPR (cardiopulmonary resuscitation). Introduction of Basic Hand Tools and Cutting Tools. Linear measurement: - a) Line standard b) End standard. Precision Measuring Instruments like Vernier Calliper, Micrometers height Gauge etc with their parts, principle, reading, application, least

		• D: Check for Danger • R: Check for a Response • S: Send for help • A: Open the Airway • B: Check for normal Breathing • C: Perform CPR (Cardio Pulmonary Resuscitation) • D: Attach Defibrillator / Monitor as soon as available. 8. Illustrate different types of machines and safety related to each machines. 9. Perform Filing job including flatness, Squareness and parallelness. Material identification. 10. Review care and maintenance of measuring tools like Vernier calipers, steel rule, try square, vernier micrometer, height gauge, combination set etc. 11. Demonstrate handling of measuring instruments, checking of zero error, finding of least count.	count, application of Dial Test Indicator, care and maintenance
		12. Demonstrate and practice on Pedestal grinders. Safety, selection, use of grinding wheels. 13. Assess & monitor precision job for fitting machining, grinding. 14. Demonstrate and practice on twist drill bit grinding.	Concept of interchange ability, Elements of interchangeable System Types of fit - clearance, transition, interference, selective assembly- definition & function, Hole basis system, shaft basis system.
Practical 35Hrs	Plan and manage the work to make jobs as	15. Perform & evaluate raw material cutting as per	Surface Finish and Symbols. Power Transmission -

Theory 14Hrs	per requirement selecting different operations ensuring accuracy by using appropriate measuring instruments [power saw machine operation, external and internal thread cutting (using tap and die), demonstrate reaming (manual/ on machine), counter-boring, counter-sinking].(NOS: CSC/N9467)	size in Power Hacksaw machine. 16. Plan & perform internal and external thread making with the use of Tap and Die. 17. Use Hand Reamer and machine reamer.	Classification, types, elements, individual vs. group drive. Related to various machine tools.
		18. Practice on Drilling, Counter sinking, counter boring, use of hand reamer and machine reamer.	Drilling Machine- Specifications and types Constructions - pillar drill and radial drill. Different operation in drilling machine Drill - nomenclature, types Reamers - types, nomenclature Tap drill size, calculation Cutting speed, feed, depth of cut, drilling time, calculations.
		19. Demonstrate Work holding devices - drill jig, vice, V-block, direct clamping on table. 20. Check accuracy of different types of tool holding devices.	Practice on Drilling, Counter sinking, Counter boring
Practical 35Hrs Theory 14Hrs	Plan, organize and perform various jobs by selection of appropriate operation, tools, accessories, attachments and processes like making flat surface, angular surface, slot, formed surfaces, dovetail and T-slots etc. on shaping machine. Assess accuracy using appropriate measuring instruments.(NOS: CSC/N9472)	21. Demonstrate and practice on various chip formation process on shaper operations like - Flat surface, Angular surface, Slot, Formed surface etc.	Cutting tools materials- HCS,HSS, Tungsten carbide, coated carbide, ceramics - Properties and uses - Cutting tool life -Equation for cutting tool life - Factors affecting on cutting tool life. Tool failure reasons, Cutting tool classifications, nomenclature of a single point cutting tool, tool angles and its influence. Machinability, classification in Cutting tool.
		22. Demonstrate and practice on shaping machine.	Introduction to Hydraulic drives, need and applications. Hydraulic shaper -Working principle, construction & quick return mechanism.
		23. Plan & organize shaping Contours with form Tools Shaping a 'V' Block. 24. Demonstrate cutting Keyways in a bush (internal) T-slots etc.	Shaper Machine: Construction, types and parts. Specification of Shaper and applications. Crank slotted link mechanism (adjustment of length of stroke &position of stroke). Quick Return Mechanism.

Practical 25Hrs Theory 10Hrs	Monitor & supervise work to ensure correct functional operation, selection of appropriate tools, accessories, attachments and processes like making of flat surface, angular surface, slot, formed surfaces, dovetail and T-slots etc. on Planer machine. Check accuracy using appropriate measuring instruments.(NOS: CSC/N9472)	25. Demonstrate and practice on planning machine.	Planning m/c- Specifications, construction & types. Quick return mechanism a) Open & Cross belt b) Variable speed.
		26. Plan a flat Surface, slot cutting, angle cutting on Planner Machine.	Cutting speed, feed, depth of cut & machining time calculation in Shaper & Planer Types of Cutting tool. Job holdings devices - Fixture, Vice, Directly over table. Difference between Planner & Shaper.
Practical 15Hrs Theory 05Hrs	Demonstrate slotting machine parts, mechanisms & their functions. Conduct various jobs on slotting machine. Evaluate accuracy with appropriate instruments. [Key-way cutting, regular and irregular polygon, spline cutting etc.]. (NOS:CSC/N9406)	27. Plan & arrange exercises of cutting Key ways. 28. Check machining of Regular Polygon. 29. Check spline fitting on slotting.	Slotting Machine: Specifications, types. Construction & applications. Different types of Tools used Work and Tool Holding devices.
Practical 60 Hrs Theory 25Hrs	Demonstrate lathe machine parts, mechanisms & their functions. Perform various jobs on lathe machine. Assess accuracy with appropriate instruments. [Plain turning, facing, taper turning, step turning, drilling & boring,	30. Plan, perform & assess different operations on lathe.	**Lathe Machine:** Working principle, types & construction Different parts and their functions Drives - cone pulley, back gear, all geared drive Attachment and accessories Different mechanisms - apron mechanism, feed mechanism
		31. Demonstrate Taper turning by different methods to an accuracy of 0.04 mm	Tool setting in correct center height - effects of rake & clearance angle Different operation on lathe Taper turning methods,

	knurling, thread cutting external and internal etc.].(NOS: CSC/N9474)		working principle and calculations. Thread cutting - Different types, Gear Calculation, Tool Setting, Checking the thread,
		32. Review Tool angle measurement, regrinding of cutting tool for orthogonal and oblique cutting. 33. Use the above tool for practical.	Orthogonal and oblique cutting, cutting force, cutting power, Concept of chip formation, types of chips. Built-up edge formation. Coolant used in metal cutting and its applications
		34. Analyze & assess eccentric turning to an accuracy of 0.04 mm.	Definition and calculation of Cutting speed, feed, depth of cut & machining time of lathe.
		35. Plan & organize thread cutting in Lathe Machine - gear calculation, tool setting, measurement of thread sections, arrangement in cutting.	Capstan and turret lathe Need and application of capstan &turret lathe. Comparison between capstan and turret lathe.
		36. Industrial Visit	Job holding devices - chucks, collets, bar feeding mechanism. Tool holding devices - roller steady box, knee tool holder & self-opening die.
Practical 25Hrs Theory 10Hrs	Demonstrate milling machine parts, mechanisms & their functions. Plan, organize and make various jobs by selection of appropriate operation, tools, accessories, attachments and processes on milling machine. Check accuracy with appropriate instruments. [Face milling, slot milling, gang milling, angular milling, end milling and process of up &	37. Demonstrate and practice on Milling Operations. 38. Monitor & ensure plain milling, step milling to an accuracy of 0.04 mm.	**Milling Machine** Milling Machine construction, different types, parts and specification. Different accessories and attachments for Milling Machine. Difference between plain milling & universal milling. Cutter holding device, Work holding Devices.
		39. Perform & monitor slot milling, angular milling	Milling processes- Peripheral milling, Up & Down milling, Different type of Milling operations - Face milling, End milling, Straddle milling, Plain milling, Side milling, Angular milling, Gang milling, End milling etc.

	down milling etc.].(NOS: CSC/N9474)		
Practical 25Hrs Theory 10Hrs	Demonstrate parts of vertical milling machine, mechanisms & their functions. Monitor selection of appropriate operation, tools, accessories, attachments and processes on vertical milling machine. Check accuracy with appropriate instruments. [Operation: -slot milling, end milling, pocket milling, dovetail, T-slot milling and cam profile milling etc.](NOS: CSC/N9474)	40. Demonstrate and practice on Vertical Milling Machine.	JIGS & FIXTURE Definition, Purpose, Difference between Jigs & Fixture Locating principle, locating elements, Clamping elements, types of clamp Different types of Jigs and Fixture.
		41. Demonstrate and practice on Milling Operations. T - slot and Dovetail milling	Milling cutters- Types, elements, negative rake cutter (purpose). Cutting speed, feed, depth of cut & machining time calculations.
Practical 25Hrs Theory 10Hrs	Plan and perform simple repair, overhauling of different machines used in machinist section and Check for functionality. [Cleaning, oiling, greasing, belt replacement and setting etc.].(NOS:	42. Plan & arrange simple Maintenance jobs on the machines used in Machinist Section.	Introduction to General Maintenance, objective, classification (Routine, Breakdown, preventive, emergency etc.) Maintenance planning , planning activities, routine card, critical path scheduling , planned maintenance cycle, spare part planning, standard time for maintenance work.

	CSC/N9475)	43. Perform Simple Maintenance jobs on the machines used in Machinist Section. 44. Demonstrate and practice, fitting of different types of milling cutters on different arbores, tool holders and fitting of inserts on cutter/tool holders.	ISO tool nomenclature, tool holders, inserts for tool holders for different operation like plain turning, threading, grooving, and parting-off. Use of collets, adopters, boring bars & precision boring bars. Different types of milling cutters such as face cutter, side & face cutter, angular milling cutter form cutters & insert used on it. Concept of wiper insert in face cutters.
Practical 35Hrs Theory 14Hrs	Demonstrate various types of grinding on jobs using different types of grinding machines (surface and cylindrical grinder etc.). Explain wheel Mounting, balancing, dressing & truing and other setting for surface / cylindrical grinder. Explain Honing and lapping and its practice. Check accuracy with appropriate instruments. [Surface grinding, angular grinding, cylindrical grinding, step and camshaft grinding etc.]. (NOS: CSC/N9476)	45. Demonstrate surface grinding. 46. Assess balancing & mounting a grinding wheel, Dressing & Truing. 47. Perform dry run and its importance. Practice on Surface Grinding.	Grinding Machine - Types, Construction, Operations and parts. Specification of a grinding wheel.
		48. Perform & practice cylindrical Grinding	Factors selecting a grinding wheel, inspection of grinding wheel, Balancing & Mounting a grinding wheel Glazing & Loading of wheels. Care & Maintenance of grinding wheel. Dressing & Truing
		49. Execute Honing & Lapping practice.	Honing & Lapping - Principle & Use. Concept of heat treatment of steel & purpose of heat treatment. Iron -carbon diagram
		50. Evaluate Countershaft Turning Precision Cylindrical Grinding practice.	Introduction to conventional and non-conventional Sources of energy. Differentiates between conventional energy and Non-conventional energy. Advantages and disadvantages of non- Conventional energy. Solar energy.
Practical 15Hrs Theory	Execute and monitor operations of sharpening/ re-sharpening different	51. Demonstrate Tool and Cutter grinding practice - Plain milling cutter, Side & Face milling	Heat treatment, its objective. Different types of heat treatment process like Annealing, normalizing,

05Hrs	cutting tools and cutters using tool and cutter grinder. Check accuracy with appropriate instruments. [Plain milling cutter, side & face milling cutter, angular cutter, end mill etc.]. (NOS: CSC/N9476)	cutter, Angular cutter. 52. Visit to heat treatment Industry.	hardening, tempering of steel. Purpose & uses of each process. Study of Surface hardening – Carburizing, Nitriding, cyaniding, Flame hardening, Induction hardening principle, purpose & uses.
Practical 50Hrs Theory 20Hrs	Analyze & set different machining parameters and cutters to prepare components by performing different milling operation with indexing. [Different machining parameters – feed, speed and depth of cut. Different components – Rack, Spur Gear, External Spline, Clutch, Helical Gear, bevel gear, cam profile, worm & worm wheel]. (NOS: CSC/N9474)	53. Demonstrate and practice on indexing head. 54. Monitor clutch milling operation.	Indexing- Purpose, types, description & working principle, gear cutting with indexing head and calculation.
		55. Perform & assess spur gear milling and rack cutting with simple dividing head and milling machine.	Different methods of Gear Manufacturing process, study and application of dividing head for gear cutting using milling machine.
		56. Plan & perform helical gear cutting, bevel gear cutting.	Types of gear- important terms and definition related to spur gear (pitch, pitch circle, addendum, dedendum, module etc.), velocity ratio, simple gear train, compound gear train, power transmitted by gears, Calculation on spur gear train. Mass production of gear - Gear shaper, Gear Hobber.
		57. Check machining of different types of cams.	Cam - types, application in modern machines, its special advantages, manufacturing processes, calculation for milling different cams.
		58. Practice on machining worm and worm wheel.	Bearing, Comparator gauge- Introduction, construction, types & uses.
Practical 60Hrs Theory 25Hrs	Demonstrate operations on machines and check components and its functioning. [Machines: - EDM, Gear Shaper, Gear Hobber, Jig Boring, Broaching and CMM](NOS: CSC/N9482)	59. Demonstrate jig boring Machine using audio visual aids.	Jig boring - concept, application and its operation. Development in cutting tool material and effects of alloying elements in cutting tools. Introduction to powder metallurgy & its application and uses.
		60. Practice demonstrations on Gear Shaper and Gear Hobber.	Limit gauge, Sine bar, slip gauge-Introduction, construction, types & uses.
		61. Practice demonstrations	Broaching Machine:

		on broaching machine	Construction, types, parts, operation and specifications. Advantage & disadvantage of using a Broaching machine. Broaching tool - Elements, free hand sketch of a Broach tool.
		62. Perform demo on EDM using audio visual aids.	Non-Conventional Machining Difference between conventional & non-conventional machining. Different types like - a) EDM b) USM c) ECM d) LBM, and their Application
		63. Plan & arrange an assembly job preparation combining different machining operations. 64. Practice on demonstrations of CMM operation using audio visual aids.	Inspection and Quality Control Inspection, Need and types of inspection. Quality control and quality assurance Meaning and need for quality control Statistical quality control Q.C. curves. Concept of TQM Machine capability studies Surface protection method. Co-ordinate Measuring Machine (CMM) and its function.
Practical 40Hrs Theory 14Hrs	Plan, and perform setting of job and tool in CNC turning centre/ CNC machining centre. Produce components through various modes of operations, prepare/ edit part program, simulation and execution as per drawing/ requirement. [face milling and drilling application, tool selection and setting on machine, tool offset].(NOS: CSC/N9433)	65. Identify & select different parts & different drives, accessories, tools of CNC machine.	NUMERICAL CONTROL MACHINE TOOL Introduction, N.C. & C.N.C. M/c Comparison between N.C. & C.N.C. M/c Advantages of C.N.C. M/c Construction and different parts & CNC machine.
		66. Make part-programming and practice on simulation software.	Different types of control system used in CNC Machines Flow Chart for manufacturing Components in CNC Machine
		67. Plan & program for face milling and drilling application and setting of job on CNC machine, check tool selection and setting. Edit the program on the machine and manufacturing of components.	Fundamental of manual part programming: Axis identification, Coordinate system, M/c zero, job zero, Reference Zero, G-Codes & M-Codes, Work Offset, Tool Offset. Feed function, Spindle Speed Function, Simple part program.
Engineering Drawing: 40 Hrs.			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different	**CIRCLES, TANGENTS AND ELLIPSE:** Practical applications procedure for constructing tangent to given circle-lines- loop	

	application in the field of work.NOS ASC/N9410	pattern-- tangential circles- external tangents- internal tangents ellipse **PARABOLIC CURVES, HYPERBOLA:** Involutes - Properties and their application. Procedure for constructing parabolic curve- hyperbolic curve-in volute curve. epicycloids, hypocycloid, Involutes, spiral & Archimedes spiral **TECHNICAL DRAWING/ SKETCHING OF COMPONENTS' PARTS:** Views of object Importance of technical sketching- types of sketches-Isometric drawing sketching- Oblique drawing sketching. **PROJECTIONS**: Theory of projections (Elaborate theoretical instructions), Reference planes, orthographic projections concept 1st Angle and 3rd Angle, Projections of points, Projections of Lines–determination of true lengths & inclinations. Projections of plane, determination of true shape. Exercises on missing surfaces and views. Orthographic drawing or interpretation of views. Introduction to first angle projections of solids. **ISOMETRIC VIEWS**: Fundamentals of isometric projections (Theoretical Projections) Isometric views from 2 to 3 given orthographic views. Preparation of simple working drawing of Furniture items like table, stool and any job prepared in the workshop. **SECTIONAL VIEWS:** Importance and salient features, Methods of representing sections, conventional sections of various materials, classification of sections, conventional in sectioning. Drawing of full section, half section, partial or broken out sections, offset sections, revolved sections and removed sections. Drawing of different conventions for materials in section, conventional breaks for shafts, pipes, Rectangular, square angle, channel, rolled sections. Exercises on sectional views of different objects. - **DEVELOPMENT AND INTERSECTIONS:** Development of surfaces-Types of surface- Methods of development- Intersection- Methods of drawing intersection lines-critical point or key point. **FASTENERS**: Sketches of elements of screw threads, Sketches of studs, cap screws machine screws, set screws, Locking devices, bolts, Hexagonal & square nuts & nut bolt & washer

		assembly. Sketches of plain spring lock, toothed lock, washers, cap nut, check nut, slotted nut, cassel nut, sawn nut, wing nut, eye blot, tee bolt & foundation bolt. Sketches of various types of rivet heads (snap–pan–conical– countersunk) Sketches of keys (sunk, flat, saddle, gib head, woodruff) Sketches of hole & shaft assembly. **DETAIL DRAWING AND ASSEMBLY DRAWING:** Details of machine drawing- Assembly drawing- surface quality-surface finish standard- Method of indicating surface roughness for general engineering drawing-symbols used for indication of surface roughness-symbols for direction of lay. Geometrical tolerance. Detail drawing of the following with complete dimensioning, tolerances, material and Surface finish specifications 1. Universal couplings 2. Ball bearing and roller bearing. 3. Fast and loose pulley. 4. Stepped and V belt pulley. 5. Flanged Pipe joints, right angle bend. 6. Tool Post of Lathe Machine. 7. Tail Stock of Lathe Machine 8. Stepped and V belt pulley. 9. Flanged Pipe joints, right angle bend. 10. Tool Post of Lathe Machine. 11. Tail Stock of Lathe Machine Practice of blue print reading on limit, size, fits, tolerance, machining symbols, and reading out of assembly drawing etc., ISO Standards. **READING OF ENGINEERING DRAWING:** Blue print and machine drawing reading exercises. **GRAPHS & CHARTS**: Types (Bar, Pie, Percentage bar, Logarithmic), Preparation & interpretation of the graphs and

		charts. **AUTO CAD:** Familiarization with AutoCAD application in engineering drawing. Practice on AutoCAD using Draw & Modify commands. Practice on AutoCAD with Rectangular snap using Draw, Modify, Inquiry commands. Practice on AutoCAD using text dimensioning& dimensioning styles Practice on AutoCAD to draw nuts, bolts & washers. Isometric views-isometric views with square, taper and radial surface-simple & complex views. Perspective views. Practice on AutoCAD using isometric snap to make isometric drawings Practice on AutoCAD using Hatch command and application. Practice on AutoCAD using 3D primitives with UCS (User Co-ordinate system).
WORKSHOP CALCULATION & SCIENCE: 40 Hrs.		
Professional Knowledge WCS- 40 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS:ASC/N9411	**<u>WORKSHOP CALCULATION:</u>** **Fraction:** Concept of Fraction, Numbers, Variable, Constant, **Ratio & Proportion**: - Trade related problems **Percentage:** Definition, changing percentage to decimal and fraction and vice versa. Applied problems related to trade. Estimation and cost of product. **Algebra:** Fundamental Algebraic formulae for multiplication and factorization. Algebraic equations, simple & simultaneous equations, quadratic equations and their applications. **Mensuration 2D:** Concept on basic geometrical definitions, basic geometrical theorems. Determination of areas, perimeters of triangles, quadrilaterals, polygons, circle, sector etc. **Mensuration 3D:** Determination of volumes, surface areas of cube, cuboids cylinders, hollow cylinder, sphere prisms, pyramids cone spheres, frustums etc. Mass, Weight, Volume, Density, Viscosity, Specific gravity and related problems. **Trigonometry:** Concept of angles, measurement of angles in degrees, grades and radians and their conversions. Trigonometrical ratios and their relations. Review of ratios of some standard angles (0, 30,45,60,90 degrees), Height & Distances, Simple problems. **Graphs:** basic concept, importance. Plotting of graphs of simple linear equation. Related problems on ohm's law, series-parallel combination. **Statistics:** Frequency tables, normal distribution, measure of central tendency – Mean, Median & Mode. Concept of probability. Charts like pie chart, bar chart, line diagram, Histogram and frequency polygon.

		WORKSHOP SCIENCE: **Units and Dimensions:** Conversions between British & Metric system of Units. Fundamental and derived units in SI System, Dimensions of Physical Quantities (MLT)-Fundamental & Derived. **Engineering Materials:** Classification properties and uses of ferrous metals, non-ferrous metals, alloys etc. Properties and uses of non-metals such as wood, plastic, rubber, ceramics industrial adhesives. **Heat & Temperature:** Concepts, differences, effects of heat, different units, relation, specific heat, thermal capacity, latent heat, water equivalent, mechanical equivalent of heat. Different Temperature measuring scales and their relation. Transference of heat, conduction, convection and radiation. Thermal Expansion related calculations. **Force and Motion**: Newton's laws of motion, displacement, velocity, acceleration, retardation, rest & motion such as linear, angular. Force – units, different laws for composition and resolution of forces. Concept on centre of gravity and equilibrium of forces in plane. Concept of moment of inertia and torque. **Work, power & energy**: Definitions, units, calculation & application. Concept of HP, IHP, BHP and FHP – related calculations with mechanical efficiency. S.I. unit of power and their relations. **Friction:** Concept of friction, laws of friction, limiting friction, coefficient of friction and angle of friction. Rolling friction & sliding friction with examples. Friction on inclined surfaces **Stress & Strain:** Concepts of stress, strain, modulus of elasticity. Stress- strain curve. Hook's law, different module of elasticity like Young's modulus, modulus of rigidity, bulk modulus and their relations. Poisson's ratio. **Simple machines:** Concept of Mechanical Advantage, Velocity Ratio, Efficiency and their relations. Working principles of inclined plane, lever, screw jack, wheel and axle, differential wheel and axle, worm and worm wheel, rack and pinion. Gear train. **Electricity:** Basic definitions like emf, current, resistance, potential difference, etc. Uses of electricity. Difference between AC and

		DC. Safety devices. Difference between conductors and semiconductors and resistors, Materials used for conductors, semiconductors and resistors. Ohm's Law. Series, parallel and series-parallel combination of resistances. Concept, definitions and units of electrical work, power and energy with related problems. **Fluid Mechanics:** Properties of fluid (density, viscosity, specific weight, specific volume, specific gravity) with their units. Concept of atmospheric pressure, gauge pressure, absolute pressure, vacuum and differential pressure.

SYLLABUS FOR CORE SKILLS
1. Training Methodology (Common for all CITS trades) (270Hrs + 180Hrs)

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

7. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENT CRITERIA
TRADE TECHNOLOGY (TT)	
1. Demonstrate workshop safety measures and monitor job as per specification perform different types of filing jobs, pedestal grinder operations and check for dimensional accuracy by using appropriate measuring and checking instruments. (NOS: CSC/N9466)	Demonstrate pedestal grinding machine operation with its components.
	Demonstrate appropriate work supporting devices.
	Assess the setting of job as per shape.
	Demonstrate the appropriate wheel type.
	Check and demonstrate operation of the Grinding machine observing standard operating practice correct position of standing for operator.
	Perform and monitor pedestal grinder operation viz., make components such as cutting tools like single point cutting tools, threading tools, parting tool, drill bits as per specification.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement.
	Ensure safety procedure during above operation as per standard norms and company guidelines.
2. Plan and manage the work to make jobs as per requirement selecting different operations ensuring accuracy by using appropriate measuring instruments [power saw machine operation, external and internal thread cutting (using tap and die), demonstrate reaming (manual/ on machine), counter-boring, counter-sinking]. (NOS: CSC/N9467)	Demonstrate power-saw machine operation with its components.
	Demonstrate appropriate work holding devices and acquaint with functional application of each device.
	Assess setting the job on table as per shape.
	Demonstrate setting of the power saw machine on appropriate speed & feed.
	Check operation of the power saw machine and demonstrate standard operating practice.
	Perform threading- external and internal using tap and die, counter-boring, counter-sinking and reaming operation using appropriate tools.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement.
	Ensure safety procedure during above operation as per standard norms and company guidelines.
3. Plan, organize and perform various jobs by selection of appropriate operation, tools, accessories, attachments and processes like making flat surface, angular surface, slot, formed surfaces, dovetail and T-slots etc. on shaping machine. Assess accuracy using appropriate measuring	Demonstrate working principles, mechanisms, parts with their functions and safety aspect of shaping machine.
	Explain functional application of different levers, stoppers, adjustment etc. for shaping machine.
	Demonstrate different lubrication points of shaping machine.
	Monitor lubricants and their usage for application in shaper machine as per machine manual.
	Illustrate different job holding devices and acquaint with functional application of each device.
	Evaluate shaping machine with required alignment and check for its

instruments. (NOS: CSC/N9472)	functional usage to perform shaping machine operations.
	Assess problem solving by applying basic methods and information during setting.
	Demonstrate safety procedure during operation as per standard norms.
4. Monitor & supervise work to ensure correct functional operation, selection of appropriate tools, accessories, attachments and processes like making of flat surface, angular surface, slot, formed surfaces, dovetail and T-slots etc. on Planer machine. Check accuracy using appropriate measuring instruments.(NOS: CSC/N9472)	Demonstrate working principles, mechanisms, parts with their functions and safety aspect of planer.
	Describe functional application of different levers, stoppers, adjustment etc. for planer.
	Demonstrate different lubrication points of shaping machine.
	Monitor lubricants and their usage for application in planer as per machine manual.
	Explain different job holding devices and acquaint with functional application of each device.
	Evaluate planer with required alignment and check for its functional usage to perform planer operations.
	Analyze & assess problem solving by applying basic methods and information during setting.
	Demonstrate safety procedure during operation as per standard norms.
5. Demonstrate slotting machine parts, mechanisms & their functions. Conduct various jobs on slotting machine. Evaluate accuracy with appropriate instruments. [Key-way cutting, regular and irregular polygon, spline cutting etc.]. (NOS: CSC/N9406)	Demonstrate working principles, types of slotter, mechanisms, specification, parts with their functions, different operations, processes and safety precautions.
	Ascertain cutting tool, holding devices, coolants required, raw material etc. as per drawing/requirement of job.
	Determine machine parameters feed, speed & depth of cut through calculations.
	Collect and organize information to determine use of specific machine, operation, processes.
	Make automatic movements setting for various cutting operations as and when required.
	Select and justify use of various accessories, attachments, cutter holding and work holding devices.
	Check and evaluate skill of operating with consideration for dimensional accuracy of job and method of performing slotting operations and processes.
	Measure / check the dimensions or geometry with instruments / gauges as per drawing within the prescribed accuracy.
	Evaluate consciousness about safety procedures as per standard norms and specific on the machine.
	Conclude possible solutions the problem arising in execution using desired mathematical skills, knowledge of facts, principles, processes and general concept in the field of work.
6. Demonstrate lathe machine parts, mechanisms & their functions. Perform various	Demonstrate working principles, types of lathe, mechanisms, specification, parts with their functions, different operations, processes and safety precautions.

jobs on lathe machine. Assess accuracy with appropriate instruments. [Plain turning, facing, taper turning, step turning, drilling & boring, knurling, thread cutting external and internal etc.]. *(NOS:* CSC/N9474)	Ascertain & use cutting tool/holding devices/ coolants/required raw material etc. as per drawing/requirement of job.
	Determine machine parameters feed, speed & depth of cut through calculations.
	Collect and organize information to determine use of specific machine, operation, processes.
	Make automatic movements setting for various cutting operations as and when required.
	Select and justify use of various accessories, attachments, cutter holding and work holding devices.
	Check and evaluate skill of operating with consideration for dimensional accuracy of job and method of performing lathe operations and processes.
	Measure / check the dimensions or geometry with instruments / gauges as per drawing within the prescribed accuracy.
	Evaluate consciousness about safety procedures as per standard norms and specific on the machine.
	Conclude possible solutions the problem arising in execution using desired mathematical skills, knowledge of facts, principles, processes and general concept in the field of work.
7. Demonstrate milling machine parts, mechanisms & their functions. Plan, organize and make various jobs by selection of appropriate operation, tools, accessories, attachments and processes on milling machine. Check accuracy with appropriate instruments. [Face milling, slot milling, gang milling, angular milling, end milling and process of up & down milling etc.]. (NOS: CSC/N9474)	Demonstrate working principles, types, mechanisms, specification, parts with their functions, different operations, processes and safety precautions.
	Ascertain & select cutting tool/ holding devices/ coolants required/ raw material etc. as per drawing/requirement of job.
	Collect and organize information to determine use of specific machine, operation, processes.
	Determine machine parameters feed, speed & depth of cut through calculations.
	Make automatic movements setting for various cutting operations as and when required.
	Select and justify use of various accessories, attachments, cutter holding and work holding devices.
	Check and evaluate skill of operating with consideration for dimensional accuracy of job and method of performing milling operations and processes.
	Measure / check the dimensions or geometry with instruments / gauges as per drawing within the prescribed accuracy.
	Evaluate consciousness about safety procedures as per standard norms and specific on the machine.
	Conclude possible solutions the problem arising in execution using desired mathematical skills, knowledge of facts, principles, processes and general concept in the field of work.
8. Demonstrate parts of vertical milling machine, mechanisms & their functions. Monitor selection of appropriate	Demonstrate working principles, types, mechanisms, specification, parts with their functions, different operations, processes and safety precautions.
	Ascertain, select & use cutting tool/ holding devices/ coolants/

operation, tools, accessories, attachments and processes on vertical milling machine. Check accuracy with appropriate instruments. [Operation: -slot milling, end milling, pocket milling, dovetail, T-slot milling and cam profile milling etc.] (NOS: CSC/N9474)	required raw material etc. as per drawing/requirement of job.
	Collect and organize information to determine use of specific machine, operation, processes.
	Determine machine parameters feed, speed & depth of cut through calculations.
	Make automatic movements setting for various cutting operations as and when required.
	Select and justify use of various accessories, attachments, cutter holding and work holding devices.
	Check and evaluate skill of operating with consideration for dimensional accuracy of job and method of performing vertical milling operations and processes.
	Measure / check the dimensions or geometry with instruments / gauges as per drawing within the prescribed accuracy.
	Evaluate consciousness about safety procedures as per standard norms and specific on the machine.
	Conclude possible solutions the problem arising in execution using desired mathematical skills, knowledge of facts, principles, processes and general concept in the field of work.
9. Plan and perform simple repair, overhauling of different machines used in machinist section and Check for functionality. [Cleaning, oiling, greasing, belt replacement and setting etc.]. *(NOS:* CSC/N9475)	Ascertain and select tools and materials for the repair, overhauling and make this available for use in a timely manner.
	Plan & organize work in compliance with standard safety norms.
	Demonstrate possible solutions and agree tasks within the team.
	Select specific parts to be repaired and ascertain for appropriate material and estimated time.
	Repair, overhaul and assemble the parts in the machine with the help of blue print.
	Check for functionality of part and ascertain faults of the part/ machine in case of improper function.
	Rectify faults of assembly.
10. Demonstrate various types of grinding on jobs using different types of grinding machines (surface and cylindrical grinder etc.). Explain wheel Mounting, balancing, dressing & truing and other setting for surface / cylindrical grinder. Explain Honing and lapping and its practice. Check accuracy with appropriate instruments. [Surface grinding, angular grinding, cylindrical grinding, step	Demonstrate grinding machine working principles, types, mechanisms and parts with their functions.
	Relate the selection of grinding wheel/holding devices/ coolants/ required raw material etc. as per drawing/requirement of job.
	Collect and organize information to determine use of specific machine, operation, processes, grinding wheels etc..
	Trace and correct defects such as loading, glazing, manufacturing defects etc. of grinding wheel wherever possible.
	Calculate feed, speed & depth of cut for a particular operation and job.
	Set machine for automatic/manual operation.
	Assess setting of the job on machine table as per operation using holding devices.
	Select and justify appropriate method to perform surface and cylindrical grinding operations on jobs.

and camshaft grinding etc.]. *(NOS:* CSC/N9476)	Measure / checking the dimensions with instruments / gauges as per drawing for achieving required accuracy.
	Demonstrate dressing, truing, balancing and mounting of grinding wheel using various tools and maintain the grinding wheel.
	Demonstrate possible solutions to problems using desired mathematical skills, knowledge of facts, principles, processes and general concept in the field of work.
	Evaluate consciousness about safety procedures as per standard norms and specific on the machine.
11. Execute and monitor operations of sharpening/ re-sharpening different cutting tools and cutters using tool and cutter grinder. Check accuracy with appropriate instruments. [Plain milling cutter, side & face milling cutter, angular cutter, end mill etc.]. (NOS: CSC/N9476)	Demonstrate the tools & cutter grinder machine working principles, mechanisms and parts with their functions, accessories & attachments.
	Evaluate re-sharpening of radial clearance angle on various cutting tools considering different cutting angles of the tool.
	Check operation of the grinder to observe standard operating practice.
	Identify and correct defects such as loading, glazing, manufacturing defects etc. of grinding wheel wherever possible.
	Demonstrate dressing, truing, balancing and mounting of grinding wheel using various tools and maintain the grinding wheel.
	Check accuracy/ correctness of job using appropriate gauges and measuring instruments for their functional requirement.
	Ensure safety rules when performing the above operations.
12. Analyze & set different machining parameters and cutters to prepare components by performing different milling operation with indexing. [Different machining parameters – feed, speed and depth of cut. Different components – Rack, Spur Gear, External Spline, Clutch, Helical Gear, bevel gear, cam profile, worm & worm wheel]. *(NOS:* CSC/N9474)	Select cutter as per specification of gear/ cam/ clutch/ rack/ worm & worm wheel and plan to make the same as per drawing.
	Work out and apply indexing parameters as per different components to be produced to determine gear setting and set indexing head, milling machine.
	Demonstrate possible solutions within the team using desired mathematical skills, knowledge of facts, principles, processes and general concept in the field of work to set the indexing head.
	Solve problems during operation by selecting and applying basic methods, tools, materials and collect and organize information for quality output.
	Set the job and produce component following the standard operating procedure with compliance to safety rules when performing the above operations.
	Make components observing standard operating procedure.
	Measure with instruments/gauges as per drawing and check functionality of gear.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
13. Demonstrate operations on machines and check components and its	Demonstrate working principles, mechanisms, parts with their functions and safety aspect of machine.
	Demonstrate appropriate machine parameters to set automatic

functioning. [Machines: - EDM, Gear Shaper, Gear Hobber, Jig Boring, Broaching and CMM]. *(NOS:* CSC/N9482)	movements for various cutting operations and compliance with safety rules.
	Demonstrate appropriate method to perform respective operation on the machine and make required mathematical calculations for the same.
	Identify appropriate raw material, cutting tool, holding devices and coolants accordingly calculate the cutting speed, feed and depth of cut.
	Demonstrate possible solutions using desired mathematical skills, knowledge of facts, principles, processes and general concept in the field of work and collect and organize information to determine use of specific machine.
	Demonstrate method of measuring and checking of the dimensions/ geometry of job using CMM machine/ instruments/ gauges as per drawing.
14. Plan and perform setting of job and tool in CNC turning centre/ CNC machining centre. Produce components through various modes of operations, prepare/ edit part program, simulation and execution as per drawing/ requirement. [face milling and drilling application, tool selection and setting on machine, tool offset]. *(NOS:* CSC/N9433)	Demonstrate working principles, types, mechanisms, specification, parts with their functions, different operations, processes, identify axis, drives, coordinate system and safety precautions.
	Select cutting tool/ holding devices/ accessories/ attachments/ coolants required/ raw material as per drawing/ job requirement.
	Demonstrate the setting of job, machine and the component as per standard operating procedure involving different operations.
	Collect and organize information to determine use of specific machine, operation, processes.
	Determine machine parameters feed, speed & depth of cut through calculations.
	Make automatic movements setting for various cutting operations as and when required.
	Plan and prepare/ edit part program as per drawing, simulate for its correctness with appropriate software/ simulator.
	Test/Dry run the part program on the machine.
	Evaluate skill of operating with consideration for accuracy of job and method of performing various operations and processes.
	Evaluate accuracy/ correctness of job using appropriate gauge and measuring instruments.
	Evaluate consciousness about safety procedures as per standard norms and specific on the machine.
	Conclude possible solutions the problem arising in execution using desired mathematical skills, knowledge of facts, principles, processes and general concept in the field of work.
15. Read and apply engineering drawing for different application in the field of work.. NOS ASC/N9410	
	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.

16. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study NOS ASC/N9411	Solve different mathematical problems
	Explain concept of basic science related to the field of study

8. INFRASTRUCTURE

LIST OF TOOLS AND EQUIPMENT FOR MACHINIST & OPERATOR ADVANCE MACHINE TOOL(CITS)			
(For the batch of 25 candidates)			
S No.	**Name of the Tool &Equipment**	**Specification**	**Quantity**
A. Hand Tools			
1.	Steel Rule	30cm. graduated both in Metric units.	5 nos.
2.	Divider	150mm	5 nos.
3.	Centre Punch		5 nos.
4.	Hammer Ball Pane	0.8Kg approx. with handle	13 nos.
5.	Combination Plier	150mm	5 nos.
6.	Safety goggles		13 nos.
7.	File flat Bastard	300mm	13 nos.
8.	File flat 2nd Cut	250mm	13 nos.
9.	Engineers Screw Driver	200 mm	13 nos.
10.	File flat smooth	200mm	13 nos.
11.	Cold chisel flat	25x200mm	13 nos.
12.	Surface Plate	600x600X80mm grade 1	1 no.
13.	Marking Table	1200X1200x900mm high	1 no.
14.	Scribing Block Universal	300mm	5 nos.
15.	V-Block	100/7-80-A	2 nos.
16.	Try Square	300mm/ 150 mm	13 nos.
17.	Straight Edge Steel	500mm	1 no.
18.	Steel Tape	2 meter in Case	1 no.
19.	Soft Hammer	250 gm with Handle	5 nos.
20.	Sprit level	25 cm	1 no.
21.	Hammer Ball Pein	450 gm	8 nos.
22.	Screw Driver, heavy duty	300 mm	5 nos.
23.	Hammer lead	1 kg	2 nos.
24.	Combination Set	300mm	1 Set
25.	Screw driver	100mm	5 nos.
26.	Allen hexagonal Keys	2.5 to 12mm	5 Sets
27.	Spanner Double Ended metric		6 sets
28.	Adjustable Spanner	300mm	2 nos.
29.	Reduction Sleeve Morse taper	1-1,3-1,4-1,4-2,5- 1,5-2,6-1.	2 sets
30.	Angle Plate	Size 200x100x200mm	2 nos.
31.	Angle Plate Adjustable	250x150x175mm	2 nos.
32.	Solid parallels in pair (different size) in metric		26 nos.
33.	Oil cane pressure feed	500mg.	6 nos.
34.	Oil stone	150x50x25mm	2 nos.
35.	Number drill H.S.S (Parallels shank)	1-80Nos	1 set

36.	Drill (Parallel Shank)	1.00mm to 10.00mm with 0.1mm difference	2 sets
37.	Twist Drills	10.00mm to 12.5mm.with 0.5mm difference	2 sets
38.	Drill Chuck	0 to20 with taper shank	5 nos.
39.	Centre Drill Al to 5		2 sets
40.	Grinding wheel dresser (diamond)		6 nos.
41.	Grinding wheel dresser Hunting Type		2 nos.
42.	Clamp	"C"100mm	2 nos.
43.	Clamp	"C"200mm	2 nos.
44.	Tap & Die set in box metric pitch		1 Set
45.	File Flat 2Nd cut	250mm	6 nos.
46.	File Flat smooth	200mm	6 nos.
47.	File H/R 2Nd cut	250mm	6 nos.
48.	File Triangular smooth	200mm	6 nos.
49.	Needle File set		6 nos.
50.	File Square 2ND cut	250mm.	6 nos.
51.	Reamer	6mm to 25 mm by 1 mm step	1sets
52.	Reamer Adjustable	10mm to 15mm by 0.75mm step	1sets
53.	Hacksaw frame Adjustable with blades.	250-300mm	13 nos.
54.	Machine Vice	100mm jaw swivel base.	5 nos.
55.	Machine Vice	200mm swivel base.	5 nos.
56.	Machine Vice	160mm swivel base.	5nos.
57.	Hand Vice	50mm jaw.	2 nos.
58.	Universal machine vice	160mm	5nos.
59.	Universal table angle plate		1 no.
60.	Taper shank twist drill set	13mm to30mm, to suit radial drilling machine	1sets
61.	Shaper tool holder turret type		13 nos.
62.	Knurling tools (set of 3) straight and diamond		5 Sets
63.	Plier cutting	200mm	5 nos.
64.	Magnifying- Glass	75mm	2 nos.
65.	Carbide Tipped Tools of different sizes and shapes (through away tips)		13 Sets
66.	Hand hammer 1 kg with handle		2 nos.
67.	Equipment for conducting BLS (Basic Life Support) training.		1 set
B. Measuring Tools			
68.	Micrometer outside	0-25mm	2 nos.
69.	Micrometer outside	25-50mm	2 nos.
70.	Micrometer outside	50-75mm	2 nos.
71.	Digital Micrometer outside	0-25mm	1nos.
72.	Digital Micrometer outside	25-50mm	1nos.
73.	Digital Micrometer outside	50-75mm	1nos.
74.	Digital Vernier Caliper	200mm	3 nos.
75.	Micrometer depth gauge	0-200mm	2 nos.
76.	Dial Vernier caliper	300mm	2 nos.

77.	Vernier height gauge	250mm	2 nos.
78.	Vernier bevel protractor with blade	150mm	2 Sets
79.	Bevel gauge	200mm	2 nos.
80.	Telescopic gauge	13mm to 300rnm	1 set
81.	Sine Bar	200mm	2 nos.
82.	Inside Micrometer	25-50mm	2 nos.
83.	Inside Micrometer	50-150mm	2 nos.
84.	Dial Test Indicator with magnetic base.		2 nos.
85.	Centre gauge 60		3 no.
86.	Slip gauge set (normal set) metric	Set of 116pcs.	2 Sets
87.	Screw pitch gauge for metric pitches (25-6)		2 Sets
88.	Radius gauge metric set (1-6)		2 Sets
89.	Plug gauges	5mm to 25mm by 2.5mm step	2 Sets
90.	Ring gauges	5mm to 25mm by 2.5mm step(GO & NO GO)	2 Sets
91.	Feeler Gauge		2 nos.
92.	Snap Gauge	5mm to 25mm by 2.5mm step	1 no.
93.	Vernier Caliper	200mm	2 nos.
C. Milling Cutters			
94.	Cylindrical cutter	63x100x27mm	4 nos.
95.	Cylindrical cutter	75x80x27mm	4 nos.
96.	Side and face cutter	100x8x27mm	4 nos.
97.	Side and face cutter	150x10x27mm	4 nos.
98.	Side and face cutter	150x15x27mm	4 nos.
99.	Side and face cutter	200x20x27mm	2 nos.
100.	Equal angle cutter	45/100x28x27mm	2 nos.
101.	Equal angle cutter	60/100x28x27mm	2 nos.
102.	Equal angle cutter	90/100x28x27mm	2 nos.
103.	"T" Slot	Cutter Dia-18,Width-8,shank-12mm	4 nos.
104.	"T" Slot Cutter	Dia-21,Width-9,shank-12mm	4 nos.
105.	"T" Slot Cutter	Dia-25,Width-11,shank-16mm	4 nos.
106.	"T" Slot Cutter	Dia.-32,Width.-14,shank-16mm	4 nos.
107.	Single angle cutter	63x18x27x45 R.H	2 nos.
108.	Single angle cutter	63x18x45 L.Hx27mm	2 nos.
109.	Single angle cutter	63x18x60 R.Hx27mm	2 nos.
110.	Single angle cutter	63x18x60 L.Hx27mm	2 nos.
111.	Double Unequal Angular cutter	40x16x27mmx48x12 L.H	2 nos.
112.	Double Unequal Angular cutter	40x16x27mmx53x12 R.H	2 nos.
113.	End Mill Cutter	H.S.S,(6mm to 18mm) 12 nos. in a set	2 sets
114.	Concave cutter	H.S.S 75X18X27mm	2 nos.
115.	Convex cutter	H. S. S 75X18X27mm	2 nos.
116.	Corner Rounding Cutter	12x10x27mm	2 nos.
117.	Corner Rounding Cutter	36x15x27mm	2 nos.
118.	Slotting Cutter	100x30x27mm	2 nos.

119.	Slotting Cutter	100x12x27mm	2 nos.
120.	Slitting Saw cutter	150x2.5x27mm	2 nos.
121.	Slitting Saw cutter	150x3x27mm	3 nos.
122.	Slitting Saw cutter	100x4x27mm	3 nos.
123.	Dovetail milling cutter parallel shank	6x22mmx45	5 nos.
124.	Dovetail milling cutter parallel shank	6x25mmx45	5 nos.
125.	Dovetail milling cutter parallel shank	6x22mmx60	5 nos.
126.	Dovetail milling cutter parallel shank	6x25mmx60	5 nos.
127.	Shell & End mill cutter	40x32x27mm	2 nos.
128.	Shell & End mill cutter	50x36x27mm	2nos.
129.	Face mill cutter with inserted tip	6x80x27mm	3 nos.
130.	Face mill cutter with inserted tip	6x63x27mm	3 nos.
131.	Face mill cutter with inserted tip	6x100x27mm	2 nos.
132.	Involutes gear module	2 module PA 20 %°	1 Set
133.	Involutes gear module	2.5 module PA 20 %°	1Set
D. List of Machines &Equipment for the trade machinist			
134.	Shaping machine	450mm stroke (motorized) with all attachments.	2 nos.
135.	Shaping machine	315mm stroke (hydraulic) with all attachments	2 nos.
136.	Double column planer	1500x1000x1000(motorized) with all attachments.	1 no.
137.	Slotter	180mm (motorized) with all attachments.	2 nos.
138.	SS and SC centre lathe (all geared) with having minimum specification	Centre height 150 mm and centre distance 1000 mm along with 4 jaw and 3 jaw chucks, auto feed system, safety guard, motorized coolant system and lighting arrangement.	3 nos.
139.	Drilling Machine pillar type with drill chuck & key.	0- 20mm capacity	1 no.
140.	Radial Drill motorized with tapping attachment	1200mm area	1 no.
141.	Pedestal Grinder Double End type.		2 nos.
142.	Power Saw Machine		1 no.
143.	Universal Milling machine with minimum specification having motorized up & down movement along with auto feed arrangement and with following attachments such as: a. Vertical head b. Slotting attachment c. Rack cutting attachment d. Rotary table e. Dividing head f. Adaptors, arbors and collects etc. for holding straight shank	Table Length x width 1200 x 300 mm	2 nos.

	drills and cutters from 3 mm to 25 mm.		
144.	Horizontal Milling Machine with minimum specification having motorized up & down movement along with auto feed arrangement and 150mm Universal vice.	Table Length x width 1200 x 300 mm	3 nos.
145.	Vertical Milling Machine with minimum specification having motorized up & down movement along with auto feed arrangement in X-Y direction along with 150mm universal vice.	Table Length x width 1200 x 300 mm	3 nos.
146.	Surface Grinding Machine	Grinding machine plain surface, wheel dia. 175 mm (or near) with reciprocating table having longitudinal table traverse 200 mm (or near) fully automatic and fitted with adjustable traverse stops, machine to be fully motorized and fitted with ace guards and pumps, tank and pump fittings and also to be supplied with magnetic chuck 250 x 112 mm. Diamond tool holder, set of spanners, grease gun, oil-can and spare grinding wheel for general purpose grinding.	2 nos.
147.	Cylindrical Grinder	Grinding machine external cylindrical fully motorized and supplied with face plates and driving dogs, 3-jaw self centering chuck 4- jaw independent chuck tail stock assorted centers, stud pumps tank all guards and pipe fittings spanners and grease gun (each machine to be supplied with assorted grinding wheels and tool grinding machine for general purpose work with internal grinding attachment) to accommodate 750mm job with centre height 150mm and wheel diameter x width = 300 x 25mm.	1 no.
148.	CNC Machining Centre	Table size: 500x250mm Travel X-axis x Y-axis x Z-axis: 300 x 250 x 250mm Auto Tool	1 no.

		Changer: 8 nos. Spindle power: 3.7kW (continuous rating) preferably with popular control system like Fanuc/Sinumeric along with motorized coolant system.	
149.	CNC milling tools to suit above machine: to accommodate face cutter, shell end mill cutter, taper shank and parallel shank drills/cutters, Reamers. taps with suitable tool holders.		2 sets each along with cutters &inserts.
150.	CNC turn Centre	Chuck size: 1 35mm Between centre distance: 250mm Travel in X: 1 00mm Travel in Z: 200mm No. of tool stations: 8 station turret Spindle power: 3.7kW (continuous rating) preferably with popular control system like Fanuc/Sinumeric along with motorized coolant system.	1 no.
151.	Tool holders to suit the CNC machine for Turning, Threading (external & internal), Grooving(external & internal), Parting off operations, Drilling, Boring, Under cutting (with 20 inserts for each operation)		2 each
152.	Power Saw Machine - hydraulic feed system	- 400 mm blade size	1 no.
153.	Co-ordinate Measuring Machine (Optional)		1 no
154.	EDM (Optional)		1 no
155.	Gear Shaper		1 no.
156.	Gear Hobber		1 no.
157.	Jig Boring (Optional)		1 no.
158.	Multimedia teach ware/ courseware for CNC technology and interactive CNC part programming software for turning & milling with virtual machine operation and simulation using popular operation control system such as Fanuc, Siemens, etc. (Web-based or licensed based)		13 users
159.	Desktop computer	CPU: 32/64 Bit i3/i5/i7 or latest processor, Speed: 3 GHz or Higher. Cache Memory: - Minimum 3 MB or better. RAM: - 8 GB DDR-III or Higher. Hard Disk	13 nos.

		Drive: 500GB or Higher, 7200 rpm (minimum) or Higher, Wi-Fi Enabled. Network Card: Integrated Gigabit Ethernet (10/100/1000) - Wi-Fi, USB Mouse, USB Keyboard and Monitor (Min. 17 Inch), Standard Ports and connectors. DVD Writer, Speakers And Mic. Licensed Windows Operating System / OEM Pack(Preloaded), Antivirus / Total Security	
160.	Air conditioner split		As required


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