MACHINIST (GRINDER)

NSQF LEVEL – 4.5

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 (GRINDER)

(Engineering Trade)

SECTOR –CAPITAL GOODS & MANUFACTURING

(Revised in 2024)

Version 2.1

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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 (Grinder)” CITS trade is applicable for Instructors of “Machinist (Grinder)” CTS Trade.

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 asan 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 (GRINDER)-CITS**
Trade code	**DGT/4029**
Reference NCO 2015	2356.0100, 7224.0100, 7224.0400, 7224.0300, 7223.2200, 7224.0401
NOS Covered	CSC/N9506, CSC/N9474, CSC/N9507, CSC/N9508, CSC/N9496, CSC/N9499, CSC/N9509, CSC/N9476, CSC/N9474, CSC/N9510, CSC/N9433, CSC/N9498, CSC/N9472, ASC/N9410, ASC/N9411
NSQF Level	Level-4.5
Duration of Craft Instructor Training	One Year
Unit Strength (No. Of Student)	25
Entry Qualification	Degree in Mechanical/Production Engineering from AICTE/ UGC recognized Engineering College/ University. OR 03 years Diploma in Mechanical/Production 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 (Grinder).
Minimum Age	16 years as on first day of academic session.
Space Norms	120 Sq. m
Power Norms	8 KW
Instructors Qualification for	
1. Machinist (Grinder) -CITS Trade	B.Voc./Degree in appropriate branches of Mechanical/ Production Engineering from AICTE /UGC recognized University with two years experience in relevant field. OR 03 years Diploma in appropriate branches of Mechanical/ Production Engineering from AICTE/ recognized Board/ University with five years experience in relevant field. OR NTC/ NAC passed in Machinist (Grinder) trade with seven years experience in relevant field. OR Ex-serviceman from Indian Armed forces with 15 years of service in related filed as per equivalency through DGR. Candidate should have undergone methods of instruction course or minimum 02 years of experience in technical training institute of Indian armed forces. **<u>Essential Qualification:</u>** National Craft Instructor Certificate (NCIC) in Machinist (Grinder) trade, 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.

4. JOB ROLE

Brief description of job roles:

Manual Training Teacher/Craft Instructor; Instructs students in ITIs/Vocational Training Institutes in respective trades. Imparts theoretical instructions for the use of tools, mechanical drawings, blueprint reading and related subjects. Demonstrates processes and operations in the workshop; supervises, assesses and evaluates students in their practical work. Ensures availability & proper functioning of equipment & tools in stores.

Grinder, General; grinds and smoothens metal surfaces to specified accuracy using one or more type of grinding machine. Examines drawings and other specifications of part to be ground. Selects grinding wheel of appropriate size, shape and abrasive quality and fastens it on spindle of machine. Mounts metal part accurately in position on machine using chucks, jigs, fixtures or between centres of head and tail stock of machine as required and sets it accurately either parallel or at angle in relation to grinding wheel as specified using appropriate devices and instruments necessary. Adjusts machine table, guides, stops and other controls to determine direction and limit of metal and grinding wheel movements. Selects grinding wheel speed and starts machine for grinding. Manipulates hand wheel or sets and starts automatic controls to bring grinding wheel in contact with work. Checks progress of grinding with measuring instruments and gauges for accuracy. May balance dress or change grinding wheel, stone or abrasive. May oil and clean machine.

Surface Grinder; grinds flat surfaces of machined metal objects to required finish and thickness by surface grinding machine. Studies drawings and other specifications for nature of grinding operations required. Selects appropriate grinding wheel and fits it on machine spindle. Places work in position on magnetic chuck on the machine. Sets required speed of grinding wheel and feed of machine and adjust guides and stops to control to and fro travel of machine table. Starts machine and brings grinding wheel into contact with work. Applies cut and observes progress of operation. Stops machine and measure work as necessary to ensure required accuracy. Removes work from machine when grinding completed. May operate horizontal or vertical spindle surface grinding machine. May oil and clean machine.

Roll Grinder; grinds shafts, rollers, commutator etc., to accurate finish for various mechanical purposes by centreless, cylindrical or universal grinding machine. Studies drawing and other specifications of parts to be ground. Selects and mounts appropriate abrasive wheels on machine. Turns hand wheel to adjust gap between rims of wheels according to diameter of part to be ground. Moves levers to select appropriate speeds for eachwheel. Sets feed guide to guide work into position between two wheel rims and clamps coil guide properly to receive work from between wheel rims. Starts machine and feeds work on to feed guide or keeps hopper filled with objects that are automatically fed between wheels. Observes progress of work and checks periodically ground parts with micrometre or gauge to ensure that they conform to prescribed specifications. May do cylindrical grinding of parallel, step and taper

shafts and internal bores set between centres or otherwise by processes of traverse plunge or angular grinding and be designated as CYLINDRICAL GRINDER or INTERNAL GRINDER as appropriate. May set or adjust grinding wheel distance for different operations. May clean and oil machine.

Grinder, Tool and Cutter; grinds machine tools and cutter to correct specifications by special grinding machines and wheel. Studies drawings and other specifications to understand nature of grinding operation required. Fastens appropriate abrasive wheel to spindle of machine. Mounts cutting tool to be ground on machine using dividing head, jig or fixture as required. Manipulates swivel tables, wheel head and work holding device, guide finger, etc. as necessary to set machine to appropriate angle for grinding desired level on cutting edges of tool selects and sets speed and feed to machine according to nature of work and wheel used. Starts machine, brings rotating grinding wheel in contact with edge of tool and grinds proper angles, clearance, flutes etc. as required on tool or cutter set, frequently checking it with gauge or measuring instrument while grinding to ensure accuracy. Rotates work through proper angle by dividing head or otherwise to set next flute or teeth of tool or cutter for grinding and continues operation. Uses cutting fluid or coolant as found necessary and ensures that no part of work gets burnt or damaged while grinding. Stops machine and removes tool when grinding is completed. Changes grinding wheel and position of tool as and when required. May give final finish to cutting edge by hand using hones. May oil and clean machine. May specialize in grinding a particular type of tool and be designated accordingly. May check ground tool or cutter by shadow projector to ensure accurate finish.

Grinder – Hand held and Power Tools; selects appropriate grinding equipment, tools and methods to suit work requirements, preparing the tools, applying grinding procedures for carrying out the grinding operations, inspecting the components after grinding operations and correcting faults.

NCO Code 2015:

a) 2356.0100 - Manual Training Teacher/Craft Instructor
b) 7224.0100 - Grinder, General
c) 7224.0400 - Surface Grinder
d) 7224.0300 - Roll Grinder
e) 7223.2200 - Grinder, Tool and Cutter
f) 7224.0401 - Grinder, Hand held and Power Tools

Reference NOS:

i) CSC/N9506
ii) CSC/N9474
iii) CSC/N9507
iv) CSC/N9508
v) CSC/N9496
vi) CSC/N9499
vii) CSC/N9509
viii) CSC/N9476
ix) CSC/N9474
x) CSC/N9510
xi) CSC/N9433
xii) CSC/N9498
xiii) CSC/N9472
xiv) ASC/N9410
xv) ASC/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 LEARNING OUTCOMES (TRADE TECHNOLOGY)

1. Demonstrate workshop safety measures and Monitor job as per specification applying different types of basic fitting operation and check for dimensional accuracy by using steel rule, caliper etc. [Basic Fitting operation- marking, hack sawing, taping, off-hand grinding etc. accuracy±0.25mm] (NOS: CSC/N9506)
2. Check simple components prepared by setting different machine parameters and performing different lathe operation, grinding wheel mounting, balancing, dressing, truing and set surface grinder. [Simple components like cylindrical straight parallel, step, etc.; Different machine parameters: - Cutting, speed, feed, depth of cut; Different lathe operation – Facing, plain turning, taper turning, etc.] (NOS: CSC/N9474)
3. Monitor cylindrical grinder for producing job/ components by performing external and internal cylindrical operations like straight parallel, taper, bush, eccentric etc using different machine accessories. [Different Producing job/ components like long parallel bar, crankshaft, bush etc.; Different machine accessories like steady rest, chuck face plate etc. Accuracy limit: - ±0.25mm.] (NOS: CSC/N9507)
4. Access dry & wet grinding for making different shaped job like square block angle plate, angular block etc. of various metals like cast iron & steel. [Accuracy limit ±0.02 mm.] (NOS: CSC/N9508)
5. Evaluate components made by performing bore grinding and check accuracy by telescopic gauge. [Accuracy limit ±0.02 mm.] (NOS: CSC/N9496)
6. Evaluate components like V' block, parallel bar, drill point angle etc. with angular and straight surface and check accuracy with different gauges and instruments. [Different gauges: - sine bar, slip gauge & DTI (dial test indicator) Accuracy limit ±0.02 mm.] (NOS: CSC/N9499)
7. Assess operations done on tools & cutter grinder and re-sharpening different tools on pedestal grinder. [Different tools: - lathe tools, drill and tool bit] (NOS: CSC/N9509)
8. Evaluate jobs of different materials done by cylindrical parallel grinding with appropriate accuracy. [Different material: - soft & hard metals; Accuracy limit±0.01mm] (NOS: CSC/N9476)
9. Monitor preventive maintenance of grinding machines both surface & cylindrical. (NOS: CSC/N9476)
10. Access re-sharpening of different milling cutters. [Different milling cutters: -plain, slitting saw etc.] (NOS: CSC/N9474)
11. Evaluate different components having straight & angular surface with close tolerance limit and check different fault. [Different components: - V' block, plain cylindrical bar, cube; tolerance limit - ±0.01mm; different faults - cracks, blow-holes, chatters etc.] (NOS: CSC/N9510)

12. Check different gauges with close tolerance limit and check accuracy with different gauges. [Different gauges: - snap gauge, ring gauge; tolerance limit- (H7/h7); Checking gauges- ring, plug etc.] (NOS: CSC/N9510)
13. Demonstrate different components of CNC cylindrical grinder to understand working and evaluate part programme by using simulation software. (NOS: CSC/N9433)
14. Perform CNC cylindrical grinding operation to produce different parts and check accuracy. (NOS: CSC/N9433)
15. Analyze surface of a component by honing operation & Check accuracy. [Accuracy limit: ±0.001mm] (NOS: CSC/N9498)
16. Monitor surface of a job by performing lapping & buffing to close limit h5. (NOS: CSC/N9498)
17. Monitor components by different grinding to close tolerance limit and check accuracy. [Different grinding: - cylindrical taper, surface grinding & shoulder grinding; tolerance limit- h6] (NOS: CSC/N9472)
18. Read and apply engineering drawing for different application in the field of work. (NOS: ASC/N9410)
19. 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 FOR MACHINIST (GRINDER) - CITS TRADE			
TRADE TECHNOLOGY			
Duration	**Reference Learning Outcome**	**Professional Skill (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Practical 52 Hrs Theory 23 Hrs	Demonstrate workshop safety measures and Monitor job as per specification applying different types of basic fitting operation and check for dimensional accuracy by using steel rule, caliper etc. [Basic Fitting operation- marking, hack sawing, taping, off-hand grinding etc. accuracy±0.25mm]	1. Occupational Safety & Health Importance of housekeeping & good shop floor practices. 2. Health, Safety and Environment guidelines, legislations & regulations as applicable. 3. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. 4. Basic safety introduction, Personal protective Equipment (PPE):- Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution & personal safety message. 5. Preventive measures for electrical accidents & steps to be taken in such accidents. 6. Use of Fire extinguishers. Technical English: Prepare different types of documentation as per industrial need by different methods of recording information. 7. Basic Life support training: Be able to perform DRSABCD: D: Check for Danger R: Check for a Response S: Send for help A: Open the Airway B: Check for normal	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).

		Breathing C: Perform CPR (Cardio Pulmonary Resuscitation) D: Attach Defibrillator/ Monitor as soon as available.	
		8. Grinding of HSS single point boring tool, forming tools, threading tool on a pedestal grinder and measuring the Angles. 9. Grinding of different size drills on a Pedestal grinder and measuring the angles using bevel protractor and std. templates.	Revision to measuring and checking instruments viz. vernier caliper, vernier height gauge, external micrometers, vernier micrometers, inside micrometer, three pin micrometer, groove micrometer, depth vernier, bevel protractor, dial test indicators, slip gauge, sin bar, 2D height master, etc. their care and maintenance.
		10. Surface grinding Cubes and Cuboids using precision tri bloc and angle plates to - size accuracy h5, flatness 0.010mm, parallelism 0.010mm.and squareness 0.010mm. (machine accuracy to be ensured)	Principles of grinding process. Surface grinding machines - horizontal spindle reciprocating table grinding machine and horizontal spindle rotary table grinding machines - vertical spindle reciprocating table grinding machines and vertical spindle rotary table grinding machines - construction and applications. Work holding devices for surface grinding - magnetic chucks, precision grinding vice, magnetic vice, universal vice, sine table, compound sine table, magnetic sine table, sine vice, angle plates, L-angles, adjustable angle plate, plain 'V' - block, magnetic 'V' block, clamps, Vacuum chuck and industrial adhesive tape. De magnetizing after grinding. Surface grinding parameters- wheel speed, work traverse speed, cross feed and down feed. Surface grinding allowance.
		11. Marking the job for drilling, hand reaming, machine reaming, hand tapping, machine tapping, counter boring	Glazing, loading and gumming of grinding wheels and how to correct them. Difference between truing and dressing and different types of truing

		and counter sinking using engineer steel rule and vernier height gauge Drilling, hand reaming, machine reaming, hand tapping, counter boring and counter sinking on drilling machine.	and dressing tools and Selection criteria of diamond dressing tools as per latest IS: 2794. Surface grinding defects causes and remedy. Drilling machines - types, constructional features, applications and operations. Calculation of tap drill size, cutting speeds and feeds. Conversion of cutting speeds in to RPM Types of centre drilling on work pieces, selection criteria of center drill sizes and center grinding.
Practical 52 Hrs Theory 23 Hrs	Check simple components prepared by setting different machine parameters and performing different lathe operation, grinding wheel mounting, balancing, dressing, truing and set surface grinder. [Simple components like cylindrical straight parallel, step, etc; Different machine parameters: - Cutting, speed, feed, depth of cut; Different lathe operation – Facing, plain turning, taper turning, etc.]	12. Truing a shaft using four jaw independent chucks on a centre lathe. 13. Facing, centre drilling, step turning, shoulder drilling, taper turning by compound side method, boring, grooving, chamfering and die passing on lathe - size accuracy +/- 0.05 mm.	Lathe - types, constructional features, applications, tool holding & work holding devices and operations. Cutting speed, feed and depth of cut. Conversion of cutting speed in to RPM. Turning operations such as centre drilling, step turning, shoulder drilling, taper turning by compound side method, boring, grooving, chamfering and die passing on lathe. Specification and selection criteria of centre drill according to weight and diameter of job.
		14. Turning a plain shaft in-between center - size accuracy +/- 0.05 mm. 15. Taper turning a shaft using tailstock offset method Cutting internal and external metric 'V' threads on a lathe.	Tapers - elements, classification and uses. Taper tuning methods and calculation for taper turning on a lathe Elements of metric threads and calculation for cutting metric thread on a Lathe. Ferrous and nonferrous materials and mechanical properties, Heat treatment of metals and its importance. Various methods of heat treatment such as stress relieving, hardening, tempering, annealing and normalizing.
		16. Balancing a grinding wheel, mounting and truing the wheel on a surface grinding machine. 17. Mounting a magnetic	Grinding wheels - Types of abrasives, manufacturing process of abrasives, bond and bonding process, grit, grade and Structure. Grinding wheels shapes, sizes and applications. Methods of

		table on a surface grinding machine, pre-grinding and checking the geometrical parallelism using dial test indicators.	specifying grinding wheels as per latest IS-551. Selection of grinding wheels for grinding wheels as per latest IS 1249.
		18. Milling and surface grinding a parallel block using precision tri blocks and angle plate - size accuracy - +/- 0.005mm, flatness 0.005 mm, parallelism 0.005mm, squareness 0.005mm. 19. Maintenance of grinding machines - cleaning, greasing, oiling etc.	Balancing truing and dressing of grinding wheels. Angle truing attachment - description and use Dismounting and mounting procedure of grinding wheels. Surface grinding parameters and grinding allowance Checking geometrical accuracy of horizontal spindle surface grinding machine as per latest IS 2743
		20. Grinding taper surface using of sine vice and sine table Milling and Grinding Vee - block with close accuracy as per dimensions of latest IS – 2949. 21. Surface Grinding tapered surfaces (compound angles) using adjustable angle plate and universal vice Alignment of wheel head, work head and tail stock on cylindrical grinding machine.	Necessity of coolant for surface grinding, types of coolants, coolant recirculation system, necessity of filtration, filtration methods, coolant oil mixing ratio and method of mixing soluble oil. Dry and wet grinding. Dust extractors for dry grinding Limits and fits as per latest IS-919. International tolerance grades (IT) obtainable by various machining process Geometric tolerances as per IS 8000 (Part I & II) Geometrical accuracies obtainable by various machining process.
Practical 30 Hrs Theory 15 Hrs	Monitor cylindrical grinder for producing job/ components by performing external and internal cylindrical operations like straight parallel, taper, bush, eccentric etc using different machine accessories. [Different Producing job/ components like long parallel bar,	22. Grinding a plain mandrel on universal grinding machine - size accuracy grade Js5, roundness +/- 0.010 mm, cylindricity +/- 0.010 mm and checking circularity and roundness and cylindricity.	Cylindrical grinding machines - constructional features- Plain entre type cylindrical grinding machine, universal cylindrical grinding machine, Plunge centre type cylindrical grinding machine and chucking type cylindrical grinding machines - description, parts and function and operations possible on these machines. Checking geometrical accuracy of an universal cylindrical grinding machine a per latest IS 2368 Importance of coolant for cylindrical grinding, coolant

	crankshaft, bush etc.; Different machine accessories like steady rest, chuck face plate etc. Accuracy Limit: - ±0.25mm.]		filtration and recirculating system.
		23. Machine setting for automatic in-feed for grinding parallel cylindrical grinding on universal grinding machine Step grinding a shaft on universal cylindrical grinding machine to close limits - js6 and checking with micrometer and Ringgauge.	Internal cylindrical grinding machines - Chucking and planetary types and operations possible on these machines. Work holding and work supporting devices for cylindrical grinding machines - Carriers, drive plates, 3- jaw self-centering chucks, 4- jaw independent chuck, collect chucks, full center, half center, mandrels etc.
Practical 10 Hrs Theory 05 Hrs	Access dry & wet grinding for making different shaped job like square block angle plate, angular block etc. of various metals like cast iron & steel. [Accuracy limit ±0.02 mm.]	24. Grinding parallel diameters and shoulders on universal cylindrical grinding machine and checking with micrometer and Ring gauge. 25. Plunge grinding steps and shoulders on universal grinding machine.	Cylindrical grinding parameter - wheel speed, work speed, work traverse feed, cross feed and infeed for roughing and finish grinding operations. Cylindrical grinding allowances. Conversion of wheel speed and work speed into RPM. Inspection of work piece prior to cylindrical grinding.
Practical 10 Hrs Theory 05 Hrs	Evaluate components made by performing bore grinding and check accuracy by telescopic gauge. [Accuracy limit ±0.02 mm.]	26. Turning and grinding a bush bearing using mandrel outside diameter accuracy js5, roundness 0.010 mm, cylindricity0.010 mm, - parallelism between face 0.010mm. 27. Class of fit H5/js5 Grinding internal steep tapers by swiveling work head on universal grinding machine.	Work holding devices for internal grinding - 4 jaw independent chucks, collets, face plate fixture and magnetic chucks. Method of grinding parallel bore and taper bore on an universal grinding machine Selection criteria of grinding spindle (quill) and grinding wheels for internal bore grinding. Mounting an internal grinding wheel on spindle.
Practical 30 Hrs Theory 15 Hrs	Evaluate components like V' block, parallel bar, drill point angle etc with angular and straight surface and check accuracy with different gauges and instruments. [Different gauges: -	28. Grinding internal groves on universal grinding machine Inspection of bush bearing using Plug gauge, Telescopic gauge, internal micrometers, bore dial gauge and three pin micrometer,	Rough dressing and finish dressing internal grinding wheel. Dressing front face of internal grinding wheel Methods of checking internal bore - plug gauge, bore dial gauge, telescopic gauge, inside micrometer, three pin micrometer and pneumatic gauge.
		29. Grinding a plain Go and No- Go plug gauge with	Description of Tool and cutter grinding machine- constructional

	sine bar, slip gauge & DTI (dial test indicator) Accuracy limit ±0.02 mm.]	accuracy as per latest IS: 3484. 30. Grinding a Morse taper sleeve - inside and outside (MT-6/MT5)	features. Application of tool and cutter grinding machine applications and uses. Attachment and accessories of tool and cutter grinding machines centering gauge and applications.
		31. Inspection of external and internal tapers using sine bar, plug gauges. 32. Re-sharpening single point cutting tool on tool and cutter grinding machine using universal vice - Tool geometry as per latest IS-3019.	Wheel truing attachment, clearance angle setting gauge, universal work head, small end mill grinding attachment, face mill grinding attachment, cylindrical grinding attachment, internal grinding attachment, long reamer grinding attachment, radius grinding attachment, surface grinding attachment (universal vice), hob grinding attachment and magnetic chucks. Importance of using coolant while grinding carbide cutting tools.
		33. Grinding outside diameter of reamers. 34. Grinding of carbide tipped tools as per tool geometry of latest IS 2163 and IS 6075 on tool and cutter grinder using attachment.	Types of profile sharpened milling cutters - light duty plain milling cutters, heavy duty plain milling cutters, straight teeth side and face cutters, helical teeth side and face cutter, staggered teeth side and face cutter, end mills, shell end mills, slot drills, metal slitting saws, single angle cutters, double angle cutters, T-slot cutters, woodruff key seat cutter, dovetail cutter and fly cutters. Types of form relieved milling cutters—concave cutter, convex cutter, corner rounding cutter, involute gear cutters, and drill fluting cutters. Recommended tool geometry of milling cutters for face milling, end milling and side/slot milling operations.
Practical 30 Hrs Theory 15 Hrs	Assess operations done on tools & cutter grinder and re-sharpening different tools on pedestal grinder. [Different	35. Re-sharpening radial clearance angle on side and face cutter on tool and cutter grinder by tilting the wheel head. 36. Re-sharpening of radial clearance angle of	Principles of re-sharpening clearance angles on milling cutter. Determination of primary and secondary clearance angle and land width according to material to be milled and diameter of cutters. Importance

	tools: - lathe tools, drill and tool bit]	slotting cutter by offsetting the milling cutter using cup wheel.	of maintaining land width according to diameter of cutters. Shapes of grinding wheels used for tool and cutter grinder. Advantages of using cup wheel for re-sharpening milling cutter over disc wheel.
		37. Re-sharpening of radial clearance angle of side and face cutter by offsetting disc wheel. 38. Re-sharpening of radial clearance angle of side and face cutter by using clearance angle setting gauge.	Abrasive sticks for dressing cup and saucer wheel. Calculation of offset for grinding of radial clearance angle by offset method -(i) by using cup wheel (ii) by using disc wheel Procedure of grinding of radial clearance angle for helical plain milling cutter (slab milling cutter).Procedure of grinding of radial clearance angle on staggered teeth side and face cutter.
		39. Re-sharpening of radial clearance angle on helical plain Milling cutter (slab milling cutter). 40. Re-sharpening radial clearance angle of staggered teeth side and face cutter Re-sharpening slitting saw.	Diamond and CBN grinding wheels and their applications. Specifying Diamond and CBN wheels as per latest IS 3264. Inspection of ground job by NDT magnetic particle testing and Die penetrant testing. Description and use of universal work head of Tool and Grinding Cutter machine and methods of indexing.
Practical 10 Hrs Theory 05 Hrs	Evaluate jobs of different materials done by cylindrical parallel grinding with appropriate accuracy. [Different material: - soft & hard metals; Accuracy limit±0.01mm]	41. Re-sharpening radial clearance angle of end mills and shell end mills. 42. Re-sharpening axial clearance angle of side and face cutter using universal work head.	Procedure of re-sharpening axial clearance angle of end mills and shell end mills. Procedure of grinding a slot drill. Tool geometry of Broaches and re-sharpening methods. Snap gauges, sine bar, slip gauges, roundness measuring machine and their description and use.
Practical 10 Hrs Theory 05 Hrs	Monitor preventive maintenance of grinding machines both surface and cylindrical.	43. Re-sharpening single angle cutters LH and RH Re-sharpening double angle cutters. 44. Grinding a slot drill. 45. Re- sharpening of form relieved cutters viz.	Special type of grinding machines- Thread grinding machines, Jig grinding machines, Crank shafts grinding machine and Cam shaft grinding machines, single lip cutter grinding machine and centers grinding machine,

		concave / convex / corner rounding / involute gear cutters using attachment. 46. Check machines oil level, all belts tension and other movable parts etc.	Double disc grinding machines, Roll grinding machines, Optical projection profile grinders, NC and CNC grinding machines their working principles, brief description and applications
Practical 10 Hrs Theory 05 Hrs	Access re-sharpening of different milling cutters. [Different milling cutters: -plain, slitting saw etc.]	47. Re- sharpening gear hobbing cutter on tool and cutter grinding machine using hob grinding attachment. 48. Corner chamfering on end mill and Shell end mill using universal work head.	Surface roughness - primary texture, secondary texture (waviness) and lay Surface finish obtainable by various machining process.
Practical 110 Hrs Theory 40 Hrs	Evaluate different components having straight & angular surface with close tolerance limit and check different fault. [Different components: - V' block, plain cylindrical bar, cube; tolerance limit - ±0.01mm; different faults - cracks, blow-holes, chatters etc.]	49. Re-sharpening of relief angle on Reamer Cylindrical grinding on eccentric job with suitable fixtures. 50. Dry and wet grinding on metals such as cast iron, brass, bronze, aluminium and different classes of steel. 51. Measurement of surface roughness using comparator.	Evaluation of surface roundness - Roughness average Ra, Centre Line Average CLA, ten point height irregularities (Rz), Root mean square method and sampling length surface roughness measuring instrument - Description and use.
		52. Centreless grinding - through feed grinding different diameter hardened pins	External Centreless grinding machine -- working principles, constructional features, parts and functions. Advantage of Centre less grinding over cylindrical grinding and limitations. External Centreless grinding machine operations - through feed grinding; in feed grinding, end feed grinding, infeed and through feed grinding.
		53. Centreless grinding – infeed grinding different diameter hardened pins	Centreless grinding procedures- truing of grinding wheel and regulating wheel, machine setting procedure for centreless grinding, grinding parameters maintenance and troubleshooting Internal centreless grinding machines - methods of holding job and process of grinding and selection of grinding wheel.

		54. Shoulder grinding practice on cylindrical grinder close to limits h5. 55. Slot and shoulders grinding practice on surface grinding machine using magnetic vice to close limit H5.	Use of surface finish symbol as per latest IS - 3073 Method of indicating surface texture on Technical drawing as per latest IS 10719 Thread grinding- procedure for holding job, method of grinding threads and threads calculation, various types of thread grinding wheels and their selection, types of dressers and process of dressing, selection of coolants.
		56. Cylindrical grinding steep tapper by swiveling work head, internal and external. 57. Plunge grinding steep taper by swivelling wheel head. 58. Surface grinding thin nonferrous metals by holding work by industrial adhesive tape.	Creep feed grinding machine- working principle, constructional feature and advantages over conventional surface grinding machines and limitations.
		59. Grinding long cylindrical job using closed and open steady rest to close limit h6.	Importance of quality and quality concepts Awareness on ISO - 9001-2008 quality system.
		60. Grinding thin plates, to close limit h6. 61. Cylindrical Grinding practice on parallel and taper pins using chucks and collets. 62. Grinding internal stepped bore. Grinding a taper by compound setting on cylindrical grinder.	Methods of grinding gashes on fluted cutters Methods of polishing and buffing. Description and use of special type measuring instruments- comparators and profile projectors.
		63. Truing the cylindrical grinding wheel for form grinding concave and convex profiles using radius truing attachment. 64. Plunge cylindrical grinding practice for grinding concave and convex profile	Application and use advanced measuring instrument - such as Marposs in process gauge for measuring internal and external diameters, Digital height gauge and digital micrometer.
Practical 10 Hrs	Check different gauges with close	65. Inspection of ground jobs by Dye Penetrant method Grinding a GO and NO GO	Gauge tolerance and wear allowance for plug Cylindrical grinding defects, their causes and

Theory 05 Hrs	tolerance limit and check accuracy with different gauges. [Different gauges: - snap gauge, ring gauge; tolerance limit- (H7/h7); Checking gauges- ring, plug etc.]	Snap gauge to close limit Grinding GO and NO GO ring gauges on ring gauge and checking with air gauge.	remedies- out of round, out of parallel, taper on end, irregular marks, spiral scratches, burnt surface, chatters - short close, evenly spaced, long and regularly spaced, marks in phase with vibration of floor, random marks; random waves etc.
Practical 30 Hrs Theory 15 Hrs	Demonstrate different components of CNC cylindrical grinder to understand working and evaluate part programme by using simulation software.	66. Familiarization for operating CNC control system for working on CNC cylindrical grinding machine. 67. Machine set up and machining plain cylinders on CNC cylindrical grinding machine.	CNC cylindrical grinding machines- working principles, features of CNC system and elements of CNC machines, two axes fundamentals concept of CNC programming, with basic G codes and M codes, wheel truing system, programming for plain and step grinding. CNC cylindrical grinding machine, operator control panels CNC Programming basics for wheel speed, work speed, work traverse speed and infeed.
	Perform CNC cylindrical grinding operation to produce different parts and check accuracy	68. Machining stepped diameters on CNC cylindrical grinding machine. 69. Plunge grinding on CNC cylindrical grinding machine.	CNC Cylindrical grinding machine maintenance and trouble shooting.
		70. Machining shoulders on CNC cylindrical grinding machine. 71. Machining external tapers on CNC cylindrical grinding machine.	Practice on CNC Programming for cylindrical grinding.
		72. Machining external parallel diameters on CNC cylindrical grinding machine.	Methods of preserving ground components. Checking of circularity and roundness on cylindrical components.
Practical 10 Hrs Theory 05 Hrs	Analyse surface of a component by honing operation& Check accuracy. [Accuracy limit: ±0.001mm]	73. Hand honing of small bushes. (27 mm ID) 74. Re-sharpening of Taps by grinding. 75. Practice of Manual Lapping on flat surfaces.	Honing process -working principles, applications, equipment, selection of honing stones and honing procedures. Lapping process- working principles, methods of lapping applications, equipment, selection of abrasive powders and carriers

			and lapping procedures.
Practical 10 Hrs Theory 05 Hrs	Monitor surface of a job by performing lapping & buffing to close limit h5.	76. Machine lapping of Flat surfaces on lapping machine. 77. Measurement of flatness by optical flat with monochromatic light.	Lapping of external cylindrical surface by using adjustable ring lap. Lapping of bore using a lapping mandrel.
Practical 66 Hrs Theory 24 Hrs	Monitor components by different grinding to close tolerance limit and check accuracy. [Different grinding:- cylindrical taper, surface grinding & shoulder grinding; tolerance limit- h6]	78. Cylindrical grinding of Press tool punches to a tolerance +/- 0.005 mm.	Maintenance and trouble shooting of Surface grinding machine Maintenance and trouble shooting of Cylindrical grinding machine Maintenance and trouble shooting of Tool and cutter grinding machine.
		79. Surface grinding compound angles using magnetic sine table. 80. Radius truing of surface grinding wheel using radius truing attachment and grinding curved profiles.	Introduction to TPM, TQM, JIT etc.
		81. Angular truing of surface grinding wheel using angle truing attachment and grinding angular profiles.	Drill point grinder - Description, parts and functions and applications Router milling cutters- types, tool geometry, applications and re-sharpening methods.
		82. Grinding point angles of different diameter drills on Drill point grinder attachment.	Cost estimation of grinding operation - raw material cost, labor cost, overhead cost and profit. Automatic re-sharpening machine for larger diameter slit saw.
		83. Re-sharpening Gear shaper cutters on tool and cutter grinder. 84. Grinding different diameter die sinking single lip cutters on Single lip cutter grinder.	Single lip cutter grinder- Description, parts and functions and applications Ball nose and bull nose cutters - types, tool geometry and applications Super finishing process- description and working principles of super finishing machine- size accuracy, geometrical accuracy and surface finish obtainable by super finishing process - difference between honing and

			super finishing, forms and shapes which can be super finished, super finishing oil properties and filtration method, super finishing allowance and centreless super finishing machines.
		85. Make stub arbor, plug gauge, thread plug gauge, ring gauge & Test mandrel.	Modern new development in the trade. Job evaluation practice using various instruments.
Engineering Drawing: 30 Hrs.			
Professional Knowledge ED- 30 Hrs.	Read and apply engineering drawing for different application in the field of work.	**CIRCLES, TANGENTS AND ELLIPSE:** Practical applications procedure for constructing tangent to given circle-lines- loop 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: 30 Hrs.		
Professional Knowledge	Demonstrate basic	**<u>WORKSHOP CALCULATION:</u>** **Fraction:** Concept of Fraction, Numbers, Variable, Constant,

WCS- 30 Hrs.	mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**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 Core Skills subjects which is common for all the CITS trades, provided separately in www.bharatskills.gov.in./ dgt.gov.in

7. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENT CRITERIA
TRADE TECHNOLOGY (TT)	
1. Demonstrate workshop safety measures and Monitor job as per specification applying different types of basic fitting operation and check for dimensional accuracy by using steel rule, caliper etc. [Basic Fitting operation- marking, hack sawing, taping, off-hand grinding etc. accuracy±0.25mm] (NOS: CSC/N9506)	Demonstrate raw materials, instruments and equipment for marking and make this available for use in a timely manner.
	Evaluate visual inspection for defects.
	Evaluate the job for Hacksawing, chiselling, filing, drilling, tapping and off-hand grinding.
	Demonstrate basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job.
	Illustrate as per specification applying desired mathematical calculation and observing standard procedure.
	Demonstrate all dimensions in accordance with standard specifications and tolerances.
2. Check simple components prepared by setting different machine parameters and performing different lathe operation, grinding wheel mounting, balancing, dressing, truing and set surface grinder. [Simple components like cylindrical straight parallel, step, etc; Different machine parameters: - Cutting, speed, feed, depth of cut; Different lathe operation – Facing, plain turning, taper turning, etc.] (NOS: CSC/N9474)	Demonstrate lathe machine operation with its components.
	Demonstrate appropriate work holding devices and acquaint with functional application of each device.
	Assess setting the job on chuck as per shape.
	Demonstrate setting the lathe machine on appropriate speed & feed.
	Check operation of the lathe to demonstrate lathe operation, observing standard operating practice.
	Perform lathe operation viz., facing, plain turning, taper turning, boring and simple thread cutting to make components 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.
3. Monitor cylindrical grinder for producing job/ components by performing external and internal cylindrical operation like straight parallel, taper, bush, eccentric etc using different machine accessories. [Different	Demonstrate basic working principles and safety aspect of grinding wheel mounting, balancing, dressing and truing of grinding wheel.
	Explain functional application of different levers, stoppers, adjustment etc for surface grinder.
	Demonstrate different lubrication points of surface grinder.
	Monitor lubricants and their usage for application in surface grinder as for machine manual.
	Explain different grinding wheel mounting devices and acquaint with functional application of each device.

Producing job/ components like long parallel bar, crankshaft, bush etc.; Different machine accessories like steady rest, chuck face plate etc. Accuracy limit: - ±0.25mm.] (NOS: CSC/N9507)	Evaluate grinding wheel with required alignment and check for its functional usage to perform surface grinding operations.
	Assess problem solving by applying basic methods and information during setting.
	Demonstrate safety procedure during mounting as per standard norms.
4. Access dry & wet grinding for making different shaped job like square block angle plate, angular block etc. of various metals like cast iron & steel. [Accuracy limit ±0.02 mm.] (NOS: CSC/N9508)	Demonstrate functional application of different levers, stoppers, adjustment etc.
	Evaluate mounting of the work and tool holding devices with required alignment and check for its functional usage to perform grinding operations.
	Assess problem by applying basic methods, tools, materials and information during setting.
	Ensure safety procedure during mounting as per standard norms.
	Check heat generated in grinding for different types of metal.
	Evaluate selection of appropriate coolant for different types of metal grinding.
	Assess problem solving by applying desired mathematical skill, basic methods, select speed, feed, depth of cut and organize information during setting.
	Observe safety procedure during operation as per standard norms.
5. Evaluate components made by performing bore grinding and check accuracy by telescopic gauge. [Accuracy limit ±0.02 mm.] (NOS: CSC/N9496)	Demonstrate appropriate machine parameters to set for automatic movements.
	Demonstrate appropriate method to perform Turning and grinding a bush bearing using mandrel.
	Evaluate class of fit, and grinding internal steep tapers by swiveling work head using universal grinding machine.
	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
	Measure the dimensions with instruments/gauges as per drawing.
	Comply with safety rules when performing the above operations.
6. Evaluate components like V' block, parallel bar, drill point angle etc with angular and straight surface and check accuracy with different gauges and instruments. [Different gauges: - sine bar, slip	Evaluate the appropriate methods to produce various components with the help of surface grinder.
	Assess selection of the appropriate grinding wheel and work holding devices.
	Check application of desired mathematical skills, collection and organization of information to work out the machining parameters.
	Evaluate Production of components as per drawing.
	Inspect external and internal tapers using sine bar, plug gauges etc.

gauge & DTI (dial test indicator) Accuracy limit ±0.02 mm.] (NOS: CSC/N9499)	Evaluate grinding of diameter of reamers and carbide tipped tools as per specification.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement.
	Comply with safety rules when performing the above operations.
7. Assess operations done on tools & cutter grinder and re-sharpening different tools on pedestal grinder. [Different tools: - lathe tools, drill and tool bit] (NOS: CSC/N9509)	Evaluate re-sharpening of radial clearance angle on side and face cutter by tilting of the wheel head.
	Monitor re-sharpening by offsetting disc wheel.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement.
	Evaluate re-sharpening of radial clearance angle on helical plain milling cutter.
	Check re-sharpening of staggered teeth side and face cutter.
	Ensure safety rules when performing the above operations.
8. Evaluate jobs of different materials done by cylindrical parallel grinding with appropriate accuracy. [Different material: - soft & hard metals; Accuracy limit±0.01mm] (NOS: CSC/N9476)	Evaluate selection of appropriate method to produce various components with the help of cylindrical grinder.
	Evaluate selection of appropriate grinding wheel according to material to be ground and work holding devices.
	Assess application of desired mathematical skills and machining parameters for end mills and shell end mills.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement.
	Observe safety procedure during operation as per standard norms.
9. Monitor preventive maintenance of grinding machines both surface & cylindrical. (NOS: CSC/N9476)	Ascertain for the aligning / parallelism of grinding machines.
	Monitor proper Plan work for lubrication schedule, simple estimation.
	Check the mechanism, driving system of grinding machines and set properly if required.
	Observe safety procedure during operation as per standard norms.
10. Assess re-sharpening of different milling cutters.[Different milling cutters: -plain, slitting saw] (NOS: CSC/N9474)	Monitor planning and select of appropriate method to Resharpen the plain, side and face milling cutter.
	Evaluate setting up of milling cutter and re-sharpening the milling cutter as per standard operating procedure of the machine.
	Evaluate measurement of the dimensions with instruments/gauges.
	Ensure Compliance with safety rules when performing the above operations.
11. Evaluate different components having straight & angular surface with close tolerance limit and check different fault. [Different components: - V' block, plain cylindrical bar, cube; tolerance limit -	Evaluate planning and selection of appropriate method to produce various components on reamer cylindrical grinding machine.
	Assess selection of the appropriate grinding wheel and work holding devices.
	Evaluate measurement of surface roughness using comparators.
	Evaluate centreless grinding through feed and infeed grinding different diameter hardened pins.
	Monitor slot and shoulder grinding on surface grinding machine

±0.01mm; different faults - cracks, blow-holes, chatters etc.] (NOS: CSC/N9510)	using magnetic vice.
	Evaluate cylindrical grinding steep tapper by swiveling work head, internal and external.
	Check plunge grinding steep tapper of thin non ferrous metals by holding work with industrial adhesive tapes.
	Assess truing the cylindrical grinding wheel for form grinding concave and convex profiles.
	Check accuracy/ correctness of job adhering to close limit.
	Observe safety procedure during operation as per standard norms.
12. Check different gauges with close tolerance limit and check accuracy with different gauges. [Different gauges: - snap gauge, ring gauge; tolerance limit- (H7/h7); Checking gauges- ring, plug etc.] (NOS: CSC/N9510)	Inspect ground jobs by dye penetrant method.
	Check gauge tolerance and wear allowance for plug cylindrical grinding defects.
	Check shafts with simple GO and NO-GO snap/ ring gauges.
	Check holes using plug gauges.
	Assess problem solving for grinding defects, understanding their causes and remedies.
13. Demonstrate different components of CNC cylindrical grinder to understand working and evaluate part programme by using simulation software. (NOS: CSC/N9433)	Demonstrate different components of CNC Cylindrical grinder.
	Demonstrate working principles, features and elements of CNC control system on CNC cylindrical grinder.
	Explain CNC programming for machining stepped diameters and plunge grinding.
	Explain the operator control panels in CNC programming basics for machining shoulders and external tappers.
	Demonstrate possible solutions within the team.
14. Perform CNC cylindrical grinding operation to produce different parts and check accuracy. (NOS: CSC/N9433)	Plan and prepare and explain part programme as per drawing.
	Demonstrate machining stepped diameters and plunge grinding on CNC cylindrical grinding machine.
	Evaluate job using plug gauge, thread plug gauge, ring gauge and test mandrel.
	Check for accuracy of the job done.
15. Analyze surface of a component by honing operation & Check accuracy. [Accuracy limit: ±0.001mm] (NOS: CSC/N9498)	Explain honing process and lapping process related with Grinding procedures.
	Analyse hand honing of small bushes.
	Honed the work piece as per standard operating practice.
	Evaluate manual lapping on flat surfaces.
	Check the dimension of job by precession instrument and observe safety precautions during operation.
16. Monitor surface of a job by performing lapping & buffing to close limit h5. (NOS: ASC/N9498)	Monitor selection of appropriate method to produce the work piece as per drawing.
	Assess Lapping/buffing the product following standard operating practice.
	Set the job and finish the surfaces as per specification/drawing

	following standard operating practice.
	Check the dimension of job by precession instrument.
17. Monitor components by different grinding to close tolerance limit and check accuracy. [Different grinding: - cylindrical taper, surface grinding & shoulder grinding; tolerance limit- h6] (NOS: CSC/N9472)	Evaluate Cylindrical grinding of press tool punches to the required tolerance limit.
	Explain surface grinding compound angles using magnetic sine tables.
	Assess solving of problems by applying basic methods, tools, materials and information during machining
	Check the dimension of components by precession instrument.
	Dispose waste as per procedure.
18. 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
19. 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.

INFRASTRUCTURE

LIST OF TOOLS AND EQUIPMENT FOR MACHINIST (GRINDER) (CITS)			
For batch of 25 candidates			
S No.	**Name of the Tool & Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1.	Steel rule	150 mm (graduated both English and Metric) as per IS 1481	26 Nos.
2.	Try square Engineers	150 mm as per IS 2103	26 Nos.
3.	Hammer	ball peen with handle 0.50 Kg	13 Nos.
4.	Scriber	150 MM x 3mm	26 Nos.
5.	Vernier caliper	200 mm, inside and outside (graduated in inches and millimeters) least count 0.020 mm as per IS 3651	13 Nos.
6.	Micro meter	outside 0 - 25 mm with least count 0.010 as per IS 2967	13 Nos.
7.	Micro meter	outside 25 - 50 mm least count 0.010 as per IS 2967	13 Nos.
8.	Goggles	(fiber plastic cup) safety glasses (interchangeable glasses)	26 Nos.
9.	D.E Spanner	6 to 28 mm as per IS 2028	26 Nos.
10.	Allen key	5 to 12 mm	6 sets
11.	Hand file	flat smooth 10"	26 Nos.
B. TOOLS, MEASURING INSTRUMENTS AND GENERAL SHOP OUTFIT			
12.	Hammer	Copper 0.50 kg	2 Nos.
13.	Scribing Block	with adjustable Vertical spindle 225 mm	2 Nos.
14.	Precision tri block	2'' x 4'' x 6'' with 23 tapped holes with strap clamps and screws	2 pairs
15.	Angle plate	(L type)150x150x 40 mm	2 Nos.
16.	Angle plate	adjustable (graduated in degrees),150 mm x 150 mm x150 mm	2 Nos.
17.	Vee Blocks	150x100x100 mm (fitted with C-clamps, (hardened and ground) as per IS 2949	2 Pair
18.	Vee Blocks	(grooved and fitted with C-clamps) (Hardened and ground) 75x75x50 mm as per IS 2949	2 Pair
19.	Parallel blocks	of 6 mm, 8mm, 10 mm 12 mm, 16mm,20mm and 25mm with length 125 mm as per IS 4241	2 Pair each
20.	Vernier caliper digital	200 mm, inside and outside (graduated in inches and millimeters) least count 0.01 mm.	2 Nos.
21.	Vernier caliper,	outside 300 mm (graduated in inches and millimeters) least count 0.020 mm to IS 3651	2 Nos.
22.	C-Clamps	50 mm, 100 mm and 150 mm	2 Each
23.	Oilcan,	drip delivery VV point capacity	2 Nos.
24.	Vernier Height Gauge	(as per IS - 2921) (Metric and English	2 Nos.

		graduated) 300 mm, least count 0.02 mm with holder for lever type dial test indicators and carbide tipped scribers.	
25.	Bevel protractor,	least count 5 minutes as per IS - 4239	2 Nos.
26.	Drill chuck	12 mm capacity (Taper shank suitable to drilling machine)	2 Nos.
27.	Key less drill chuck	12 mm capacity	2 Nos.
28.	Diamond, Wheel Dressing	Single stone mounted	4 Nos.
29.	File Flat	Rough 300 mm	4 Nos.
30.	File Flat	250 mm Second Cut	4 Nos.
31.	Files, Hand Flat,	250 mm smooth	4 Nos.
32.	Files,	150 mm Half round smooth	4 Nos.
33.	Files,	round Dead smooth 200 mm	4 Nos.
34.	Files,	Triangular, dead smooth 200 mm	2 Nos.
35.	Feeler Gauge	Metric Set as per IS 3179	1 set
36.	Gauge,	Radius (Inside and Outside) (Metric)	2 sets
37.	Gauge, Slip	(Metric),122 Nos., set, grade -1, Tungsten Carbide as per IS 2984	2 Set
38.	Gauge,	Telescopic 12 to 150 mm	1 Set
39.	Gauge,	Morse Taper, Plug Nos. 1,2,3,4	1 each
40.	Gauge,	Morse Taper, Ring Nos. 1,2,3,4	1 each
41.	Limit plug gauge	5mm - 25 mm incremental by 2.5 mm (GO & NO GO ends) as per IS 3484	1 set
42.	Ring gauge	5 mm - 25 mm incremental by 2.5 mm (GO& NO GO ends) as per IS 2251	1 set
43.	Glass Magnifying	250x25x75 mm dia. with handle	1 No.
44.	Hacksaw frame	200 to 300 mm adjustable	4 Nos.
45.	Keys Allen	14 mm	2 Nos.
46.	Keys Allen	3 to 12 mm, by 1.5mm	1 Set
47.	Keys Allen	16mm	2 Nos.
48.	Spirit Level,	size 200 mm, block type, sensitivity 0.02 mm/m as per IS - 5706	1 No.
49.	Micrometer outside	digital 0 to 25 mm, least count 0.001 mm	2 Nos.
50.	Micrometer outside	digital 25 to 50 mm, least count 0.001 mm	2 Nos.
51.	Micrometer outside	digital 50 to 75 mm, least count 0.010 mm	1 No.
52.	Micrometer outside	75 to 100 mm and, least count 0.010 mm as per IS 2967	1 No.
53.	Internal Micrometer	35 to 150 mm with extension Rods	1 No.
54.	Inside micrometer	caliper type range 25 to 50 mm, least count 0.010 mm	1 No.
55.	Three pin micrometer	range 25 to 35mm, least count 0.010 mm	1 No.
56.	Drill gauge	for checking 118° point angle and clearance angles	1 No.
57.	Oil stone (consumable)	Carborandum, Coarse on one side and fine on the other side 200x50x25mm	2 Nos.
58.	Oil Stone (consumable)	Carborandum, Coarse on one side and fine on other side 100x12 mm triangular	2 Nos.
59.	Oil Stone (consumable)	Carborandum, Coarse round 12 mm dia.	2 Nos.
60.	Square, Try	Engineer's 400L x 250 W x 10T as per IS	1 No.

		2103	
61.	Straight Edge Engineer's	500L x 150 H x12T as per IS 2220	1 No.
62.	Screw Driver	200 mm blade	2 Nos.
63.	Screw Driver	300 mm blade, heavy duty	2 Nos.
64.	Spanner Double ended	metric 30-32 mm	2 Nos.
65.	Rings spanner	3 to 22mm all sizes	2 sets
66.	Adjustable spanner	300 mm	1 No.
67.	Sine bar	200 mm roller type with stopper as per IS 5359	2 Nos.
68.	Tachometer	non contact type (9999 RPM)	1 No.
69.	Table Chuck	75 mm Jaw Swivel Base 200 mm dia.	1 No.
70.	Table Chuck	3 Jaw with tilting arrangement and graduated in degrees	1 No.
71.	Vices machine	200 mm jaw opening	1 No.
72.	Vice Universal	for surface Grinding Machine 4" to set 3 compound angles simultaneously	1 No.
73.	Wheel Dressers (consumable)	Steel Type (Huntington) (Large)	2 Nos.
74.	Wheel Dressers (consumable)	Steel (Huntington type Small)	2 Nos.
75.	Demagnetizer unit		1 No.
76.	Centre Punch	150 x 6 mm dia.	4 Nos.
77.	Number punch		1 set
78.	Letter punch		1 set
79.	Granite Surface Plate,	grade 0, 630 x 630 x 100mm with adjustable stand as per IS 7327	1 Nos.
80.	Granite marking Table	1000x630 x 150mm, grade 1 with adjustable stand as per IS 7327	1 Nos.
81.	Hand Drilling machine electric	12 mm	1 No.
82.	Taps and Dies set	complete in box (Metric) with tap wrenches and die stocks	1 set
83.	Drill Twist (Metric)	3 mm to 12 mm, in step of 0.5 mm	2 Set
84.	Drill	Twist, taper shank, 16 mm	4 Nos.
85.	Drill	Twist, taper shank, 19.5 mm	2 Nos.
86.	Drill Twist	(Metric) 29.5 mm	2 Nos.
87.	Hand reamer	8 mm	4 Nos.
88.	Hand reamer	10 mm	4 Nos.
89.	Machine reamer	20mm	4 Nos.
90.	Machine reamer	30mm	4 Nos.
91.	Counter boring tool	10 mm	2 Nos.
92.	Counter sinking tool	16 mm	2 Nos.
93.	Set of Morse Sockets	(0-1,1-2, 2-3 and 3-4)	2 sets
94.	Combination Drill	type 'A' body diameter 10 mm	5 Nos.
95.	Screw Pitch Gauge	metric	2 sets
96.	Working Benches	340 x 120 x 75 Cms. with 4 bench vices 150 mm jaw	2 Nos.
97.	Fire Extinguisher		1 No.
98.	Fire Buckets with stand		4 Nos.
99.	Trainees locker with keys (to accommodate 20 lockers)		1 No.

100.	Metal Rack.	180 x 150 x 45 cms	1 No.
101.	Stools		As required
102.	Ceramic class room board	size 2mx1m	1 No.
103.	Magnifying Glass with surface illuminator		1 No.
104.	Hammer	(Nylon face) 30 mm	4 Nos.
105.	Grease Gun		1 No.
106.	Oil gun		1 No.
107.	Magnetic V-Block,	90° size 100 mm x 75 mm x 75 mm	2 sets
108.	Magnetic stand	with holding stem for Dial Indicators 75 x 75 x 100 mm	2 Nos.
109.	Magnetic Stand Flexible type base	60 mm x 47.5 mm Magnetic Power 75 kg ON-OFF Lever control	1 No.
110.	Dial Test Indicator-	Lever type-long point type-0.8 mm range graduation 0.01 mm as per IS 11498	2 Nos.
111.	Dial Test Indicator-Lever type-	long point type-0.8 mm range graduation 0.002 mm as per IS 11498	2 Nos.
112.	Dial Test Indicator-	Lever type-long point type-0.8 mm range graduation 0.001 mm as per IS 11498	2 Nos.
113.	Plunger type dial,	least count 0.01mm, range10mm as per IS 2092	1 No.
114.	Plunger type dial,	least count 0.001mm, range 1mm	1 No.
115.	Bore dial gauge range	10 to 18 mm	1 No.
116.	Bore dial gauge range	18 to 30 mm	1 No.
117.	Bore dial gauge range	30 to 50 mm	1 No.
118.	Bore dial gauge range	50 to 150 mm	1 No.
119.	Glass Show case for display of jobs	450 mm x 600 mm x 850 mm	1 No.
120.	Digital height gauge	0 to 300 mm, L.C 0.001 mm, carbide tipped scriber.	1 No.
121.	Trainees work table		1 No.
122.	Face mask		26 Nos.
123.	Apron leather		26 Nos.
124.	Silicon carbide dressing stick coarse		02 Nos.
125.	Silicon carbide dressing stick fine		02 Nos.
126.	Shell end mill cutter	HSS 63x40x27 mm	4 Nos.
127.	Shell end mill cutter	HSS 80x45x27 mm	4 Nos.
128.	End mill cutters,	HSS, parallel shank, diameters 6 mm,8 mm, 10 mm, 12 mm, 16mm, 20 mm, 25 mm, 28 mm, 30 mm	4 each
129.	Slot drills,	HSS, straight shank, straight fluted 10mm,12mm,16mm	2 each
130.	Two fluted end mill,	straight fluted 10 mm, 12, mm, 16 mm	1 each
131.	Cylindrical cutter	(Slab milling cutter) 63 x70x27mm	4 Nos.
132.	Silicon carbide	dressing stick coarse	02 Nos.
133.	Face milling cutter	80 mm diameter, height 50 mm, bore size 27 mm, cutting edge angle 90°,No. of	1 No.

		inserts 4 to 6 with suitable inserts.	
134.	Face milling cutter	80 mm diameter, height 50 mm, bore size 27 mm, cutting edge angle 45°, No. of inserts 4 to 6 with suitable inserts.	1 No.
135.	Side and face cutter	HSS straight teeth, Type - B, size 80x10x27mm	4 Nos.
136.	Side and face cutter	HSS staggered teeth, Type - A 80x10x27 mm	4 Nos.
137.	Single angle cutter	RH, 63x18x27 mm 60°	4 Nos.
138.	Single angle cutter	LH 63x18x27mm 60°	4 Nos.
139.	Double angle cutter	50x16x27 MM,60°	4 Nos.
140.	Equal angle cutter	80x16x27mm,45°	4 Nos.
141.	Equal angle cutter	80x20x27mm,60°	4 Nos.
142.	Equal angle cutter	80x20x27mm,90°	4 Nos.
143.	Metal slitting saw	100 mm OD, 6 mm thick, 27 mm bore	4 Nos.
144.	HSS tool bits	6" x 1/2"	2 dozen
145.	Straight turning tool	carbide tipped (ISO 1), designation 2020 as per IS-2163	2 Nos.
146.	Cranked turning and facing tool	carbide tipped (ISO 2), designation 2020 as per IS-2163	2 Nos.
147.	Cranked finishing tool	carbide tipped (ISO 3), designation 2012 to IS-2163 as per IS-2163	2 Nos.
148.	Broad turning tool	carbide tipped. (ISO 4), designation 2012 as per IS-2163	2 Nos.
149.	Cranked facing tool	carbide tipped. (ISO 5), designation 2020 as per S-2163	2 Nos.
150.	Cranked turning tool	carbide tipped. (ISO 6), designation 2020 as per IS-2163	2 Nos.
151.	Parting off tool	carbide tipped. (ISO 7), designation 2012 as per IS-2163	2 Nos.
152.	Pointed turning tool	carbide tipped. (ISO 8), designation 2012 as per IS-2163	2 Nos.
153.	Straight planning tool p1	carbide tipped, shank size 32x20 mm as per IS- 6075	2 Nos.
154.	Cranked planning tool p2	carbide tipped, size 32x20 mm as per IS 6075	2 Nos.
155.	Broad planning tool p3	carbide tipped, size 32x20 mm as per IS-6075	2 Nos.
156.	Cranked finishing tool p4	carbide tipped size 32x20 mm as per IS-6075	2 Nos.
157.	Broad finishing tool p5	carbide tipped, size 32x20 mm as per IS-6075	2 Nos.
158.	Carbide corner cutting tool p6	carbide tipped, to size 32x20 mm as per IS-6075	2 Nos.
159.	Grooving tool p7	carbide tipped, size 32x20 as per IS-6075	2 Nos.
160.	Side way planning tool p8	carbide tipped, size 32x20 mm as per IS 6075	2 Nos.
161.	Boring tool (ISO 8) -	carbide tipped, size designation 2020 as per IS-2163	2 Nos.

162.	Involute gear cutters	2.5 mm module, 25mm bore dia. 20° pressure angle	1 set
163.	Concave Cutter	3.5mm Circle Radius x 63mm Cutter dia. x 16mm width x 27mm bore	2 Nos.
164.	Convex cutter	Convex Cutter 5mm radius,63 mm OD,10 width, 27mm bore dia.	2 Nos.
165.	Corner rounding cutter.	27 mm bore dia	2 Nos.
166.	Angle plate adjustable	(graduated in degrees) 150 mm x 150 mm x 150 mm	2 Nos.
167.	Sine vice	235L x 76W x 100H, opening 110 mm (C.D-200)	1 No.
168.	Sine table	250L x 150W x 65 H as per IS 5939-	1 No.
169.	First aid kit		1 No.
170.	Class room chairs with writing pad		As required
171.	Equipment for conducting BLS (Basic Life Support) training. (Optional)		1 set
172.	Lapping plate cast iron	300 mm diameter x 80 mm height with serrations (with lapping paste 320 mesh size 500 grams)	1 no.
173.	Silicon carbide dressing stick coarse		02 nos.
174.	Silicon carbide dressing stick fine		02 nos.
175.	Magnetic Sine table to size	250L x 150W x 105W x105H, inclination 0 to 45°	1 No.
176.	HSS tool bits (consumable)	150 mm long 6 to 12 mm dia. in steps of 1 mm	1 set
177.	Magnetic Vice	160 x 225 x 90, jaw holding area 150 x 75 mm	1 No.
178.	Industrial adhesive tape (consumable)		As required
179.	C-clamps	50 mm,100 mm and 150mm	2 each
180.	Compound sine table size	250L x 150W x 96H	1 No.
181.	Optical flat with monochromatic light		1 No.
182.	Surface roughness comparator		1 No.
183.	Dye penetrant testing kit		1 set
184.	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 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	1 each (for class room) 1 each (for sectional use) Total 02 sets of each.

		Mic. Licensed Windows Operating System / OEM Pack (Preloaded), Antivirus / Total Security	
185.	Laptop	Latest configuration	02
186.	Laser jet Printer, LCD Projector for class room application & sectional use for demonstration purpose.	Latest configuration	Two sets of each.
187.	UPS		As required
188.	First aid kit		1 No.
189.	Class room chairs with writing pad		As required
190.	Copper mallet	25 mm dia.	2 Nos.
191.	Radius Truing Attachment for surface grinding machine		1 No.
192.	Angle Truing Attachment for surface grinding machine		1 No.
193.	Diamond, Wheel Dressing (single stone mounted)		4 Nos.
C: GENERAL MACHINERY			
194.	Drilling Machine pillar type 0-25 mm capacity with drill chuck & key.	Spindle rpm -150 to 1200 Accessories: Drill vice 150 mm jaw opening	2 Nos.
195.	Lathe Machine (All geared) with auto feed system, motorized coolant system and lighting arrangement.	75 cm between centers x 180 cm centre height. self-centering chuck ,4 jaw independent chuck and set of lathe tools, lathe carriers, safety guard, etc. complete with taper turning attachment	3 Nos.
196.	Vertical Milling Machine	Universal milling head, swivel angle = 45 ° each side Table Length x width 1200 x 300 mm having motorized up & down movement along with auto feed arrangement in X-Y direction along with DRO facility. Accessories: Swivel base machine vice 150 mm jaw opening, Stub arbors 16 mm, 22 mm & 27 mm and C- type collet adaptor with set of collets for all standard size of end mills up to 30 mm dia.	2 Nos.
197.	Universal Milling machine	Table Length x width 1200 x 300 mm 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	02 Nos.

		f. Adaptors, arbors and collects etc. for holding straight shank drills and cutters from 3 mm to 25 mm.	
198.	Grinding machine hydraulic external cylindrical, universal type with internal grinding attachment fully motorized and standard accessories.	Centre height - 150mm Distance between centers- 800 mm Least in-feed - 0.0025 mm Accessories: Face plates and driving dog carriers,3 jaw self-centering chuck, 4-jaw independent chuck, tailstock, fixed steady, adjustable steady, wheel dressers for external and internal grinding wheels, straight carriers for holding different diameter shafts, coolant tank assembly with coolant filtration and circulation system, carbide tipped centers(half/full), wheel guards, front guard, (each machine supplied with assorted grinding wheels for general purpose work of internal and external grinding)	2 Nos.
199.	Additional accessories for Universal cylindrical grinding machines.	Testing mandrel, Extra wheel flange with balancing blocks, wheel balancing mandrel, wheel balancing stand, Micromatic shoulder grinding device for precise grinding of shoulders	1 each
200.	Surface grinding machine hydraulic, horizontal spindle reciprocating table manual and auto cross feed, adjustable traverse stop, auto reverse cross movement, power raise and fall of wheel head	Wheel speed - 2800 rpm Table size - 650 x 150 mm Fine down feed - 0.001 mm Accessories: wheel guards, coolant system with baffle tank and motor, magnetic chuck 300x150mm, wheel balancing mandrel, additional wheel flange with mandrel, wheel balancing stand, wheel truing device, spare grinding wheel for general purpose grinding standard accessories.	2 Nos.
201.	Surface grinding machine, single column vertical spindle, reciprocating table with standard accessories.	Table size 400x 200 mm Accessories: magnetic chuck 250x120mm, Wheel guard, coolant system with baffle tank and motor	1No.
202.	Tool and cutter grinding machine universal, tilting wheel head and power raise and fall of wheel head attachment, and standard accessories.	Distance between centre -760 mm, Accessories: Grinding flanges 50 mm & 75 mm, Wheel guards with long and short holders, Grinding wheel arbors with flanges,100 mm long x 75 mm flange dia., Universal work head with indexing mechanism suitable for 24 divisions, Sleeves Morse No. 5/4,5/3,5/2, and ISA - 50/40,collet holder with set of collets for holding end mill cutters, RH and LH tail stock with centre, Clearance angle setting device	2 Nos.

		with carriers, Centre height setting gauge, Universal tooth rest assembly with fixed tooth support and universal tooth support, Different shapes of tooth rest fingers, Wheel truing attachment , Clamping arbor for tools with ISA taper, Mandrel 16 mm dia., Mandrel 22 mm dia., Mandrel 27 mm dia. set of silicon carbide(green)grinding wheels, Universal vice, Lighting equipment, Inspection mandrel, Diamond dressing tool with holder, Assorted grinding wheels for all tool room work, and Standard hand tools	
203.	Additional accessories for Tool and cutter grinding machines	Gear milling cutter grinding attachment with bushes, Attachment for grinding carbide tipped cutting tools, Radius grinding attachment for grinding face mills and inserted tooth cutters of 200 mm dia. and radius grinding of flat tools	1 each
204.	Pedestal Grinder Double End type.	Grinder fitted with coarse and medium grain size grinding wheels. Wheel 300x40x50.8mm Wheel centre distance 650 mm approx. Power of motor 1HP.	2 Nos.
205.	Power Saw Machine Stroke length 160 mm	No of speed stroke 3 Range of speed stroke 80-100-125 Blade size 525x45x2.25 Power of motor 1.5 kw	1 No.
206.	Centreless grinding machine	Grinding dia. 1.5 to 63 mm, grinding length through feed without any attachment 200 mm, grinding length for infeed grinding 95 mm, grinding wheel size (OD X ID X WIDTH) 350 X 127 X 100 mm, grinding wheel speed 11,900 rpm for new wheel and 12 200 rpm for worn out wheel, regulating wheel size (OD X ID X WIDTH) 250 X 127 X 100 mm, regulating wheel speed 20 to 300 rpm, swivel range for regulating wheel for taper grinding + 4° - 2°, swivel range for regulating wheel for through feed grinding + 4° - 2°, Max. movement of regulating wheel head 0.003 mm, grinding wheel head power 7.4 KW, regulating wheel head power 0.75 KW with standard accessories	1 No.
207.	CNC Cylindrical grinder with minimum specification as:	Centre height -130 mm, distance between centre 300 to 500 mm, grinding length 200 to 300 mm, Swing diameter 200 to 250 mm, wheel surface speed 33 m/sec., table speed 10 m/min. Spindle power 3.7 kW (Continuous rating) with popular Control	1 No.

		system like - FANUC/SINUMERIC and with standard and essential accessories.	
208.	Small type hand honing machine with motors and brackets suitable	For honing 27 mm bore and different types of honing stones and accessories	1 No.
209.	Flat lapping machine	300 mm dia. bench model	1 No.
210.	Single lip cutter grinder with standard accessories	Cutter shank dia. -12 mm with std. Collet, Radius ground - 20 mm, Relief angle ground - 45 degree, cutter head std. - 12 index, grinding cup wheel size 100 dia. X 50 width x 20 thick mm, spindle speed 4500 rpm.	1 No.
211.	Personal computers, Internet with excellent strength facilities (For sectional use)	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 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	13 Nos.
212.	Laptop, Internet with excellent strength facilities. (For sectional use)	With latest configuration.	02 Nos.
213.	External Hard-disk for data storage (For sectional use)	1 tb	02 Nos.
214.	Table & Chair for computers (For sectional use)		27 Nos.
215.	Multimedia teach ware/ courseware for CNC technology and interactive CNC part programming software for turning, milling & grinding with virtual machine operation and simulation using popular operation control system such as Fanuc, Siemens, etc. (Web-based or licensed based) (25 trainess + 2 faculty)	Compatible to CNC cylindrical grinding machine	27 users.


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