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

COMPETENCY BASED CURRICULUM

OPERATOR ADVANCED MACHINE TOOL

(Duration: Two Years)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

SECTOR–CAPITAL GOODS AND MANUFACTURING

Directorate General of Training

OPERATOR ADVANCED MACHINE TOOL

(Engineering Trade)

(Revised in July2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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1. COURSE INFORMATION

During the two-year duration, a candidate is trained on subjects- Professional Skill, Professional Knowledge and Employability Skills related to job role. In addition to this, a candidate is entrusted to make/do project work and Extra Curricular Activities to build up confidence. The practical skills are imparted in simple to complex manner & simultaneously theory subject is taught in the same fashion to apply cognitive knowledge while executing task.

The content broadly covers manufacturing of different components by operating different conventional and CNC machines. The broad components covered under Professional Skill subject are as below:

FIRST YEAR: - In this year, the contents covered are from safety aspect related to the trade, basic fitting operations viz., making, filing, sawing, chiseling, drilling, tapping, grinding and sheet metal work. The practical also involves producing components by different turning and milling operations along with basic maintenance of machines. The practical training, it starts with operation of grinding machine and broad information on different special machines is provided. Followed by different advanced turning and milling machines operation with extensive coverage of different operations & manufacturing components viz., taper turning, eccentric turning, boring, screw thread, multi start thread, gang milling, splines & different gears. Further inspections of components using different instruments & gauges and testing geometrical accuracy of machines are conducted.

SECOND YEAR: -In this year,all aspect of CNC turning covered starting from machine operations, programming and producing components on actual machine. The CNC milling operation is covered in all aspect of CNC milling covered starting from machine operations, programming and producing components on actual machine. Finally, different basic maintenance of machines is carried out so that trainees get acquainted with a different machine maintenance required in day to day operation.

2. TRAINING SYSTEM

2.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under the aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer schemes of DGT for strengthening vocational training.

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

Candidates broadly need to demonstrate that they are able to:

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

2.2 PROGRESSION PATHWAYS:

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.

- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE:

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

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

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

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

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

2.4 ASSESSMENT & CERTIFICATION

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

a) The Continuous Assessment (Internal) during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain individual *trainee portfolio* as detailed in

assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in.

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

2.4.1 PASS REGULATION

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

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/wastage as per procedure, behavioral attitude, sensitivity to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.
Assessment will be evidence based, comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming semester examination for audit and verification by examination body. The

following marking pattern to be adopted for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b)Marks in the range of above75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A good level of neatness and consistency in the finish • Little support in completing the project/job
(c) Marks in the range of above 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

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

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

May be designated as **Operator Advanced Machine Tool** according to nature of work done.

Reference NCO-2015:

a) 7223.0500–Mechanist, General/Machinist
b) 7224.0100–Grinder, General

Reference NOS:

a) CSC/N0304
b) CSC/N0901
c) CSC/N0108
d) CSC/N0109
e) CSC/N0110
f) CSC/N0120
g) CSC/N9401
h) CSC/N9402

4. GENERAL INFORMATION

Name of the Trade	**OPERATOR ADVANCED MACHINE TOOL**
Trade Code	DGT/1075
NCO - 2015	7223.0500, 7224.0100
NOS Covered	CSC/N0304, CSC/N0901,CSC/N0108, CSC/N0109, CSC/N0110, CSC/N0120, CSC/N9401, CSC/N9402
NSQF Level	Level – 4
Duration of Craftsmen Training	Two years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session
Eligibility for PwD	LD, LC, DW, AA, LV, DEAF
Unit Strength (No. Of Students)	16 (There is no separate provision of supernumerary seats)
Space Norms	144 Sq. m
Power Norms	25 KW
Instructors Qualification for	
1. Operator Advanced Machine Tool Trade	B.Voc/Degree in Mechanical/ Production Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Mechanical/Production Engineering from AICTE recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/NAC passed in the Trade of "Operator Advanced Machine Tool" With three years' experience in the relevant field. **Essential Qualification:** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) in any of the variants under DGT. ***Note: Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC***

	qualifications. However, both of them must possess NCIC in any of its variants.
2. Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants of NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
4. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two

	years' experience withshort term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
5. Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

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

5.1 LEARNING OUTCOMES

FIRST YEAR

1. Plan and organize the work to make job as per specification applying different types of basic fitting operation and check for dimensional accuracyfollowing safety precautions. [Basic fitting operation – marking, Hack sawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm] *NOS:*CSC/N0304
2. Plan & perform simple repair, maintenance of different machines and check for functionality. [Different Machines – Drill Machine, Power Saw and Bench Grinder] *NOS:*CSC/N0901
3. Prepare different cutting tool to produce jobs to appropriate accuracy by performing different turning operations. [Different cutting tool – V tool, side cutting, parting, thread cutting (both LH & RH), Appropriate accuracy: - ±0.06mm, Different turning operation – Plain, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U -cut, Reaming, knurling.] *NOS:*CSC/N0110
4. Set the different machining parameters and cutters to prepare job by performing different milling operation and indexing. [Different machining parameters – feed, speed and depth of cut. Different milling operations – plain, face, angular, form, gang, straddle milling] *NOS:*CSC/N0108
5. Produce components of high accuracy by different operations using grinding. [Different operations – surface grinding, cylindrical grinding with an accuracy of ± 0.01 mm] *NOS:*CSC/N0109
6. Set different components of machine & parameters to produce taper/ angular components and ensure proper assembly of the components. [Different component of machine: Form tool, Compound slide, tail stock offset; Different machine parameters- Feed, speed, depth of cut.] *NOS:*CSC/N0110
7. Set the different machining parameters to produce screw & multi start threaded components applying method/ technique and test for proper assembly of the components. *NOS:*CSC/N0110
8. Set the different machining parameters and cutters to prepare components by performing different milling operation and indexing. [Different machining parameters – feed, speed and depth of cut. Different components – Rack, Spur Gear, External Spline, bevel gear, Helical Gear, worm & work wheel.] *NOS:*CSC/N0108

9. Measure components using different instrument/ gauge and test machine tool accuracy. [Different instrument/ gauges- limit gauges, Sine Bar, snip gauges, tool maker's microscope and profile projector; Simple Machines – Drill Machine, Power Saw and Lathe] *NOS:*CSC/N0110
10. Read and apply engineering drawing for different application in the field of work. *NOS:*CSC/N9401
11. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. *NOS:*CSC/N9402

SECOND YEAR

12. Set (both job and tool) CNC turning centre and produce components as per drawing by preparing part programme. *NOS:*CSC/N0120
13. Set (both job and tool) CNC machining centre and produce components as per drawing by preparing part programme. *NOS:*CSC/N0120
14. Plan and perform simple repair and maintenance of different machines and check for functionality. [Different Machines – Drilling Machine, milling machine and Lathe] *NOS:*CSC/N0110
15. Read and apply engineering drawing for different application in the field of work. *NOS:*CSC/N9401
16. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. *NOS:* CSC/N9402

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Plan and organize the work to make job as per specification applying different types of basic fitting operation and check for dimensional accuracy following safety precautions. [Basic fitting operation – marking, Hack sawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm] *NOS:*CSC/N0304	Plan & identify tools, instruments and equipments for marking and make this available for use in a timely manner.
	Select raw material and visual inspection for defects.
	Mark as per specification applying desired mathematical calculation and observing standard procedure.
	Measure all dimensions in accordance with standard specifications and tolerances.
	Identify hand tools for different fitting operations and make these available for use in a timely manner.
	Prepare the job for Hacksawing, chiselling, filing, drilling, tapping, grinding.
	Perform basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job.
	Observe safety procedure during above operation as per standard norms and company guidelines.
	Check for dimensional accuracy as per standard procedure.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
2. Plan &perform simple repair, maintenance of different machines and check for functionality. *[Different Machines – Drill Machine, Power Saw and Bench Grinder] NOS:*CSC/N0901	Ascertain and select tools and materials for the repair, maintenanceand make this available for use in a timely manner.
	Plan work in compliance with standard safety norms.
	Demonstrate possible solutions and agree tasks within the team.
	Select specific parts to be repaired and ascertain for appropriate material and estimated time.
	Repair and assemble the parts in the machine with the help of blue print.
	Check for functionality of part and ascertain faults of the part/ machine in case of improper function.

	Rectify faults of assembly.
3. Prepare different cutting tool to produce jobs to appropriate accuracy by performing different turning operations. *[Different cutting tool – V tool, side cutting, parting, thread cutting (both LH & RH), Appropriate accuracy: - ±0.06mm, Different turning operation – Plain, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U -cut, Reaming, knurling.] NOS:*CSC/N0110)	Identify cutting tool materials used on lathe machine as per the specification and their application.
	Plan and grind cutting tools.
	Measure the tool angles with gauge and Bevel protractor as per tool signature.
	Mount the job and set machine parameter.
	Perform turning operations viz., *facing, Parallel Turning, Step Turning, chamfering, grooving, U-cut, parting, drilling, boring (counter & stepped), Reaming, internal recess and knurling to make component as per specification.*
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
4. Set the different machining parameters and cutters to prepare job by performing different milling operation and indexing. [Different machining parameters – feed, speed and depth of cut. Different milling operations – plain, face, angular, form, gang, straddle milling] *NOS:* CSC/N0108	Identify different work and tool holding devices and acquaint with functional application of each device.
	Mount the work and tool holding devices with required alignment and check for its functional usage to perform milling operations.
	Observe safety procedure during mounting as per standard norms.
	Solve problem by applying desired mathematical skill, basic methods, tools, materials and collect and organize information during setting.
5. Produce components of high accuracy by different operations using grinding. [*Different operations – surface grinding, cylindrical grinding with an accuracy*	Plan and select appropriate method to produce the work piece as per drawing.
	Select appropriate tools, equipment and machine to produce the work piece as per drawing and make these available for use in a timely manner.
	Grind the cutting tool following standard operating practice.

of+/- 0.01 mm] *NOS:*CSC/N0109	Set the job on grinding machine and grind the surfaces as per specification/drawing (parallel and stepped) following standard operating practice.
	Check the dimension of parallel and stepped job by precession instrument. (micrometer).
	Observe safety precautions during operation ofmachine.
	Check for desired performance.
6. Set different components of machine & parameters to produce taper/ angular components and ensure proper assembly of the components. *[Different component of machine: Form tool, Compound slide, tail stock offset; Different machine parameters- Feed, speed, depth of cut.]* *NOS:*CSC/N0110	Plan and select appropriate method to produce taper/ angular components.
	Evaluate angles to set up the tool and machine component for machining.
	Demonstrate possible solutions and agree tasks within the team.
	Produce taper/ angular components as per standard operating procedure.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement.
	Assemble the components to ascertain functionality.
7. Set the different machining parameters to produce screw & multi start threaded components applying method/ technique and test for proper assembly of the components. *NOS:*CSC/N0110	Plan and select appropriate method to produce threaded components.
	Plan and prepare thread cutting tool in compliance with standard thread parameters.
	Produce components as per drawing.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement and suit to male/female part.
	Test the proper assembly of the threaded components.
8. Set the different machining parameters and cutters to prepare components by performing different milling operation and indexing. *[Different machining*	Select cutter as per specification of gear and plan to make spur gear, helical,rack& pinion, bevel gear, worm & worm wheel as per drawing.
	Comply with safety rules when performing the above operations.
	Work out and apply indexing parameters as per different

*parameters – feed, speed and depth of cut. Different components – Rack, Spur Gear, External Spline, bevel gear, Helical Gear, worm & worm wheel] NOS:*CSC/N0108	components to be produced to determine gear setting and set indexing head, milling machine.
	Demonstrate possible solutions within the team using desired mathematical skills, knowledge of facts, principles, processes and general concept in the field of work to set the indexing head.
	Solve problems during operation by selecting and applying basic methods, tools, materials and collect and organize information for quality output.
	Set job and produce component following the standard operating procedure.
	Make components observing standard operating procedure.
	Measure with instruments/gauges as per drawing and check functionality of gear.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
9. Measure components using different instrument/ gauge and test machine tool accuracy. *[Different instrument/ gauges-* limit gauges, Sine Bar, snip gauges, tool maker's microscope and profile projector; *Simple Machines – Drill Machine, Power Saw and Lathe] NOS:*CSC/N0110	Ascertain measuring and testing procedure as per manual of machine and select appropriate tools & equipment for undertaking job.
	Set up workplace/ assembly location with due consideration to operational stipulation
	Plan to carry out the measuring components and testing of simple machine by collecting necessary information.
	Demonstrate possible solutions and agree tasks within the team.
	Put the machine in operation complying Standard operating procedure.
	Check alignment of machine and other parameters of simple machine as per manual.
10. Read and apply engineering drawing for different application in the field of work. (NOS:CSC/N9401)	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information

	and make own calculations to fill in missing dimension/parameters to carry out the work.
11. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:CSC/N9402)	Solve different mathematical problems
	Explain concept of basic science related to the field of study
SECOND YEAR	
12. Set (both job and tool) CNC turning centre and produce components as per drawing by preparing part programme. *NOS:*CSC/N0120	Plan and prepare part programme as per drawing, simulate for its correctness with appropriate software.
	Prepare tooling layout and select tools as required.
	Demonstrate possible solution within the team.
	Set selected tools on to the machine.
	Test/Dry run the part programme on the machine.
	Set up the job and machine the component as per standard operating procedure involving parallel, step, taper, drilling, boring, radius, grooving and threading operations, etc.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
	Observe safety/ precaution during machining.
	Avoid wastage, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
13. Set (both job and tool) CNC machining centre and produce components as per drawing by preparing part programme. *NOS:*CSC/N0120	Plan and prepare part programme as per drawing applying range of cognitive and practical skills, simulate for its correctness with simulation software.
	Demonstrate possible solutions within the team.
	Prepare tooling layout and select tools as required.
	Set selected tools on to the machine.
	Test/Dry run the part programme on the machine.
	Set up the job and produce the component as per standard operating procedure involving face milling, contour milling with tool radius compensation, pocket milling, drilling, peck drilling,

	countersinking, tapping operations using canned cycle for hole operations.
	Solve problems during operation by selecting and applying basic methods, tools, materials and information and using quality concept.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
	Observe safety/ precaution during machining.
14. Plan and perform simple repair and maintenance of different machines and check for functionality. *[Different Machines – Drilling Machine, milling machine and Lathe] NOS:*CSC/N0110	Ascertain and select tools and materials for the repair and maintenance and make this available for use in a timely manner.
	Plan work in compliance with standard safety norms.
	Demonstrate possible solutions and agree tasks within the team.
	Select specific parts to be repaired and ascertain for appropriate material and estimated time.
	Repair and carry out maintenance of the machine with the help of blue print.
	Check for functionality of part and ascertain faults of the part/ machine in case of improper function.
15. Read and apply engineering drawing for different application in the field of work. (NOS:CSC/N9401)	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
17. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:CSC/N9402)	Solve different mathematical problems
	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS- OPERATOR ADVANCED MACHINE TOOL			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 260 Hrs; Professional Knowledge 50Hrs	Plan and organize the work to make job as per specification applying different types of basic fitting operation and check for dimensional accuracy following safety precautions. [Basic fitting operation – marking, Hack sawing, Chiseling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm] (Mapped NOS:CSC/N0304)	1. Importance of trade training, List of tools & Machinery used in the trade. (2 hrs.) 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). (2 hrs.) 3. First Aid Method and basic training. (2 hrs.) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (1 hr.) 5. Hazard identification and avoidance. (1 hr.) 6. Identification of safety signs for Danger, Warning, caution & personal safety message. (1 hr.) 7. Preventive measures for electrical accidents & steps to be taken in such accidents. (1 hr.) 8. Use of fire extinguishers. (2 hrs.)	All necessary guidance to be provided to the newcomers to become familiar with the working of Industrial Training Institute system including store's procedures. Soft skills, its importance and job area after completion of training. Importance of safety and general precautions observed in the industry/shop floor. Introduction of first aid. Operation of electrical mains and electrical safety. Introduction of PPEs. Response to emergencies e.g. power failure, fire, and system failure. Importance of housekeeping & good shop floor practices. Introduction to 5S concept & its application. Occupational Safety & Health: Health, Safety and Environment guidelines, legislations & regulations as applicable. Basic understanding on Hot work, confined space work and material handling equipment. (05 hrs)
		Basic Fitting	**Basic Fitting**

		9. Preparation of filing. (2 hrs.) 10. Marking lines on the job surface for filing to the marked lines. (4 hrs.) 11. Gripping the job suitably in the vice jaw for filing (4 hrs.) 12. Balancing of file, using rough file. (4 hrs.) 13. Measurement by using inside/ outside calipers and scale. (4 hrs.)	Vice - purpose, types, description, size, construction method to use and maintenance. File - purpose, types, description, size and method to use. Use of file card, printing of file, convexity of file and proper filing technique. Rule - purpose, types, description and method to use. (05 hrs.)
		14. Use of simple measuring instruments such as steel rule, Vernier caliper, Inside/Outside Micrometer. (4 hrs.) 15. Care and precaution to be observed in handling these instruments. (1 hr.) 16. Exercises on measurement of various geometrical shapes. (8 hrs.) 17. Exercise on marking out according to simple blue prints, using steel rule, scriber, marking blocks & divider. (4 hrs.) 18. Scribing lines on chalked or coloured (blue) surfaces of the work piece. (2 hrs.) 19. Marking location of the position of holes & scribing circles using dividers. (2 hrs.) 20. Use of Dot and Center Punch for punching the lines, centers and circles. (3 hrs.) 21. Demo on filing operation, using rough file. (3 hrs.) 22. Exercise of filing flanges of a channel for balancing of file.	Divider - purpose, types, description and method to use. Scriber - purpose, types, description and method to use. Marking Block - purpose, types, description and method to use. Punch - purpose, types, description and method to use. Micrometer - purpose, types, construction, calculation of least count, method to use and read, care and maintenance. Vernier Caliper - purpose, construction, calculation of vernier constant, method to use & read, care and maintenance. (5 hrs.)

		(4 hrs.) 23. Filing flat surface and flange of a channel maintaining parallelism between them using outside caliper within + or - 0.5mm. (9 hrs.)	
		24. Exercises on filing to develop control and Field layout the dimensional features of the work piece using vernier height gauge, engineering square, angle plate and surface plate. (5 hrs.) 25. Exercise on filing the adjoining sides Squareness with respect to one reference surface. Filing faces for maintaining flatness, squareness of adjacent side using try- square, parallelism between opposite sides and reducing thickness. (6 hrs.) 26. Filing with second cut file to prepare smooth surfaces. (4 hrs.) 27. Exercise on filing for maintaining dimensions within + or -0.1mm using vernier caliper. (8 hrs.)	Vernier height gauge - purpose, types, Construction, method to use and read, care and maintenance. Engineer's square - purpose, description and method to use. Surface Plate - purpose, description, method to use, care and maintenance. Angle Plate - purpose, description and method to use. (04 hrs.)
		28. Marking of profiles - combination of straight lines, circles, arcs and angles using scale, divider height gauge, protractor, combination set etc. (3 hrs.) 29. Marking geometrical profiles on sheet metal and filing to mark lines. (3 hrs.) 30. Sharpening of marking tools,	Combination set - purpose, description and method to use. Vernier bevel protractor - purpose, description, calculation of vernier constant, method to read and use, care and maintenance. Bench Grinder - purpose, description, procedure and precautions to be observed during grinding of marking tools, chisels and drill bits.

		use of bench grinder for sharpening of scriber, centre punch, dot punch, divider etc. (1 hr.) 31. Marking on the job piece for saw cuts. (1 hr.) 32. Gripping the job suitably in the vice jaws for hack sawing to dimensions. (1 hr.) 33. Hack sawing various metallic pieces (mild steel, aluminum, copper, brass, stainless steel etc.) of different thickness and cross sections, within + or - 0.5mm using hack saw blades of different pitches. (5 hrs.) 34. Hack sawing different lengths with hack saw frame in horizontal & vertical positions Sawing along the parallel marked lines within 0.5mm allowance for filing. (5 hrs.) 35. Hack sawing and filing steps and slots and open fitting of finished pieces. (4 hrs.)	Hack saw - purpose, types, description, method to use and precautions to be taken during hack sawing. Hack saw blade - purpose, types, description, select ON/OFFappropriate grade, fixing of blade and precautions to be observed. (04 hrs.)
		36. Hammering practice on vertical hold round job. (5 hrs.) 37. Blind hammering practice. Stamping letters and numbers on M.S. plates. (5 hrs.) 38. Exercise on stamping to develop judgment, control on hand and feel. (3 hrs.) 39. Stamping practice on flat and round surfaces using flat, cross cut and round nose chisels for chipping edges and square to the faces and edges.	Hammer - purpose, types, description, method to use and precautions to be observed. Bending of solid selections using fixtures. Letters and Numbers - purpose, description, method to use and precautions to be observed. Hollow Punch - purpose, description, method to use for preparations of gaskets and other packing materials. Pipe Fitting -material and types of pipes used in the

		(8 hrs.) 40. Checking with Try- square, use of cross peen hammer for stretching of metal strip. (4 hrs.)	trade. Method to cut, to thread and preparation of pipes for 'T' fitting elbow fitting, reducers etc. using unions. Method to fill ferrule. (04 hrs.)
		41. Preparation for drilling, marking out the position of holes and dot punching. (2 hrs.) 42. Deepening the points with centre punch. (2 hrs.) 43. Checking for centre distance. (1 hr.) 44. Drilling practice on sensitive drilling machine using different types of drills and drill holding devices. (6 hrs.) 45. Safety to be observed while working on drilling machine. (1 hr.) 46. Marking, chain drilling and filing to produce square, round and triangular openings on 6mm thick plate. (6 hrs.) 47. Preparing inserts and fitting in these openings.(2 hrs.) 48. Drilling practice on varying thickness and different materials such as M.S., C.I., S.S., Cu, Brass, Nylon, Epoxy etc. (6 hrs.) 49. Drilling on sheet metal, precautions and safety to be observed. (3 hrs.) 50. Counter Sinking, counter boring, and spot facing operations using bench drilling machine. (3 hrs.) 51. Exercise on reaming with hand	Drills - purpose, types, description, drill holding devices, method to use a drill with or without drill chuck (or collet) and precaution to be observed. Reamer -purpose, types, description, method to use, reaming allowance, coolant used and precautions to be observed during reaming. Drilling Machine with manual infeed, its purpose, types, description, drilling fixtures, method to drill and precautions to be observed during drilling. Procedure to be followed for counter sinking, counter boring, spot facing and reaming using bench drilling machine. Screw Threads - elements and forms screw threads single and multi-start thread, right and left hand thread. Taps and Tapping - purpose, types, description, precaution to be observed and method to use hand and machine taps during tapping. Types of coolant to be used. Calculation to drill size for tapping. Method to tap a blind hole, reasons for breakage of tap and method to remove broken tap. Construction and method to use tap wrench. Die and dieing purpose, types,

		reamers and machine reamers. (2 hrs.) 52. Internal threading by hand using tap sets. (2 hrs.) 53. External threading by split die and finishing of thread by die nut. (2 hrs.) 54. Marking centre of a round bar with the help of 'V' block and clamp. (1 hr.) 55. Drilling and reaming of blind holes along the axis of round jobs. (3 hrs.) 56. Grinding of drills to specifications and checking of angles with gauges. (4 hrs.) 57. Grinding of chisels. (1 hr.)	description and method to use and precaution to be observed. Description of die stock, procedure and precautions to be observed during dieing. (8 hrs.)
		58. Measurement of shaft and hole diameters using outside and inside micrometer. (2 hrs.) 59. Filing round out of square bar within ± 0.1mm. Filing to an accuracy of ±0.1 mm., checking with an outside micrometer. (6 hrs.) 60. Preparation of plates for a gauge fitting. (3 hrs.) 61. Exercise on filing radius and angular filing using templates and gauges. (5 hrs.) 62. Filing templates and gauges for checking lathe tool angles. (5 hrs.) 63. Exercise on step and taper turning. (4 hrs.)	Defining and explanation of the elements of interchangeable system basis size, limits, tolerance, allowances. System of limits, fit and tolerances types of fit. Hole basis and shaft basis. Newal, British, I.S.I./B.S.I. systems, examples of fixing limit for various types of fit commonly met within the machine. (04 hrs.)
		64. Filing of various angle & clearances o f lathe tool on square blanks. (6 hrs.)	Gauges & Template-purpose, types, description and method to use dial test indicator. Limit gauges

		65. Checking with templates & gauge already prepared. (2 hrs.) 66. Use of combination & round nose pliers to make different shapes/profiles by bending wire to match the blue print to develop manipulative skills, hand control & eye judgment. (5hrs.) 67. Cold riveting. (3 hrs.) 68. Marking out location of holes for riveting. (2 hrs.) 69. Use of dolly and snap for forming rivet heads. (3 hrs.) 70. Lap and butt joint by cold riveting. (4 hrs.)	- purpose, types, construction and method to use limit gauges. (07 hrs.)
		71. Cutting of sheet metal with chisel. Marking parallel clamp, 'C' clamp or micrometer stand using acquired skills. (8 hrs.) 72. Simple project work. (14 hrs.)	Sheet metal work-purpose, types, description and method to use snip & stake. Description and method to use hand shear. Rivets & riveting-types & description of rivets. Method of lap & butt joint using dolly and snap. Cold & hot working of strips & pipes-method of bending solid sections, using fixtures for different physical conditions. Use of cutters for pipes & method to bend in hot and cold condition using fixtures. (04 hrs.)
Professional Skill 25 Hrs; Professional Knowledge 05Hrs	Plan & perform simple repair, maintenance of different machines and check for functionality. *[Different Machines – Drill Machine, Power Saw and*	**BASIC MAINTENANCE SKILLS** 73. Using hand tools such as screw driver, single end/double end spanners, box nut spanners, ratchet spanners, circlip, pliers, wrenches, pullers, extractors, drift. (6 hrs.) 74. Correct method to be used and care to be taken in using those	**BASIC MAINTENANCE SKILLS** Screw drivers - purpose, types, description and method to use screw drivers. Spanners- purpose, types, description and method to use box, socket, tubular, hook spanner etc. Wrenches - purpose, types, description and method to use T-socket, monkey, ratchet,

	Bench Grinder] (Mapped NOS: *NOS:*CSC/N0901)	tools. (9 hrs.) 75. Lubrication of different parts of machines. (4 hrs.) 76. Care and maintenance of machines. (6 hrs.)	pipe wrenches etc. Purpose, description, precautions to be observed and method to use drift, pullers and extractors. (05 hrs.)
Professional Skill 80Hrs; Professional Knowledge 15Hrs	Prepare different cutting tool to produce jobs to appropriate accuracy by performing different turning operations. *[Different cutting tool – V tool, side cutting, parting, thread cutting (both LH & RH), Appropriate accuracy: - ±0.06mm, Different turning operation – Plain, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U -cut, Reaming, knurling.]* (Mapped NOS: *NOS:*CSC/N0110)	**BASIC TURNING** 77. Safety precautions to be observed while handling machines. (3 hrs.) 78. Demonstration of change gear in the gearbox. (4 hrs.) 79. Practice of holding work piece and tool using different devices. (6 hrs.) 80. Exercises on plain, stepped, taper and form turning, knurling etc. (16 hrs.) 81. Exercises on drilling, reaming, boring, counter boring etc. (15 hrs.) 82. Screw thread cutting both internal and external of different types. (10 hrs.) 83. Exercise on eccentric turning. (6 hrs.) 84. Grinding of lathe tools. (2 hrs.) 85. Simple projects such as hollow punch, pulleys, gear blanks, simple coupling etc. (18 hrs.)	**TURNING** Types, construction features working principles, functions, use accessories and attachments of lathe machine. Driving mechanism – cone pulley, all geared headstock, quick-change gearbox and apron mechanism. Types, materials and angles of the lathe cutting tools. Purpose and method to perform various lathe operations. Using accessories and attachments. Determination and use of cutting speed, feed. Coolant and its applications. Lubrication system. (15 hrs.)
Professional Skill 80Hrs; Professional Knowledge 15Hrs	Set the different machining parameters and cutters to prepare job by performing different milling operation and	**BASIC MILLING** 86. Safety precautions in handling machine. (5 hrs.) 87. Demonstration of various parts of the milling machines. (10 hrs.) 88. Practice on different work and	**MILLING :** Construction features, working principles, types, functions. Use of accessories and attachment of milling machine. Types of milling cutters. Different method of holding work

	indexing. [Different machining parameters – feed, speed and depth of cut. Different milling operations – plain, face, angular, form, gang, straddle milling] (Mapped NOS: CSC/N0108)	tool holding devices. (15 hrs.) 89. Exercises on: (30 hrs.) i) Parallel and angular milling. ii) Grooving using mills. iii) Milling square/hexagon using indexing head. iv) Use of slotting attachment for cutting key ways. v) Simple projects such as jaw, claw, 90. Oldham coupling, spline cutting etc. (10 hrs.) 91. Lubrication of different parts. Care &maintenance of machine. (10 hrs.)	piece and cutters. Milling operations such as plain, step, angular milling, slot and groove cutting. Gear nomenclature -definitions, symbols, explanation and gear cutting calculations. Explanation of cutting speed, feed and depth of cut. C oolant for different materials. Common fault, defects and their rectification. (15 hrs.)
Professional Skill 125Hrs; Professional Knowledge 28Hrs	Produce components of high accuracy by different operations using grinding. [*Different operations – surface grinding, cylindrical grinding with an accuracy of ±0.01 mm*] (Mapped NOS: CSC/N0109)	**GRINDING** 92. Safety precautions to be observed while using machine. (7hrs.) 93. Demonstration of various parts of the grinding machines. (13 hrs.) 94. Use of drive - both mechanical and hydraulic. (8 hrs.) 95. Grinding wheel specifications, mounting, balancing, truing and dressing of grinding wheels. (18 hrs.) 96. Lubrication of different parts and care & maintenance of grinding machine. (18 hrs.) 97. Practice on different work holding devices and grinding various jobs.(36 hrs.) 98. **Other machining process:** (25 hrs.)	Types of machines- Constructional features, working principle, types, functions and use of surface and cylindrical grinding machine. Grinding wheels and their specifications - grit, grain, size, structure, bond, grades etc. Procedure to use grinding wheels for balancing and truing. Method to hold work and grind wheel. Method to perform various grinding operation selecting proper speed, Feed. Importance of coolant. Method to detect common faults, their rectification and preventive maintenance of grinding machine. Study of hydraulic system used on the machine. (28 hrs.)

		✓ Shaping ✓ Planning ✓ Slotting ✓ Hobbing ✓ Broaching ✓ Finish machining process like • Types • Coated Abrasives (Sandpaper, Emory Cloth) • Belt Grinders • Solid Belt • Mesh Belt (Hold Grinding Fluid via Surface Tension • Wire Brushing • Wire Provides Metal Cutting/Burnishing Action • Wire (Metal) Acts as Abrasive • Honing (Interior of Holes) • Lapping (Flat Surfaces) • Polishing • Buffing • Electro-Polishing • Magnetic Float Polishing (Ceramic Ball Bearings) • Barrel Finishing • Abrasive Flow	
Professional Skill 60Hrs; Professional Knowledge 10Hrs	Set different components of machine & parameters to produce taper/ angular components and ensure proper assembly of the components. *[Different component of*	**ADVANCED MACHINING SKILLS TURNING** 99. Taper turning by using taper attachment. (10 hrs.) 100. Taper turning by using a form tool. (10 hrs.) 101. Internal and external taper turning and matching to mating parts. (10 hrs.) 102. Eccentric turning practice. (15 hrs.)	**ADVANCED MACHINING SKILLS TURNING** Taper turning attachment and form tool. Care to be taken for boring, step boring and taper boring in a blind hole. . Procedure and care to be taken eccentric turning. (10 hrs.)

	machine: Form tool, Compound slide, tail stock offset; Different machine parameters- Feed, speed, depth of cut.] (Mapped NOS: CSC/N0110)	103. Boring and stepped boring, position boring. (15 hrs.)	
Professional Skill 40 Hrs; Professional Knowledge 8Hrs	Set the different machining parameters to produce screw & multi start threaded components applying method/ technique and test for proper assembly of the components. (Mapped NOS: CSC/N0110)	104. Various Screw threads cutting to suit male and female threaded components. (25 hrs.) 105. Multi start threads cutting-2start. (15 hrs.)	Procedure for cutting various internal and external screw threads. Care to be taken during internal threading in a blind hole. (8 hrs.)
Professional Skill 130Hrs; Professional Knowledge 25Hrs	Set the different machining parameters and cutters to prepare components by performing different milling operation and indexing. *[Different machining parameters – feed, speed and depth of cut. Different components – Rack, Spur Gear, External Spline, bevel gear, Helical Gear, worm & work wheel.]* (Mapped NOS:	**MILLING** 106. Gang milling - milling jobs of different shapes and dimensions by using gang-milling process. (15 hrs.) 107. Milling hexagonal holes on a plate by attachment. Milling splines (external). (15 hrs.) 108. Milling gears by both simple and differential indexing (15hrs.) 109. Helical milling - milling helical groove on vertical milling machine by end mill cutter. (15 hrs.) 110. Milling helical gears. (15 hrs.) 111. Milling bevel gears. (15 hrs.) 112. Milling a rack. (15 hrs.)	**MILLING** Different types of milling operations. Indexing methods and its applications. Different types of gear & its application. Different cutters used in gear cutting operations and cutter nomenclature. Procedures for milling helical groove by a slab mill cutter on vertical milling machine. Care and precautions to be taken during milling. Procedure for milling helical gears, bevel gears, rack, worm and worm wheel. (25 hrs.)

	CSC/N0108)	113. Cutting worm and worm wheel on a milling. (25 hrs.)	
Professional Skill 40Hrs; Professional Knowledge 8Hrs	Measure components using different instrument/ gauge and test machine tool accuracy. *[Different instrument/ gauges*- limit gauges, Sine Bar, snip gauges, tool maker's microscope and profile projector; *Simple Machines – Drill Machine, Power Saw and Lathe]* (Mapped NOS: CSC/N0110)	**INSPECTION** 114. Familiarization with inspection and master gauge checking of finished product with limit gauges for their accuracy and usability. (2 hrs.) 115. Use of Sine Bar, snip gauges along with standard balls and rollers for measurement of taper. (5 hrs.) 116. Measuring with tool maker's microscope. (3 hrs.) 117. Testing of gears for its measurements and accuracy. (5 hrs.) 118. Use of digital profile projector. (5 hrs.)	**INSPECTION** Definition, description and use of worker's inspection and master gauge. Principle, construction and use of sine bar and sine center. Types and description of slip gauges, purpose, construction and method to use tool makers. Microscope and profile projector. (04 hrs.)
		119. Geometrical accuracy test of machine as per test chart. (20 hrs.)	Defects and remedies of turning, milling and grinding. Defects such as: Taper, Chattering, Poor Surface finish, Parallelism. (04 hrs.)
ENGINEERING DRAWING: (40 Hrs.)			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work. (NOS:CSC/N9401)	Introduction to Engineering Drawing and Drawing Instruments – • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Lines- Types and applications in drawing Free hand drawing of – • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches. • Free hand drawing of hand tools and measuring tools. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram.	

		• Lettering & Numbering – Single Stroke. Dimensioning • Types of arrowhead • Leader line with text • Position of dimensioning (Unidirectional, Aligned) Symbolic representation – • Different symbols used in the related trades. Concept and reading of Drawing in • Concept of axes plane and quadrant • Concept of Orthographic and Isometric projections • Method of first angle and third angle projections (definition and difference) Reading of Job drawing of related trades.
WORKSHOP CALCULATION & SCIENCE: (36 Hrs)		
WCS- 36 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:CSC/N9402)	**Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, subtraction, multiplication & division Decimal fractions - Addition, subtraction, multiplication& division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and square root Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Percentage Percentage - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non ferrous metals Physical and mechanical properties of metals Introduction of iron and cast iron Difference between iron & steel, alloy steel Properties and uses of insulating materials **Mass, Weight, Volume and Density** Mass, volume, density, weight and specific gravity Numerical related to L,C, O sections

		Speed and Velocity, Work, Power and Energy Work, power, energy, HP, IHP, BHP and efficiency **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Concept of pressure - Units of pressure **Basic Electricity** Introduction and uses of electricity **Mensuration** Area and perimeter of square, rectangle and parallelogram Area and perimeter of Triangles Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder Finding the lateral surface area, total surface area and capacity in litres of hexagonal, conical and cylindrical shaped vessels **Levers and Simple machines** Lever & Simple machines - Lever and its types **Trigonometry** Measurement of angles Trigonometrical ratios Trigonometrical tables
In-plant training/ Project work (indicative) a) Drill extension socket b) V-belt pulley c) Tail Stock Centre (MT – 3) d) Taper ring gauge e) Taper plug gauge. (Morse taper – 3) f) Pedestal bearing g) Crank shaft h) Arbor with clamping nut i) Threaded mandrel j) Quick change tool post		

SYLLABUS- OPERATOR ADVANCED MACHINE TOOL			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 400Hrs.; Professional Knowledge 100 Hrs.	Set (both job and tool) CNC turning centre and produce components as per drawing by preparing part programme. (Mapped NOS: CSC/N0120)	**CNC FUNDAMENTALS** 120. Familiarization of computer as CNC works station. (5 hrs.) 121. Communication between CNC and computer i.e. series, parallel port. (20 hrs.)	**CNC FUNDAMENTALS** Background application, block diagram, input devices, output devices, CPU. Memory, U se of computer as CNC workstation. Communication between CNC and computer. Introduction to CNC machine, Types, construction, Different elements of CNC machine, Comparison between conventional machines & CNC machines, Advantages & Disadvantages of CNC machines. Axis designation. (10 hrs.)
		122. Demo / Identification of different elements of CNC machine. (25 hrs.) 123. Construction & functions, Axis designation. (40 hrs.)	Familiarization with co-ordinate system. Types of co-ordinate system and their applications. Different types/functions of G codes & M codes used in CNC part programming. Different types of interpolation & its applications. (15 hrs.)
		124. Practice on exercises with different coordinate systems with linear & circular interpolation. (80 hrs.)	Cutter Radius comp Tool wear comp Tool nose radius comp Tool nomenclature, tool changecommand, work & tool offset. (20 hrs.)
		125. Writing the part program for both turning & milling manually and practice on simulation software. (60 hrs.)	Introduction to part programming for both turning & milling using geometrical information & technological information (G & M

		126. Selection of tools Practice of work & tool offset on simulator. (80 hrs.)	codes) such as feed, speed, depth of cut. (40 hrs.)
		CNC TURNING 127. Operating the CNC machine in different modes such as JOG, MPG, MDI/MDA. (20 hrs.) 128. Procedure for reaching reference point. (10 hrs.) 129. Practice on Work & Tool offset measurement. (20 hrs.) 130. Program loading and machine setting. (20 hrs.) 131. Executing the program in auto Single Block and auto continuous mode. (20 hrs.)	**CNC TURNING** Modes of operation such as JOG, MPG, REF, MDI/MDA. Program execution in different modes like auto SBL and auto cont. mode. Knowledge on CNC cutting tools-Geometry, material, cutting speed, feed, and depth of cut. Techniques of tool off-setting and tool setting. Prepare various programs as per drawing. (15 hrs.)
Professional Skill 420Hrs.; Professional Knowledge 120Hrs.	Set (both job and tool) CNC machining centre and produce components as per drawing by preparing part programme. (Mapped NOS: CSC/N0120)	132. Practice of contour program for different profiles on CNC simulation software. (100 hrs.)	Concept of contour programming for different profiles. (25 hrs.)
		133. Practice on CNC lathe. (35 hrs.) 134. TURNING - parallel, taper, step, radius, groove and threads of different pitches. (35 hrs.)	Program for different cycles such as stock removal, Grooving, Threading, Undercut & canned/ fixed cycles Tool type chart, TNRC(G41 and G42). Surface finish-Primary and Secondary. Surface roughness related BIS symbols. (15 hrs.)
		CNC MILLING 135. Operating the CNC machine in different modes such as JOG, MPG, MDI/ MDA. (15 hrs.) 136. Procedure for reaching reference point. (15 hrs.) 137. Practice on Work & Tool offset measurement. (15 hrs.) 138. Program loading and machine setting. (15 hrs.) 139. Executing the program in auto SBL and auto cont. mode. (20 hrs.)	CNC MILLING Modes of operation such as JOG, MPG, REF, MDI/MDA. Program execution in different modes like auto SBL and auto cont. mode. Knowledge on CNC cutting tools-Geometry, material, cutting speed, feed, and depth of cut. Techniques of tool off-setting and tool setting. Prepare various programs as per drawing. (28 hrs.)

		140. Practice on CNC Milling such as Facemilling, Edge milling, slot milling (Radial & circumferential), Pocket milling (square& circular),Application of Canned/Fixed cycles. (110 hrs.)	Programming for different operation such as Face milling, Edge milling, Slot milling(radial & circumferential) Tool type chart, Application and effect of Cutter radius compensation (G41 and G42). Surface finish- Primary and Secondary. Surface roughness related BIS symbols Programming for Pocket milling (square & circular) & Canned / Fixed cycles for hole machining. (28 hrs.)
		141. Prepare different Types of documentation as per industrial need by different methods of recording information. (20 hrs.)	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.(09 hrs.)
		142. Practice of contour program for different profiles on CNC simulation software. (40 hrs.)	Concept of contour programming for different profiles. (15 hrs.)
Professional Skill 20Hrs.; Professional Knowledge 04Hrs.	Plan and perform simple repair and maintenance of different machines and check for functionality. *[Different Machines – Drilling Machine, milling machine and Lathe]* (Mapped NOS: CSC/N0110)	143. Practice on routine maintenance, Periodic checking for lubrication, Hydraulic oil level, Hydraulic system pressure, chuck Pressure adjustment for different material. (10 hrs.) 144. Cleaning & adjusting the Pneumatic Filter, Pressure regulator & Lubricator. (10 hrs.)	**Preventive Maintenance, Predictive Maintenance & Concepts of TPM.** Difference between breakdown and preventive maintenance – Its importance in productivity, types. Normal procedure followed for maintenance of machine tool in the shop floor. Importance of centralized lubrication system, Hydraulics & pneumatics. (04 hrs.)
ENGINEERING DRAWING: (40 Hrs.)			

Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work. (NOS:CSC/N9401)	Reading of drawing of nuts, bolt, screw thread, different types of locking devices e.g., Double nut, Castle nut, Pin, etc. Reading of foundation drawing Reading of Rivets and rivetted joints, welded joints Reading of drawing of pipes and pipe joints Reading of Job Drawing ,Sectional View & Assembly view	
WORKSHOP CALCULATION & SCIENCE: (36 Hrs)			
WCS- 36 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:CSC/N9402)	**Friction** Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction Friction - Lubrication Friction - Co- efficient of friction, application and effects of friction in workshop practice **Centre of Gravity** Centre of gravity - Centre of gravity and its practical application **Area of cut out regular surfaces and area of irregular surfaces** Area of cut out regular surfaces - circle, segment and sector of circle Related problems of area of cut out regular surfaces - circle, segment and sector of circle Area of irregular surfaces and application related to shop problems **Elasticity** Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus Elasticity - Ultimate stress and working stress **Heat Treatment** Heat treatment and advantages **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade Estimation and costing - Problems on estimation and costing.	
In-plant training/ Project work (Any Project to be done involving CNC machine also) a) Crank and slotted link mechanism b) Stub arbor with collet and nuts c) Compound gear train			

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

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

ANNEXURE-I

LIST OF TOOLS AND EQUIPMENT			
OPERATOR ADVANCED MACHINE TOOL(For the batch of 16Candidates)			
SNo.	**Name of the Tools&Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1.	Screw drivers	150 mm	16+1 nos.
2.	Screw driver star		2 set
3.	Long nose plier	150mm.	16+1 nos.
4.	Combination plier	150mm.	16+1 nos.
5.	Diagonal cutter	150mm.	16+1 nos.
6.	Adjustable spanner or side wrench		16+1 nos.
7.	Hack saw frame adjustable	250 - 300mm. with blades	16+1 nos.
8.	Flat file	200mm.	16+1 nos.
9.	File triangular	150 mm.	16+1 nos.
10.	Half round file	150 mm	16 nos.
11.	Square file	150 mm	16 nos.
12.	Ring spanner set		2 sets
13.	Box spanner set		2 sets
14.	Hammer cross pane	750 gm with handle	10 nos.
15.	Hammer small	250gm with handle	10 nos.
16.	Neon tester		2 nos.
17.	Grease Gun		1 nos.
18.	Bearing Extractor		1 no.
B. INSTRUMENTS AND GENERAL SHOP OUTFIT			
19.	Steel rule	30 cm. Graduated both in English and Metric unit.	16 nos.
20.	Outside spring caliper	150mm.	10 nos.
21.	Inside spring caliper	150mm.	10 nos.
22.	Hermaphrodite caliper	150mm.	6 nos.
23.	Divider spring	150mm.	6 nos.
24.	Center punch	100mm.	10 nos.
25.	Prick punch	100mm.	10 nos.
26.	Scraper	A 250mm. (bearing).	16 nos.
27.	Scraper	B 250mm. (triangular).	16 nos.
28.	Scraper	C 250mm. (half round).	16 nos.

29.	Scriber	150x3 mm. (one side offset).	16 nos.
30.	Cold chisel	20x 200mm.	16 nos.
31.	Cross chisel	10x 150mm	16 nos.
32.	Diamond point chisels	10x 150mm.	16 nos.
33.	Safety glasses.		16 nos.
34.	Flat 2nd.Cut	250mm.	16 nos.
35.	Chisel flat	25x 200mm.	16 nos.
36.	Surface plate	400mm.X 400mm. Grade 1. With stand	2 nos.
37.	Marking off table	1200x 1200 x 900mm.	1 no.
38.	Scribing block universal	300mm.	1 no.
39.	Vee block	100/7-80-A	6 nos.
40.	Outside spring caliper	200mm.	16 nos.
41.	Straight edge steel	1 meter	2 nos.
42.	Straight edge steel	500mm.	2 nos.
43.	Steel tape 2 meter in case		1 no.
44.	Sprit level	2V 250, 05 meter	2 nos.
45.	Combination set	300mm.	2 nos.
46.	Hexagonal Allen keys	2.5 to 12mm.	5 sets
47.	Spanner D.E.	6mm to 32mm assorted	6 sets
48.	Adjustable spanner	300mm.	6 nos.
49.	Reduction sleeve Morse	1-2, 2-3, 3-4, 2-4	3 sets
50.	Angle plate adjustable	250x 150x 175mm.	5 nos.
51.	Solid parallels in pairs (different sizes)metric		13 nos.
52.	Oil can pressure feed	500mg.	6 nos.
53.	Oil stone	150x 50x 25mm.	3 sets
54.	Number drills HSS (parallel shank)		3 sets
55.	Drill (parallel)		3 sets
56.	Twist drills	3mm. To 13mm. (parallel shank)	3 sets
57.	Drill chuck	0-12mm with taper shank	3 sets
58.	Centre drill	A 1 to 5	2 nos.
59.	Grinding wheel dresser (diamond)		2 nos.
60.	Grinding wheel dresser (hunting tone type)		16 nos.
61.	Clamp C	100mm.	6 nos.
62.	Clamp C	200mm.	4 nos.
63.	Tap and die set in box metric pitch		3 sets
64.	Drill HSS taper shank		16 nos.

65.	Needle file set		5 set.
66.	Reamer	6mm. to 25mm. by 1mm.	2 set
67.	Reamer adjustable	10mm. to 15mm. by 75mm.	2 set
68.	Tool bits HSS	6mm. square	1 doz.
69.	Tool bits HSS	10mm. square	1 doz.
70.	Tool bits holder (Armstrong) LH		10 nos.
71.	Tool bits holder (Amstrong) RH		10 nos.
72.	Assorted tools for lathe, shaper, slotter& planner of different shapes &sizes.		8 nos. each
73.	Table chuck	75mm. jaw swivel base	2 nos.
74.	Machine vice	200mm. swivel base	4 nos.
75.	Machine vice	160mm. swivel base	2 nos.
76.	Hand vice	50mm. jaw	6 nos.
77.	Compound angle vice (standard sine)		1 no.
78.	Universal sine		1 no.
79.	Universal table angle plate		1 no.
80.	Shaper tool holder turret type		3 nos.
81.	Shaper indexing center		1 no.
82.	Knurling tools (set of 3) straight and diamond		1 each for 16 trainees
83.	Plier cutting	200mm.	2 nos.
84.	Magnifying glass	75mm.	2 nos.
85.	Carbide tipped tools of different sizes &shapes (throw away tips)		3 sets
C. MILLING CUTTERS			
86.	Cylindrical cutter (different sizes and as per the arbor of the machine)		12 nos.
87.	Side and face cutter (different sizes and as per the arbor of the machine)		12 nos.
88.	Equal angle cutter (different sizes and as per the arbor of the machine)		10 nos.
89.	Double angle unequal cutter (different sizes and as per the arbor of the machine)		10 nos.
90.	Single angle cutter LH & RH (different sizes and as per the arbor of the machine)		4 nos. each

91.	End mill cutter	Dia. 6 mm - 20 mm (in steps of 2 mm)	2 sets.
92.	Shell end mill cutter	Dia. 32 mm & 50 mm each	1 set
93.	Slitting saw (different sizes and as per the arbor of the machine)		10 nos.
94.	Slot drill (key seating)	4 mm to 12 mm in steps of 2 mm	3 sets.
95.	T-slot cutter to suit T-headed bolt	10, 12mm. straight shank	6 nos.
96.	T-slot cutter to suit T-headed bolt	12, 18, 22mm. taper shank	6 nos.
97.	Milling Cutter(involute)	Module-2,2.5 and 3	3 sets
98.	Convex milling cutter	2.5mm, 4mm, 10mm.,20mm	2 nos. each
99.	Concave milling cutter	R-2.5mm, 4mm, and 10mm.	2 nos. each
100.	Milling Cutter(Corner rounding)	R-2.5mm, 4mm, 10 mm and 16mm	2 nos. each
101.	Milling cutter face mill inserted type	100x 27 bore	3 nos.
102.	Milling cutter face mill inserted type	150x 32 bore	3 nos.
D. MEASURING INSTRUMENTS			
103.	Micrometer Outside	0-25mm.	2 nos. each
104.	Micrometer Outside	25-50mm.	
105.	Micrometer Outside	50-75mm.	
106.	Micrometer depth gauge	0-200mm.	
107.	Direct reading vernier caliper B	300 (direct reading with dial)	
108.	Vernier height gauge	250mm.	
109.	Vernier gear tooth caliper		1 no.
110.	Vernier bevel protractor	with 150mm. blade	2 nos.
111.	Bevel gauge	200mm	2 nos.
112.	Telescopic gauge	13 mm. to 300mm.	2 nos.
113.	Sine Bar	200mm.	3 set
114.	Dial test indicator with magnetic gauge type1gradeA with magnetic base		1 no.
115.	Centre gauge	60^0	2 nos.
116.	Slip gauge set (normal set)		6 sets
117.	Screw pitch gauge for metric pitches		1 set
118.	Radius gauge metric set		2 set
119.	Limit plug gauges	5mm. to 25mm.	2 set

120.	Ring gauges	5mm to 25mm. by 2.5mm (Go& No Go)	2 set
121.	Taper gauge	M.T. No. 1, 2, 3,4&5	2 set
122.	Feeler gauge		2 set
123.	Planer gauge standard size		1 set
E. GENERAL FURNITURE			
124.	Steel lockers for 20 trainees		1 no.
125.	Steel chair for instructor		2 nos.
126.	Steel table for instructor		1 no.
127.	Work bench for fitters with four vices of 100mm. jaw		5 nos.
128.	Steel cupboard 180x 90x 45cm.		16 nos.
129.	Steel cupboard 120x 60x 45cm.		12 nos.
130.	Black board with easel		1 no.
131.	Computer table and chair		10 sets
132.	FirstAid Box		1 no.
F. GENERAL MACHINERY SHOP OUTFIT			
133.	Lathe S.S &S.C. (all geared type)	with minimum specification as: 150 mm center height, 1000 mm between centers, along with 4-jaw & 3-jaw chucks, auto feed system, taper turning attachment, Motorized coolant system, safety guard, dog carriers, face plate and machine light arrangement.	3 nos.
134.	Drilling machine pillar type	20mm. capacity with drill chuck & key.	1 no.
135.	Universal Milling machine	with minimum specification as: 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	1 no.

		Adaptors, arbors and collects etc. for holding straight shank drills and cutters from 3 mm to 25 mm.	
136.	Vertical Milling Machine	with minimum specification as: Table Length x width 1200 x 300 mm having motorized up & down movement along with auto feed arrangement along with 150mm universal vice.	2 nos.
137.	Surface grinding machine wheels	dia.180mm. Reciprocating table, longitudinal table traverse 200mm fitted with adjustable traverse stop. Full motorized supplied with magnetic chuck 250mm.x 120mm. diamond tool holder, set of spanners, grease etc.	1 no.
138.	Cylindrical grinding machine	with internal grinding attachments with minimum specification as: To accommodate 750mm job with centre height 150mm. Wheel diameter x width = 300 x 25mm.	1 no.
139.	CNC lathe/CNC turn Centre **(@)**	with minimum specification as: Chuck size:135mm Between centre distance: 250mm Travel in X: 100mm Travel in Z: 200mm No. of tool stations: 8 station turret Spindle power: 3.7kW (continuous rating) preferably with popular control system like Fanuc/Siemens or equivalent along with motorized coolant system.	2 nos.

140.	CNC Milling Machine/Vertical Machining Centre **(@)**	with minimum specification as: Table size:500x250mm Travel X-axis x Y-axis x Z-axis: 300 x 250 x 250mm Auto Tool Changer: 8 nos. Spindle power: 3.7kW (continuous rating) with popular control system like Fanuc/Siemens or equivalent along with motorized coolant system.	2 nos.
141.	a) Multimedia based simulator **(@)**	CNC technology and interactive CNC part programming software for turning & milling with virtual machine operation and simulation using popular operation control system such as Fanuc, Siemens, etc. (Web-based or licensed based) (10 trainees + 1 faculty)	11 user
142.	Desktop	CPU: 32/64 Bit i3/i5/i7 or latest processor, Speed: 3 GHz or Higher. RAM:-4 GB DDR-III or Higher, Wi-Fi Enabled. Network Card: Integrated Gigabit Ethernet, with USB Mouse, USB Keyboard and Monitor (Min. 17 Inch) Licensed Operating System and Antivirus compatible with trade related software	10 nos.
143.	LCD projector/LCD TV/Interactive smart board		1 no

NOTE:

a) *No additional items are required to be provided to the batch working in the second and third shift except the items under trainee's lockers.*
b) *(@)-Only one number need be provided in each I.T.I. irrespective of No. of Units.*
c) *Institute having centralized computer lab may use the existing infrastructure to impart simulation training & in that case not required to procure item no. 146*
d) *Internet facility is desired to be provided in the class room.*

ABBREVIATIONS

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


कौशलं बलम्