



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

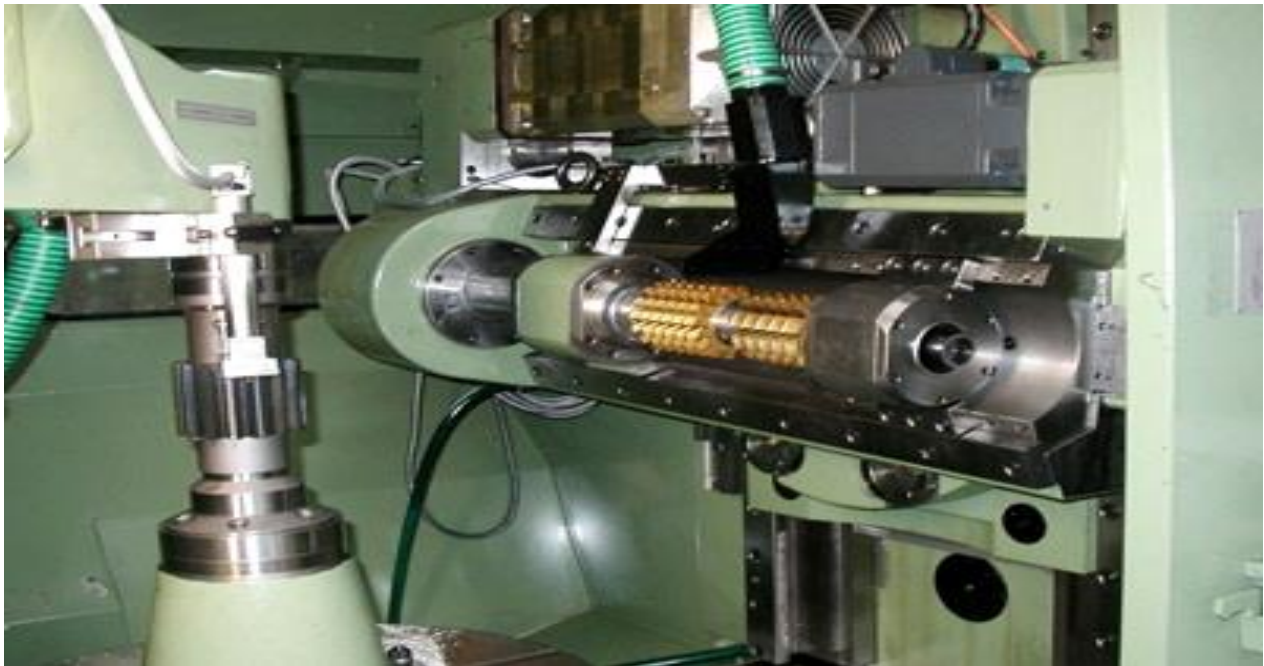
COMPETENCY BASED CURRICULUM

OPERATOR ADVANCED MACHINE TOOL

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 5



SECTOR – CAPITAL GOODS AND MANUFACTURING



Directorate General of Training

OPERATOR ADVANCED MACHINE TOOL

(Engineering Trade)

(Revised in 2019)

Version: 1.2

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 5

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

EN-81, Sector-V, Salt Lake City,

Kolkata – 700 091

www.cstaricalcutta.gov.in

CONTENTS

S No.	Topics	Page No.
1.	Course Information	1
2.	Training System	2
3.	Job Role	6
4.	General Information	7
5.	Learning Outcome	9
6.	Assessment Criteria	11
7.	Trade Syllabus	17
	Annexure I(List of Trade Tools & Equipment)	33
	Annexure II (List of Trade experts)	40

1. COURSE INFORMATION

During the two-year duration, a candidate is trained on subjects- Professional Skill, Professional Knowledge, Engineering Drawing, Workshop Science & Calculation 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 (Workshop Calculation science, Engineering Drawing and 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	
		1 st Year	2 nd Year
1	Professional Skill (Trade Practical)	1000	1000
2	Professional Knowledge (Trade Theory)	280	360
3	Workshop Calculation & Science	80	80
4	Engineering Drawing	80	80
5	Employability Skills	160	80
	Total	1600	1600

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%. 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 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 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

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 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 produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices.	<ul style="list-style-type: none"> • Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and

	<p>consistency in the finish.</p> <ul style="list-style-type: none"> • Occasional support in completing the project/job.
(b) Weightage in the range of 75%-90% to be allotted during assessment	
<p>For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices.</p>	<ul style="list-style-type: none"> • Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish. • Little support in completing the project/job.
(c) Weightage in the range of above 90% to be allotted during assessment	
<p>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.</p>	<ul style="list-style-type: none"> • High skill levels in the use of hand tools, machine tools and workshop equipment. • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

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:

- i) 7223.0500–Mechanist, General/Machinist
- ii) 7224.0100–Grinder, General

4. GENERAL INFORMATION

Name of the Trade	Operator Advanced Machine Tool
Trade Code	DGT/1075
NCO - 2015	7223.0500, 7224.0100
NSQF Level	Level – 5
Duration of Craftsmen Training	Two years (3200 hours)
Entry Qualification	Passed 10 th Class examination with Science and Mathematics
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	<p>B.Voc/Degree in Mechanical/ Production Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>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.</p> <p style="text-align: center;">OR</p> <p>NTC/NAC passed in the Trade of "Operator Advanced Machine Tool" With three years' experience in the relevant field.</p> <p>Essential Qualification: Relevant National Craft Instructor Certificate (NCIC) in any of the variants under DGT.</p> <p>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.</p>
2. Workshop Calculation & Science	<p>B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>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.</p> <p style="text-align: center;">OR</p> <p>NTC/ NAC in any one of the engineering trades with three years'</p>

	<p>experience.</p> <p><u>Essential Qualification:</u> National Craft Instructor Certificate (NCIC) in relevant trade.</p> <p style="text-align: center;">OR</p> <p>NCIC in RoDA or any of its variants under DGT.</p>					
3. Engineering Drawing	<p>B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>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.</p> <p style="text-align: center;">OR</p> <p>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.</p> <p><u>Essential Qualification:</u> National Craft Instructor Certificate (NCIC) in relevant trade</p> <p style="text-align: center;">OR</p> <p>NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.</p>					
4. Employability Skill	<p>MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills from DGT institutes.</p> <p>(Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above)</p> <p style="text-align: center;">OR</p> <p>Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills from DGT institutes.</p>					
5. Minimum Age for Instructor	21 Years					
List of Tools and Equipment	As per Annexure – I					
Distribution of training on Hourly basis: (Indicative only)						
Year	Total Hrs /week	Trade Practical	Trade Theory	Workshop Cal. & Sc.	Engg. Drawing	Employability Skills
1 st	40 Hours	25 Hours	7 Hours	2 Hours	2 Hours	4 Hours
2 nd	40 Hours	25 Hours	9 Hours	2 Hours	2 Hours	2 Hours

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 (TRADE SPECIFIC)

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: $\pm 0.25\text{mm}$]
2. Plan & perform simple repair, maintenance of different machines and check for functionality. [Different Machines – Drill Machine, Power Saw and Bench Grinder]
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: $\pm 0.06\text{mm}$, Different turning operation – Plain, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U-cut, Reaming, knurling.]
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]
5. Produce components of high accuracy by different operations using grinding. [Different operations – surface grinding, cylindrical grinding with an accuracy of $\pm 0.01\text{ mm}$]
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.]
7. Set the different machining parameters to produce screw & multi start threaded components applying method/ technique and test for proper assembly of the components
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.]
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]

SECOND YEAR

10. Set (both job and tool) CNC turning centre and produce components as per drawing by preparing part programme.
11. Set (both job and tool) CNC machining centre and produce components as per drawing by preparing part programme.
12. Plan and perform simple repair and maintenance of different machines and check for functionality. [Different Machines – Drilling Machine, milling machine and Lathe]

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
<p>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: $\pm 0.25\text{mm}$]</p>	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.	
<p>2. Plan & perform simple repair, maintenance of different machines and check for functionality. [Different Machines – Drill Machine, Power Saw and Bench Grinder]</p>	Ascertain and select tools and materials for the repair, 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 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. <i>[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.]</i>	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., <i>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.</i>
	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. <i>[Different machining parameters – feed, speed and depth of cut. Different milling operations – plain, face, angular, form, gang, straddle milling]</i>	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. <i>[Different operations – surface grinding, cylindrical grinding with an accuracy</i>	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]	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 of machine.
	Check for desired performance.
6. Set different components of machine & parameters to produce taper/ angular components and ensure proper assembly of the components. <i>[Different component of machine: Form tool, Compound slide, tail stock offset; Different machine parameters- Feed, speed, depth of cut.]</i>	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.	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. <i>[Different machining parameters – feed, speed</i>	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 components to be produced to determine gear setting and set

<p><i>and depth of cut. Different components – Rack, Spur Gear, External Spline, bevel gear, Helical Gear, worm & worm wheel]</i></p>	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.
<p>9. Measure components using different instrument/ gauge and test machine tool accuracy. <i>[Different instrument/ gauges- limit gauges, Sine Bar, snip gauges, tool maker's microscope and profile projector; Simple Machines – Drill Machine, Power Saw and Lathe]</i></p>	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.
SECOND YEAR	
<p>10. Set (both job and tool) CNC turning centre and produce components as per drawing by preparing part</p>	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.

programme	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.
11. Set (both job and tool) CNC machining centre and produce components as per drawing by preparing part programme	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.
12. Plan and perform simple repair and maintenance of different machines and check for functionality. <i>[Different Machines – Drilling Machine, milling machine</i>	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

<i>and Lathe]</i>	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.

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 300 Hrs; Professional Knowledge 84 Hrs	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: $\pm 0.25\text{mm}$]	<ol style="list-style-type: none"> 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). (3 hrs.) 3. First Aid Method and basic training. (2 hrs.) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (2 hr.) 5. Hazard identification and avoidance. (1 hr.) 6. Identification of safety signs for Danger, Warning, caution & personal safety message. (3 hrs.) 7. Preventive measures for electrical accidents & steps to be taken in such accidents. (3 hrs.) 8. Use of fire extinguishers. (2 hrs.) 9. Practice and understand precautions to be followed while working in fitting jobs. (4 hrs.) 10. Safe use of tools and equipments used in the trade. (3 hrs.) 	<p>All necessary guidance to be provided to the newcomers to become familiar with the working of Industrial Training Institute system including store's procedures.</p> <p>Soft skills, its importance and job area after completion of training.</p> <p>Importance of safety and general precautions observed in the industry/shop floor.</p> <p>Introduction of first aid. Operation of electrical mains and electrical safety. Introduction of PPEs.</p> <p>Response to emergencies e.g. power failure, fire, and system failure.</p> <p>Importance of housekeeping & good shop floor practices.</p> <p>Introduction to 5S concept & its application.</p> <p>Occupational Safety & Health: Health, Safety and Environment guidelines, legislations & regulations as applicable.</p> <p>Basic understanding on Hot work, confined space work and material handling equipment.</p> <p>(07 hrs)</p>

		<p>Basic Fitting</p> <p>11. Preparation of filing. (2 hrs.)</p> <p>12. Standing posture with respect to bench vice for filing. (4 hrs.)</p> <p>13. Marking lines on the job surface for filing to the marked lines. (5 hrs.)</p> <p>14. Gripping the job suitably in the vice jaws for filing. (5 hrs.)</p> <p>15. Balancing of file, using rough file. (4 hrs.)</p> <p>16. Measurement by using inside/ outside calipers and scale. (5 hrs.)</p>	<p>Basic Fitting</p> <p>Vice - purpose, types, description, size, construction method to use and maintenance.</p> <p>File - purpose, types, description, size and method to use. Use of file card, printing of file, convexity of file and proper filing technique.</p> <p>Rule - purpose, types, description and method to use.</p> <p>(07 hrs.)</p>
		<p>17. Use of simple measuring instruments such as steel rule, Vernier caliper, Inside/Outside Micrometer. (5 hrs.)</p> <p>18. Care and precaution to be observed in handling these instruments. (3 hrs.)</p> <p>19. Exercises on measurement of various geometrical shapes. (8 hrs.)</p> <p>20. Exercise on marking out according to simple blue prints, using steel rule, scribe, marking blocks & divider. (6 hrs.)</p> <p>21. Scribing lines on chalked or coloured (blue) surfaces of the work piece. (4 hrs.)</p> <p>22. Marking location of the position of holes & scribing circles using dividers. (2 hrs.)</p> <p>23. Use of Dot and Center Punch for punching the lines, centers and circles. (5 hrs.)</p> <p>24. Demo on filing operation, using</p>	<p>Divider - purpose, types, description and method to use.</p> <p>Scriber - purpose, types, description and method to use.</p> <p>Marking Block - purpose, types, description and method to use.</p> <p>Punch - purpose, types, description and method to use.</p> <p>Micrometer - purpose, types, construction, calculation of least count, method to use and read, care and maintenance.</p> <p>Vernier Caliper - purpose, construction, calculation of vernier constant, method to use & read, care and maintenance.</p> <p>(14 hrs.)</p>

		<p>rough file. (3 hrs.)</p> <p>25. Exercise of filing flanges of a channel for balancing of file. (4 hrs.)</p> <p>26. Filing flat surface and flange of a channel maintaining parallelism between them using outside caliper within + or - 0.5mm. (10 hrs.)</p>	
		<p>27. 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. (6 hrs.)</p> <p>28. 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.)</p> <p>29. Filing with second cut file to prepare smooth surfaces. (5 hrs.)</p> <p>30. Exercise on filing for maintaining dimensions within + or -0.1mm using vernier caliper. (8 hrs.)</p>	<p>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. (07 hrs.)</p>
		<p>31. Marking of profiles - combination of straight lines, circles, arcs and angles using scale, divider height gauge, protractor, combination set etc. (3 hrs.)</p> <p>32. Marking geometrical profiles on</p>	<p>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,</p>

		<p>sheet metal and filing to mark lines. (3 hrs.)</p> <p>33. Sharpening of marking tools, use of bench grinder for sharpening of scribe, centre punch, dot punch, divider etc. (1 hr.)</p> <p>34. Marking on the job piece for saw cuts. (1 hr.)</p> <p>35. Gripping the job suitably in the vice jaws for hack sawing to dimensions. (1 hr.)</p> <p>36. 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. (6 hrs.)</p> <p>37. Hack sawing different lengths with hack saw frame in horizontal & vertical positions Sawing along the parallel marked lines within 0.5mm allowance for filing. (6 hrs.)</p> <p>38. Hack sawing and filing steps and slots and open fitting of finished pieces. (4 hrs.)</p>	<p>procedure and precautions to be observed during grinding of marking tools, chisels and drill bits.</p> <p>Hack saw - purpose, types, description, method to use and precautions to be taken during hack sawing.</p> <p>Hack saw blade - purpose, types, description, select ON/OFF appropriate grade, fixing of blade and precautions to be observed.</p> <p>(07 hrs.)</p>
		<p>39. Hammering practice on vertical hold round job. (5 hrs.)</p> <p>40. Blind hammering practice. Stamping letters and numbers on M.S. plates. (5 hrs.)</p> <p>41. Exercise on stamping to develop judgment, control on hand and feel. (3 hrs.)</p> <p>42. Stamping practice on flat and round surfaces using flat,</p>	<p>Hammer - purpose, types, description, method to use and precautions to be observed.</p> <p>Bending of solid selections using fixtures. Letters and Numbers - purpose, description, method to use and precautions to be observed.</p> <p>Hollow Punch - purpose, description, method to use for preparations of</p>

		<p>cross cut and round nose chisels for chipping edges and square to the faces and edges. (8 hrs.)</p> <p>43. Checking with Try- square, use of cross peen hammer for stretching of metal strip. (4 hrs.)</p>	<p>gaskets and other packing materials. Pipe Fitting -material and types of pipes used in the trade. Method to cut, to thread and preparation of pipes for 'T' fitting elbow fitting, reducers etc. using unions. Method to fill ferrule. (07 hrs.)</p>
		<p>44. Preparation for drilling, marking out the position of holes and dot punching. (3 hrs.)</p> <p>45. Deepening the points with centre punch. (4 hrs.)</p> <p>46. Checking for centre distance. (1 hr.)</p> <p>47. Drilling practice on sensitive drilling machine using different types of drills and drill holding devices. (6 hrs.)</p> <p>48. Safety to be observed while working on drilling machine. (1 hr.)</p> <p>49. Marking, chain drilling and filing to produce square, round and triangular openings on 6mm thick plate. (6 hrs.)</p> <p>50. Preparing inserts and fitting in these openings.(2 hrs.)</p> <p>51. Drilling practice on varying thickness and different materials such as M.S., C.I., S.S., Cu, Brass, Nylon, Epoxy etc. (6 hrs.)</p> <p>52. Drilling on sheet metal, precautions and safety to be observed. (3 hrs.)</p> <p>53. Counter Sinking, counter boring, and spot facing</p>	<p>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.</p> <p>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</p>

		<p>operations using bench drilling machine. (3 hrs.)</p> <p>54. Exercise on reaming with hand reamers and machine reamers. (2 hrs.)</p> <p>55. Internal threading by hand using tap sets. (2 hrs.)</p> <p>56. External threading by split die and finishing of thread by die nut. (2 hrs.)</p> <p>57. Marking centre of a round bar with the help of 'V' block and clamp. (1 hr.)</p> <p>58. Drilling and reaming of blind holes along the axis of round jobs. (3 hrs.)</p> <p>59. Grinding of drills to specifications and checking of angles with gauges. (4 hrs.)</p> <p>60. Grinding of chisels. (1 hr.)</p>	<p>remove broken tap. Construction and method to use tap wrench. Die and dieing purpose, types, description and method to use and precaution to be observed. Description of die stock, procedure and precautions to be observed during dieing. (14 hrs.)</p>
		<p>61. Measurement of shaft and hole diameters using outside and inside micrometer. (2 hrs.)</p> <p>62. Filing round out of square bar within $\pm 0.1\text{mm}$. Filing to an accuracy of $\pm 0.1\text{ mm.}$, checking with an outside micrometer. (6 hrs.)</p> <p>63. Preparation of plates for a gauge fitting. (3 hrs.)</p> <p>64. Exercise on filing radius and angular filing using templates and gauges. (5 hrs.)</p> <p>65. Filing templates and gauges for checking lathe tool angles. (5 hrs.)</p> <p>66. Exercise on step and taper turning. (4 hrs.)</p>	<p>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. (07 hrs.)</p>

		<p>67. Filing of various angle & clearances of lathe tool on square blanks. (6 hrs.)</p> <p>68. Checking with templates & gauge already prepared. (2 hrs.)</p> <p>69. 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.)</p> <p>70. Cold riveting. (3 hrs.)</p> <p>71. Marking out location of holes for riveting. (2 hrs.)</p> <p>72. Use of dolly and snap for forming rivet heads. (3 hrs.)</p> <p>73. Lap and butt joint by cold riveting. (4 hrs.)</p>	<p>Gauges & Template-purpose, types, description and method to use dial test indicator. Limit gauges - purpose, types, construction and method to use limit gauges. (07 hrs.)</p>
		<p>74. Cutting of sheet metal with chisel. Marking parallel clamp, 'C' clamp or micrometer stand using acquired skills. (8 hrs.)</p> <p>75. Simple project work. (17 hrs.)</p>	<p>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. (07 hrs.)</p>
<p>Professional Skill 25 Hrs; Professional Knowledge 07 Hrs</p>	<p>Plan & perform simple repair, maintenance of different machines and check for functionality.</p>	<p>BASIC MAINTENANCE SKILLS</p> <p>76. Using hand tools such as screw driver, single end/double end spanners, box nut spanners, ratchet spanners, circlip, pliers, wrenches,</p>	<p>BASIC MAINTENANCE SKILLS</p> <p>Screw drivers - purpose, types, description and method to use screw drivers. Spanners- purpose, types, description and method to use box, socket, tubular, hook</p>

	<i>[Different Machines – Drill Machine, Power Saw and Bench Grinder]</i>	<p>pullers, extractors, drift. (6 hrs.)</p> <p>77. Correct method to be used and care to be taken in using those tools. (9 hrs.)</p> <p>78. Lubrication of different parts of machines. (4 hrs.)</p> <p>79. Care and maintenance of machines. (6 hrs.)</p>	<p>spanner etc. Wrenches - purpose, types, description and method to use T-socket, monkey, ratchet, pipe wrenches etc. Purpose, description, precautions to be observed and method to use drift, pullers and extractors. (07 hrs.)</p>
<p>Professional Skill 100 Hrs;</p> <p>Professional Knowledge 28Hrs</p>	<p>Prepare different cutting tool to produce jobs to appropriate accuracy by performing different turning operations. <i>[Different cutting tool – V tool, side cutting, parting, thread cutting (both LH & RH), Appropriate accuracy: - $\pm 0.06\text{mm}$, Different turning operation – Plain, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U -cut, Reaming, knurling.]</i></p>	<p>BASIC TURNING</p> <p>80. Safety precautions to be observed while handling machines. (6 hrs.)</p> <p>81. Demonstration of change gear in the gearbox. (5 hrs.)</p> <p>82. Practice of holding work piece and tool using different devices. (9 hrs.)</p> <p>83. Exercises on plain, stepped, taper and form turning, knurling etc. (20 hrs.)</p> <p>84. Exercises on drilling, reaming, boring, counter boring etc. (18 hrs.)</p> <p>85. Screw thread cutting both internal and external of different types. (12 hrs.)</p> <p>86. Exercise on eccentric turning. (8 hrs.)</p> <p>87. Grinding of lathe tools. (2 hrs.)</p> <p>88. Simple projects such as hollow punch, pulleys, gear blanks, simple coupling etc. (20 hrs.)</p>	<p>TURNING</p> <p>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. Periodical maintenance of Lathe. (28 hrs.)</p>
<p>Professional Skill 100Hrs;</p> <p>Professional Knowledge 28Hrs</p>	<p>Set the different machining parameters and cutters to prepare job by performing different milling</p>	<p>BASIC MILLING</p> <p>89. Safety precautions in handling machine. (8 hrs.)</p> <p>90. Demonstration of various parts of the milling machines. (12 hrs.)</p>	<p>MILLING :</p> <p>Construction features, working principles, types, functions. Use of accessories and attachment of milling machine. Types of milling cutters.</p>

	<p>operation and indexing. [Different machining parameters – feed, speed and depth of cut. Different milling operations – plain, face, angular, form, gang, straddle milling]</p>	<p>91. Practice on different work and tool holding devices. (15 hrs.) 92. 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, 93. Oldham coupling, spline cutting etc. (10 hrs.) 94. Lubrication of different parts. Care and maintenance of machine. (10 hrs.)</p>	<p>Different method of holding work 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. Coolant for different materials. Common fault, defects and their rectification. (35 hrs.)</p>
<p>Professional Skill 150Hrs; Professional Knowledge 42Hrs</p>	<p>Produce components of high accuracy by different operations using grinding. [Different operations – surface grinding, cylindrical grinding with an accuracy of ± 0.01 mm]</p>	<p>GRINDING 95. Safety precautions to be observed while using machine. (12hrs.) 96. Demonstration of various parts of the grinding machines. (18 hrs.) 97. Use of drive - both mechanical and hydraulic. (12 hrs.) 98. Grinding wheel specifications, mounting, balancing, truing and dressing of grinding wheels. (18 hrs.) 99. Lubrication of different parts and care & maintenance of grinding machine. (25 hrs.) 100. Practice on different work holding devices and grinding various jobs.(40 hrs.) 101. Other machining process:</p>	<p>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. (42 hrs.)</p>

		<p>(25 hrs.)</p> <ul style="list-style-type: none"> ✓ Shaping ✓ Planning ✓ Slotting ✓ Hobbing ✓ Broaching ✓ Finish machining process like <ul style="list-style-type: none"> • 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 	
<p>Professional Skill 75 Hrs; Professional Knowledge 21 Hrs</p>	<p>Set different components of machine & parameters to produce taper/angular components and ensure proper assembly of the components. <i>[Different</i></p>	<p>ADVANCED MACHINING SKILLS TURNING</p> <p>102. Taper turning by using taper attachment. (15 hrs.)</p> <p>103. Taper turning by using a form tool. (15 hrs.)</p> <p>104. Internal and external taper turning and matching to mating parts. (15 hrs.)</p> <p>105. Eccentric turning practice. (15</p>	<p>ADVANCED MACHINING SKILLS TURNING</p> <p>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. (21 hrs.)</p>

	<i>component of machine: Form tool, Compound slide, tail stock offset; Different machine parameters- Feed, speed, depth of cut.]</i>	hrs.) 106. Boring and stepped boring, position boring. (15 hrs.)	
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Set the different machining parameters to produce screw & multi start threaded components applying method/ technique and test for proper assembly of the components.	107. Various Screw threads cutting to suit male and female threaded components. (30 hrs.) 108. Multi start threads cutting- 2start. (20 hrs.)	Procedure for cutting various internal and external screw threads. Care to be taken during internal threading in a blind hole. (14 hrs.)
Professional Skill 150Hrs; Professional Knowledge 42Hrs	Set the different machining parameters and cutters to prepare components by performing different milling operation and indexing. <i>[Different machining parameters – feed, speed and depth of cut. Different components – Rack, Spur Gear, External Spline, bevel gear, Helical Gear, worm & work wheel.]</i>	MILLING 109. Gang milling - milling jobs of different shapes and dimensions by using gang-milling process. (20 hrs.) 110. Milling hexagonal holes on a plate by attachment. Milling splines (external). (20 hrs.) 111. Milling gears by both simple and differential indexing (15hrs.) 112. Helical milling - milling helical groove on vertical milling machine by a slab mill cutter. (25 hrs.) 113. Milling helical gears. (20 hrs.) 114. Milling bevel gears. (20 hrs.) 115. Milling a rack. (20 hrs.) 116. Cutting worm and worm wheel on a milling. (25 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. (42 hrs.)
Professional	Measure	INSPECTION	INSPECTION

<p>Skill 50 Hrs; Professional Knowledge 14 Hrs</p>	<p>components using different instrument/ gauge and test machine tool accuracy. <i>[Different instrument/ gauges- limit gauges, Sine Bar, snip gauges, tool maker's microscope and profile projector; Simple Machines – Drill Machine, Power Saw and Lathe]</i></p>	<p>117. Familiarization with inspection and master gauge checking of finished product with limit gauges for their accuracy and usability. (4 hrs.) 118. Use of Sine Bar, snip gauges along with standard balls and rollers for measurement of taper. (6 hrs.) 119. Measuring with tool maker's microscope. (5 hrs.) 120. Testing of gears for its measurements and accuracy. (5 hrs.) 121. Use of profile projector. (5 hrs.) 122. Geometrical accuracy test of machine as per test chart. (25 hrs.)</p>	<p>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. (07 hrs.)</p> <p>Defects and remedies of turning, milling and grinding. Defects such as: Taper, Chattering, Poor Surface finish, Parallelism. (07 hrs.)</p>
<p>In-plant training/ Project work (indicative)</p> <ul style="list-style-type: none"> 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 475Hrs.; Professional Knowledge 171 Hrs.	Set (both job and tool) CNC turning centre and produce components as per drawing by preparing part programme.	CNC FUNDAMENTALS 123. Familiarization of computer as CNC works station. (10 hrs.) 124. Communication between CNC and computer i.e. series, parallel port. (30 hrs.)	CNC FUNDAMENTALS Background application, block diagram, input devices, output devices, CPU. Memory, Use 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. (18 hrs.)
		125. Demo / Identification of different elements of CNC machine. (25 hrs.) 126. 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. (27 hrs.)
		127. Practice on exercises with different coordinate systems with linear & circular interpolation. (100 hrs.)	Cutter Radius comp Tool wear comp Tool nose radius comp Tool nomenclature, tool changecommand, work & tool offset. (36 hrs.)
		128. Writing the part program for both turning & milling manually and practice on simulation software. (80 hrs.)	Introduction to part programming for both turning & milling using geometrical information & technological information (G & M

		129. Selection of tools Practice of work & tool offset on simulator. (100 hrs.)	codes) such as feed, speed, depth of cut. (63 hrs.)
		CNC TURNING 130. Operating the CNC machine in different modes such as JOG, MPG, MDI/MDA. (20 hrs.) 131. Procedure for reaching reference point. (10 hrs.) 132. Practice on Work & Tool offset measurement. (20 hrs.) 133. Program loading and machine setting. (20 hrs.) 134. 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. (27 hrs.)
Professional Skill 500 Hrs.;	Set (both job and tool) CNC machining centre and produce components as per drawing by preparing part programme.	135. Practice of contour program for different profiles on CNC simulation software. (125 hrs.)	Concept of contour programming for different profiles. (45 hrs.)
Professional Knowledge 180 Hrs.		136. Practice on CNC lathe. (35 hrs.) 137. TURNING - parallel, taper, step, radius, groove and threads of different pitches. (40 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. (27 hrs.)
		CNC MILLING 138. Operating the CNC machine in different modes such as JOG, MPG, MDI/MDA. (20 hrs.) 139. Procedure for reaching reference point. (15 hrs.) 140. Practice on Work & Tool offset measurement. (20 hrs.) 141. Program loading and machine setting. (20 hrs.) 142. Executing the program in auto SBL and auto cont. mode. (25 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. (45 hrs.)

		<p>143. Practice on CNC Milling such as Facemilling, Edge milling, slot milling (Radial & circumferential), Pocket milling (square & circular),Application of Canned/Fixed cycles. (125 hrs.)</p>	<p>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. (45 hrs.)</p>
		<p>144. Prepare different Types of documentation as per industrial need by different methods of recording information. (25 hrs.)</p>	<p>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.)</p>
		<p>145. Practice of contour program for different profiles on CNC simulation software. (50 hrs.)</p>	<p>Concept of contour programming for different profiles. (18 hrs.)</p>
<p>Professional Skill 25 Hrs.;</p> <p>Professional Knowledge 09 Hrs.</p>	<p>Plan and perform simple repair and maintenance of different machines and check for functionality. <i>[Different Machines – Drilling Machine, milling machine and Lathe]</i></p>	<p>146. Practice on routine maintenance, Periodic checking for lubrication, Hydraulic oil level, Hydraulic system pressure, chuck Pressure adjustment for different material. (12 hrs.)</p> <p>147. Cleaning & adjusting the Pneumatic Filter, Pressure regulator & Lubricator. (13 hrs.)</p>	<p>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. (08 hrs.)</p>
<p>In-plant training/ Project work (Any Project to be done involving CNC machine also)</p> <ul style="list-style-type: none"> a) Crank and slotted link mechanism b) Stub arbor with collet and nuts c) Compound gear train 			

SYLLABUS FOR CORE SKILLS

1. Workshop Calculation & Science (Common for two year course) (80Hrs. + 80 Hrs.)
2. Engineering Drawing (Common for Group-I (Mechanical Trade Group)) (80Hrs. + 80 Hrs.)
3. Employability Skills (Common for all trades) (160Hrs. + 80 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.

LIST OF TOOLS AND EQUIPMENT			
OPERATOR ADVANCED MACHINE TOOL (For the batch of 16 Candidates)			
S No.	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 gms. With handle	16 nos.
15.	Hammer small	250gms. With handle	16 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.	16 nos.
21.	Inside spring caliper	150mm.	16 nos.
22.	Hermaphrodite caliper	150mm.	6 nos.
23.	Divider spring	150mm.	6 nos.
24.	Center punch	100mm.	16 nos.
25.	Prick punch	100mm.	16 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 2 nd .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	16 nos.
40.	Try square	300mm.	16 nos.
41.	Out side spring caliper	200mm.	16 nos.
42.	Divider spring	200mm.	16 nos.
43.	Inside spring caliper	200mm.	16 nos.
44.	Straight edge steel1 meter		2 nos.
45.	Straight edge steel	500mm.	2 nos.
46.	Steel tape 2 meter in case		1 no.
47.	Sprit level	2V 250, 05 meter	2 nos.
48.	Combination set	300mm.	3 nos.
49.	Hexagonal allen keys	2.5 to 12mm.	11 sets
50.	Spanner D.E.	6mm to 32mm assorted	6 sets
51.	Adjustable spanner	300mm.	6 nos.
52.	Reduction sleeve Morse	1-2, 2-3, 3-4, 2-4	5 sets
53.	Angle plate adjustable	250x 150x 175mm.	5 nos
54.	Solid parallels in pairs (different sizes)metric		13 nos.
55.	Oil can pressure feed	500mg.	6 nos.
56.	Oil stone	150x 50x 25mm.	3 sets
57.	Number drills HSS (parallel shank)		3 sets
58.	Drill (parallel)		3 sets
59.	Twist drills	3mm. To 13mm. (parallel shank)	3 sets
60.	Drill chuck	0-12mm with taper shank	3 sets
61.	Centre drill	A 1 to 5	2 nos.
62.	Grinding wheel dresser (diamond)		2 nos.
63.	Grinding wheel dresser (hunting tone type)		16 nos.
64.	Clamp C	100mm.	16 nos.

65.	Clamp C	200mm.	5 nos.
66.	Tap and die set in box metric pitch		3 sets
67.	Drill HSS taper shank		16 nos.
68.	Needle file set		5 set.
69.	Reamer	6mm. to 25mm. by 1mm.	2 set
70.	Reamer adjustable	10mm. to 15mm. by 75mm.	2 set
71.	Tool bits HSS	6mm. square	1 doz.
72.	Tool bits HSS	10mm. square	1 doz.
73.	Tool bits holder (Armstrong) LH		16 nos.
74.	Tool bits holder (Amstrong) RH		16 nos.
75.	Assorted tools for lathe, shaper, slotter & planner of different shapes & sizes.		8 nos. each
76.	Table chuck	75mm. jaw swivel base	2 nos.
77.	Machine vice	200mm. swivel base	4 nos.
78.	Machine vice	160mm. swivel base	2 nos.
79.	Hand vice	50mm. jaw	6 nos.
80.	Compound angle vice (standard sine)		3 nos.
81.	Universal sine		3 nos.
82.	Universal table angle plate		3 nos.
83.	Shaper tool holder turret type		3 nos.
84.	Shaper indexing center		1 no.
85.	Knurling tools (set of 3) straight and diamond		1 each for 16 trainees
86.	Plier cutting	200mm.	2 nos.
87.	Magnifying glass	75mm.	2 nos.
88.	Carbide tipped tools of different sizes & shapes (throw away tips)		3 sets
C. MILLING CUTTERS			
89.	Cylindrical cutter (different sizes and as per the arbor of the machine)		20 nos.
90.	Side and face cutter (different sizes and as per the arbor of the machine)		20 nos.
91.	Equal angle cutter (different sizes and as per the arbor of the machine)		20 nos.
92.	Double angle unequal cutter (different sizes and as per the arbor of the machine)		20 nos.

93.	Single angle cutter LH & RH (different sizes and as per the arbor of the machine)		20 nos.
94.	End mill cutter	Dia. 6 mm - 20 mm (in steps of 2 mm)	2 sets.
95.	Shell end mill cutter	Dia. 32 mm & 50 mm each	2 sets
96.	Slitting saw (different sizes and as per the arbor of the machine)		10 nos.
97.	Slot drill (key seating)	4 mm to 12 mm in steps of 2 mm	3 sets.
98.	T-slot cutter to suit T-headed bolt	10, 12mm. straight shank	6 nos.
99.	T-slot cutter to suit T-headed bolt	12, 18, 22mm. taper shank	6 nos.
100.	Milling cutters (involute)	DP-8, 10, 12, 16& 20, No.1 to8	16 nos.
101.	Milling cutters (involute)	1, 2, 2.5,3&4	16 nos.
102.	Convex milling cutter	2.5mm, 4mm, 10mm.,20mm	16 nos.
103.	Concave milling cutter	R-2.5mm, 4mm, and 10mm.	16 nos.
104.	Milling cutter	R-2.5mm, 4mm, 10mm, and 16mm.	16 nos.
105.	Milling cutter face mill inserted type	100x 27 bore	16 nos.
106.	Milling cutter face mill inserted type	150x 32 bore	16 nos.

D. MEASURING INSTRUMENTS

107.	Micrometer Outside	0-25mm.	6 nos. each
108.	Micrometer Outside	25-50mm.	
109.	Micrometer Outside	50-75mm.	
110.	Micrometer depth gauge	0-200mm.	
111.	Direct reading vernier caliper B	300 (direct reading with dial)	
112.	Vernier height gauge	250mm.	
113.	Vernier gear tooth caliper		2nos.
114.	Vernier bevel protractor	with 150mm. blade	2 nos.
115.	Bevel gauge	200mm	2 nos.
116.	Telescopic gauge	13 mm. to 300mm.	2 nos.
117.	Sine Bar	200mm.	3 set
118.	Dial test indicator with magnetic gauge type1gradeA with magnetic base		2 nos.
119.	Centre gauge	60 ⁰	2 nos.
120.	Slip gauge set (normal set)		6 nos.
121.	Screw pitch gauge for metric pitches		1 set
122.	Radius gauge metric set		2 set

123.	Limit plug gauges	5mm. to 25mm.	2 set
124.	Ring gauges	5mm to 25mm. by 2.5mm (Go& No Go)	2 set
125.	Taper gauge	M.T. No. 1, 2, 3,4&5	2 set
126.	Feeler gauge		2 set
127.	Planer gauge standard size		2 set
E. GENERAL FURNITURE			
128.	Steel lockers for 20 trainees		1 no.
129.	Steel chair for instructor		2 nos.
130.	Steel table for instructor		1 no.
131.	Work bench for fitters with four vices of 100mm. jaw		5 nos.
132.	Steel cupboard 180x 90x 45cm.		16 nos.
133.	Steel cupboard 120x 60x 45cm.		12 nos.
134.	Black board with easel		1 no.
135.	Computer table and chair		10 sets
136.	First Aid Box		1 no.
F. GENERAL MACHINERY SHOP OUTFIT			
137.	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.
138.	Drilling machine pillar type	20mm. capacity with drill chuck & key.	1 no.
139.	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 Adaptors, arbors and collects etc.	1 no.

		for holding straight shank drills and cutters from 3 mm to 25 mm.	
140.	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.
141.	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.
142.	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.
143.	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.
144.	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.
145.	a) Multimedia based simulator (@)	CNC technology and interactive CNC part programming software	11 user

		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)	
146.	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.
147.	LCD projector		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.*

ANNEXURE-II

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts, trainers of ITIs, NSTIs, faculties from universities and all others who contributed in revising the curriculum. Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

List of Expert members contributed/ participated for finalizing the course curricula of Operator Advanced Machine Tool trade.			
S No.	Name & Designation Shri/Mr./Ms	Organization	Remarks
Industry Experts			
1.	A. D. Shahane, Vice-President, (Corporate Trg.)	Larsen & Tourbo Ltd., Mumbai:400001	Chairman
2.	Dr. P.K.Jain, Professor	IIT, Roorkee, Roorkee-247667, Uttarakhand	Member
3.	N. Ramakrishnan, Professor	IIT Gandhinagar, Gujarat-382424	Member
4.	Dr. P.V.Rao, Professor	IIT Delhi, New Delhi-110016	Member
5.	Dr. Debdas Roy, Asstt. Professor	NIFFT, Hatia, Ranchi-834003, Jharkhand	Member
6.	Dr. Anil Kumar Singh, Professor	NIFFT, Hatia, Ranchi-834003, Jharkhand	Member
7.	Dr. P.P.Bandyopadhyay Professor	IIT Kharagpur, Kharagpur-721302, West Bengal	Member
8.	Dr. P.K.Ray, Professor	IIT Kharagpur, Kharagpur-721302, West Bengal	Member
9.	S. S. Maity, MD	Central Tool Room & Training Centre (CTTC), Bhubaneswar	Member
10.	Dr. Ramesh BabuN, Professor	IIT Madras, Chennai	Member
11.	R.K. Sridharan, Manager/HRDC	Bharat Heavy Electricals Ltd, Ranipet, Tamil Nadu	Member
12.	N. Krishna Murthy Principal Scientific Officer	CQA(Heavy Vehicles), DGQA, Chennai, Tamil Nadu	Member
13.	Sunil Khodke Training Manager	Bobst India Pvt. Ltd., Pune	Member
14.	Ajay Dhuri	TATA Motors, Pune	Member
15.	Uday Apte	TATA Motors, Pune	Member

16.	H B Jagadeesh, Sr. Manager	HMT, Bengaluru	Member
17.	K Venugopal Director & COO	NTTF, Peenya, Bengaluru	Member
18.	B.A.Damahe, Principal L&T Institute of Technology	L&T Institute of Technology, Mumbai	Member
19.	Lakshmanan. R Senior Manager	BOSCH Ltd., Bengaluru	Member
20.	R C Agnihotri Principal	Indo- Swiss Training Centre Chandigarh, 160030	Member
Mentor			
21.	Sunil Kumar Gupta (Director)	DGET HQ, New Delhi.	Mentor
Members of Core Group			
22.	N. Nath. (ADT)	CSTARI, Kolkata	Co-ordinator
23.	H.Charles (TO)	NIMI, Chennai.	Member
24.	Sukhdev Singh (JDT)	ATI Kanpur	Team Leader
25.	Ravi Pandey (V.I)	ATI Kanpur	Member
26.	A.K. Nasakar (T.O)	ATI Kolkata	Member
27.	Samir Sarkar (T.O)	ATI Kolkata	Member
28.	J. Ram Eswara Rao (T.O)	RDAT Hyderabad	Member
29.	T.G. Kadam (T.O)	ATI Mumbai	Member
30.	K. Mahendar (DDT)	ATI Chennai	Member
31.	Shrikant S Sonnavane (T.O)	ATI Mumbai	Member
32.	K. Nagasrinivas (DDT)	ATI Hyderabad	Member
33.	G.N. Eswarappa (DDT)	FTI Bangalore	Member
34.	G. Govindan, Sr. Draughtsman	ATI Chennai	Member
35.	M.N.Renukaradhya, Dy.Director/Principal Grade I.,	Govt. ITI, Tumkur Road, Banglore, Karnataka	Member
36.	B.V.Venkatesh Reddy. JTO	Govt. ITI, Tumkur Road, Banglore, Karnataka	Member
37.	N.M.Kajale, Principal,	Govt. ITI Velhe, Distt: Pune, Maharashtra	Member
38.	Subrata Polley, Instructor	ITI Howrah Homes, West Bengal	Member
39.	VINOD KUMAR.R Sr.Instructor	Govt.ITIDhanuvachapuramTrivendru m, Dist., Kerala	Member

40.	M. Anbalagan, Assistant Training Officer	Govt. ITI Coimbatore, Tamil Nadu	Member
41.	K. Lakshmi Narayanan, T.O.	DET, Tamil Nadu	Member
Other industry representatives			
42.	Venugopal Parvatikar	Skill Sonics, Bangalore	Member
43.	Venkata Dasari	Skill Sonics, Bangalore	Member
44.	Srihari, D	CADEM Tech. Pvt. Ltd., Bengaluru	Member
45.	DasarathiG.V.	CADEM Tech. Pvt. Ltd., Bengaluru	Member
46.	L.R.S.Mani	Ohm Shakti Industries, Bengaluru	Member

ABBREVIATIONS

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

