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

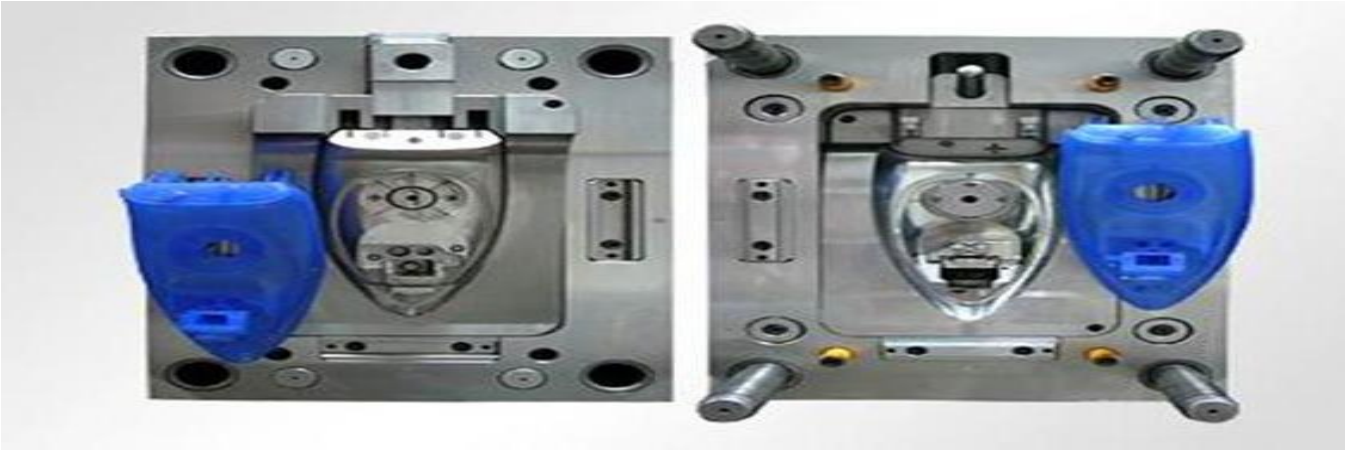
COMPETENCY BASED CURRICULUM

TOOL & DIE MAKER (DIES & MOULDS)

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4



SECTOR – CAPITAL GOODS AND MANUFACTURING

Directorate General of Training

TOOL & DIE MAKER
(DIES & MOULDS)
(Engineering Trade)

(Revised in March 2023)

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 years 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 course covers the detail aspect of mould making& testing. The broad components covered under Professional Skill subject are as below:

FIRST YEAR: The practical part starts with basic fitting covering components like filing, sawing, drilling, tapping, chipping, grinding and different fits. The accuracy proposed is of ±0.05mm and angular accuracy of 1°. Different turning operations on lathe viz., plain, facing, boring, grooving, step turning, parting, chamfering, knurling and different thread cutting by setting the different parameter, are covered in the practical part.

Different milling operations (plain, stepped, angular, dovetail, T-slot, contour, gear) along with surface & cylindrical grinding to an accuracy of ±0.02mm are covered. In addition, solid modeling of mould in CAD & Pro E taught.

SECOND YEAR: Working on EDM and wire EDM is part of practical training and produce components with an accuracy of ±0.02mm using the same. Setting operation and programme of both CNC turn centre and CNC machining centre to produce, components are covered. In addition to these constructions of injection, moulds are taught in the practical part.

Construction of single or two cavity mould (compression/ plunger type transformer mould) is covered in this year. Simple Hydraulic & Pneumatic circuits, repair & overhaul of machine, drill, milling and lathe are covered as part of practical training. Professional knowledge subject is simultaneously taught in the same fashion to apply cognitive knowledge while executing task. In addition, components like Workshop Calculation & Science and Engineering Drawing which are related and develop basic fundamental with regard to the trade are extensively covered along with Employability Skills. These skills are essential skills which are necessary to perform the job in any given situation.

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.

Tool & Die Maker (Dies & Moulds) trade under CTS is one of the popular courses delivered nationwide through network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. In the Domain area, Trade Theory & Practical impart professional skills and knowledge, while Core area imparts and Employability Skills impart requisite core skill & knowledge and life skills. After passing out the training programme, the trainee is being 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 of a Tool & Die Maker (Dies & Moulds) 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 to the level of Manager.
- Can become Entrepreneur in the related field.
- Can appear in 10+2 examination through National Institute of Open Schooling (NIOS) for acquiring higher secondary certificate and can go further for General/ Technical education.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.

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

2.3 COURSE STRUCTURE

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

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
5	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.

On the Job Training (OJT)/ Group Project	150	150
Optional Courses (10th/ 12th class certificate along with ITI certification or add on short term courses)	240	240

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

2.4 ASSESSMENT & CERTIFICATION

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

a) The **Continuous Assessment** (Internal)during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain 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 are 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 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 should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices.	● 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 consistency in the finish. ● Occasional support in completing the project/job.
(b)Marks in the range of 75% - 90% to be allotted during assessment	
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.	● 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) 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. ● A high level of neatness and consistency in the finish. ● Minimal or no support in completing the project.

3. JOB ROLE

TOOL & DIE MAKER (DIES &MOULDS):

Tool and Die Makers build, repair and modify custom made prototypes or special tools, Dies, Moulds, Die casting Moulds and various types of mechanical devices. Dies and moulds are metal forms used for moulding plastics or other moulding material. Tool and Die Makers fabricate various parts, like pieces of a puzzle, which require perfect fitting. While this occupation is closely allied with the machinist trade and encompasses many of the same skills, Tool and Die Makers usually specialize in jobs spending more time in fitting and assembling precision components which are required for plastic injection moulds and die cast moulds. A Tool and Die maker's work depend up on precise measurements and accuracy, as such math skills are important. Also, they must be able to read and interpret information from design drawings and specifications to fabricate all types of Dies and Moulds. Being mechanical minded is an additional skill.

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

The trainee after completion of this course may be designated as Tool & Die Maker (Dies & Moulds) according to nature of work done.

Reference NCO-2015:

i) 7222.0500 – Die Maker

Reference NOS:

(i) CSC/N0304
(ii) CSC/N0309
(iii) CSC/N0316
(iv) CSC/N 9401
(v) CSC/N 9402
(vi) CSC/N 9477
(vii) CSC/N 0118
(viii) CSC/N 9494
(ix) CSC/N 9488
(x) CSC/N 0901

4. GENERAL INFORMATION

Name of the Trade	**TOOL & DIE MAKER (DIES & MOULDS)**
Trade Code	DGT/1052
NCO – 2015	7222.0500
NOS Covered	CSC/N0304, CSC/N0309, CSC/N0316, CSC/N9401, CSC/N9402, CSC/N9477, CSC/N0118, CSC/N9494, CSC/N9488, CSC/N0901
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 Student)	24 (There is no separate provision of supernumerary seats)
Space Norms	166 Sq. m
Power Norms	20 KW
Instructors Qualification for	
1. Tool & Die Maker (Dies & Moulds) Trade	B.Voc/Degree in Mechanical Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Tool and Die making 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 the Trade of "Tool and Die Maker (Dies and Moulds)" with three years' experience in the relevant field. **<u>Essential Qualification</u>:** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) under DGT. **NOTE:** ***Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.***
2. Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field.

	OR 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants of NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
4. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills from DGT institutes. (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 from DGT institutes.
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 a s per specification applying different types of basic fitting operation and Check for dimensional accuracy following safety precautions. [Basic fitting operation – Filing, Marking, Hack sawing, Drilling, Taping, chipping and Grinding etc. Accuracy: ± 0.1mm] (NOS: CSC/N0304)
2. Make different fit of components for assembling as per required tolerance observing principle of interchangeability and check for functionality. [Different Fit–Open, Angular, & Square Fit; Required tolerance: ±0.05 mm, angular tolerance: 1 degree.] NOS: CSC/N0309
3. Set different shaped jobs on different chuck and demonstrate conventional lathe machine operation observing standard operation practice. [Different chucks:3 jaws & 4 jaws, different shaped jobs: round, square, hexagonal] NOS: CSC/N0316
4. 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, internal recess, knurling. NOS: CSC/N0316
5. Set the different machining parameters to produce threaded components applying method/ technique and test for proper assembly of the components with an accuracy of ± 0.05 mm. [Different threads viz., metric/ BSW/ Square] NOS: CSC/N0316
6. 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, stepped, angular, dovetail, T-slot, contour, gear milling] NOS: CSC/N0316
7. Produce components of high accuracy by surface grinding operation. [Accuracy of +/- 0.02 mm] NOS: CSC/N0316
8. Produce components of high accuracy by cylindrical grinding operations. [Accuracy of +/- 0.02mm.] NOS: CSC/N0316
9. Sharpen different cutter or multipoint cutting tool. [Different cutters – end mill cutter, side & face milling cutter, single angle cutter, Reamer] NOS: CSC/N0316
10. Develop isometric drawing and solid modelling of mould using CAD & Pro-E. NOS: CSC/N9477

11. Read and apply engineering drawing for different application in the field of work. NOS: CSC/N9401
12. 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:

13. Produce components of high accuracy by different operations using Electric Discharge machine (EDM) and Wire EDM with accuracy of ± 0.02mm. NOS: CSC/N0118
14. Set (both job and tool) CNC turn centre and produce components as per drawing by preparing part programme. NOS: CSC/N0316
15. Set (both job and tool) CNC machining centre and produce components as per drawing by preparing part programme. NOS: CSC/N0316
16. Construct a Hand Injection Mould and try out/ test the mould assembly. NOS: CSC/N9494
17. Construct of two cavity injection mould and try out component. NOS: CSC/N9494
18. Construct single cavity mould (Compression mould/plunger type transformer mould). NOS: CSC/N9494
19. Construct circuit of pneumatics and hydraulics observing standard operating procedure & safety aspect. NOS: CSC/N9488
20. Plan and perform simple repair, overhauling of different machines and check for functionality. [Different Machines – Drill Machine, milling machine and Lathe] NOS: CSC/N0901
21. Develop isometric drawing and construct two cavity moulds with side core. NOS: CSC/N9477
22. Read and apply engineering drawing for different application in the field of work. NOS: CSC/N9401
23. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS: CSC/N 9402

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 – Filing, Marking, Hack sawing, Drilling, Taping, chipping and Grinding etc. Accuracy: ± 0.1mm] 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 visually inspect for defects.
	Mark as per specification applying desired mathematical calculation and observing standard procedure.
	Measure all dimensions in accordance with standard specifications and tolerances.
	Identify hand tools for different fitting operations and make these available for use in a timely manner.
	Prepare the job for Hacksawing, chiselling, filing, drilling, tapping, grinding.
	Perform basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification.
	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.
3. Make different fit of components for assembling as per required tolerance observing principle of interchangeability and check for functionality. *[Different Fit –Open, Angular, & Square Fit; Required tolerance: ±0.05 mm, angular tolerance: 1 degree] NOS:CSC/N0309*	Plan and organize for fitting job.
	Select raw material, tools & equipments.
	Perform the work pieces for fitting according to tolerances and interchangeability.
	Check all dimensions and interchangeability in accordance with drawing and rectify, if required.
4. Set different shaped jobs on different chuck and demonstrate conventional lathe machine operation observing standard operation practice. *[Different chucks: 3 jaws & 4 jaws, different shaped jobs: round, square,*	Identify and acquaint with lathe machine operation with its components.
	Identify different work holding devices and acquaint with functional application of each device.
	Mount the appropriate work holding device and check for its functional usage to perform turning operations.
	Set the job on chuck as per shape.
	Set the lathe on appropriate speed & feed.
	Operate the lathe to demonstrate lathe operation, observing

hexagonal] NOS:CSC/N0316	standard operating practice.
	Observe safety procedure during above operation as per standard norms and company guidelines.
4. 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 turning, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U -cut, Reaming, internal recess, knurling.] NOS:CSC/N0316*	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.
5. Set the different machining parameters to produce threaded components applying method/ technique and test for proper assembly of the components with an accuracy of ± 0.05 mm. *[Different threads viz., metric/ BSW/ Square] NOS:CSC/N0316*	Plan and select appropriate method to produce threaded components.
	Plan and prepare thread cutting tool in compliance to 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.
6. 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, stepped, angular, dovetail, T-slot, contour, gear milling] NOS:CSC/N0316*	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.

7. Produce components of high accuracy by surface grinding operation. *[Accuracy of +/- 0.02 mm] NOS:CSC/N0316*	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.
	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 during machining.
	Check for desired performance.
8. Produce components of high accuracy by cylindrical grinding operations. *[Accuracy of +/- 0.02mm] NOS:CSC/N0316*	Set the machining parameter and produce the component applying technique/ machine.
	External parallel grinding on cylindrical grinding.
	Internal parallel grinding with cylindrical grinding machine using chuck/ collet.
	Step grinding in cylindrical grinding machine (external).
	Taper grinding on cylindrical grinding machine (external).
	Check the accuracy of the component using instruments.
9. Sharpen different cutter or multipoint cutting tool. *[Different cutters – end mill cutter, side & face milling cutter, single angle cutter, Reamer] NOS:CSC/N0316*	Plan and set the cutter or multipoint cutting tool to the machine.
	Set the appropriate machine parameter.
	Sharpen the cutting tool observing standard operating procedure.
	Observe safety/ precautions during the sharpening of cutting tool.
10. Develop isometric drawing and solid modelling of mould using CAD & Pro-E. *NOS:CSC/N9477*	Demonstrate the working principle of the software.
	Demonstrate simple drawing in computer using Auto CAD.
	Demonstrate to draw an assembly drawing in computer.
	Demonstrate to draw a simple hand injection mould.
	Demonstrate the working principle of the software.
	Demonstrate simple drawing in computer using Pro-E.
	Demonstrate to draw a simple hand injection mould.
11. Read and apply engineering drawing for different application in the field of work. *NOS: CSC/N9401*	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing

	dimension/parameters to carry out the work.
12. 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	
13. Produce components of high accuracy by different operations using Electric Discharge machine (EDM) and Wire EDM with accuracy of ± 0.001mm. *NOS:CSC/N0118*	Understand the parts and working principle of EDM.
	Demonstrate simple EDM operations.
	Understand the parts and working principle of Wire EDM.
	Demonstrate simple Wire EDM operations.
	Check for desired functionality.
14. Set (both job and tool) CNC turning centre and produce components as per drawing by preparing part programme. *NOS: CSC/N0316*	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.
15. Set (both job and tool) CNC machining centre and produce components as per drawing by preparing part programme. *NOS:CSC/N0316*	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.
16. Construct a Hand Injection Mould and try out/ test the mould assembly. *NOS:CSC/N9494*	Plan and assess requirement for making different parts of a mould.
	Carry out work on various tool room machines for fabricating Mould.
	Demonstrate the assembly of the hand mould.
	Explain the feed system, injection system and ejection system.
	Try out the moulding using Hand Injection Moulding machine.
	Measure with instruments/gauges as per drawing.
	Avoid wastage, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
17. Construct of two cavity injection mould and try out component. *NOS:CSC/N9494*	Plan and interpret the design of hand injection mould.
	Demonstrate design of two cavity injection mould and identify the parts.
	Carry out work on various tool room machines for fabricating Mould.
	Assemble the mould.
	Demonstrate the moulding of the part.
	Measure with instruments/gauges as per drawing.
18. Construct single cavity mould (Compression mould/ plunger type transfer mould). *NOS:CSC/N9494*	Plan and interpret the design of compression/transfer mould.
	Carryout the work in various tool room machines for fabricating Mould.
	Assemble the compression/transfer mould.
	Demonstrate the moulding of the part.
	Measure with instruments/gauges as per drawing.
19. Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspects. *NOS:CSC/N9488*	Select and ascertain tools for the job and make this available for use in a timely manner.
	Plan to construct pneumatics & hydraulics circuit as per drawing and collecting necessary information.
	Demonstrate possible solutions and agree tasks within the team for constructing circuit.
	Construct circuit of pneumatics and hydraulics observing standard procedure.
	Comply with safety rules when performing the above

	operations.
	Check different parameters and functionality of the system.
20. Plan and perform simple repair, overhauling of different machines and check for functionality. *[Different Machines – Drilling Machine, milling machine and Lathe] NOS:CSC/N0901*	Ascertain and select tools and materials for the repair, overhauling 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, overhaul and assemble the parts in the machine with the help of blueprint.
	Check for functionality of part and ascertain faults of the part/ machine in case of improper function.
	Rectify faults of assembly.
21. Develop isometric drawing and construct two cavity moulds with side core. *NOS:CSC/N9477*	Develop the isometric the drawing for two cavity mould with side core.
	Plan and carryout the work in various tool room machines for fabricating Mould.
	Explain about the actuation of slide and safety features of side core assembly.
	Assemble the mould with side core.
	Measure with instruments/gauges as per drawing after moulding.
22. 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.
23. 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

SYLLABUS FOR TOOL & DIE MAKER (DIES & MOULDS) TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill 138 Hrs.; Professional Knowledge 40 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 – Filing, Marking, Hack sawing, Drilling, Taping, chipping and Grinding etc. Accuracy: ± 0.1mm].*	1. Introduction of trade skill and work application. 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). 3. First Aid Method and basic training. 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. 5. Hazard identification and avoidance. 6. Identification of safety signs for Danger, Warning, caution & personal safety message. 7. Preventive measures for electrical accidents & steps to be taken in such accidents. 8. Use of Fire extinguishers. 9. Practice and understand precautions to be followed while working in fitting jobs. 10. Importance of trade training, List of tools & Machinery used in the trade. 11. Safe use of tools and equipments used in the trade. 12. Knowing games and memory training. 13. Motivational talk by experts. 14. 5S training.	All necessary guidance to be provided to the newcomers to become familiar with the working of Industrial Training Institute system including store's procedures. Safe working practices. 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.
		15. Identification of tools &equipments as per desired specifications for filing and	Bench work – Metal working hand tools and devices –Work bench – vices – files – hacksaw –

		marking, visual inspection of raw material for rusting, scaling, corrosion etc. 16. Familiarisation of bench vice. 17. Filing- files different sector and measure with steel rule. 18. Mark with scriber and steel rule. 19. Measuring practice with steel rule, outside & inside callipers.	hammer – spanners – screw drivers. Linear measurements- its units, steel rule dividers, Punch – types and uses. Description use and care of marking table.
		20. Dot punching and letter and number punching.	Vernier calliper – its parts, principles, reading, uses and care. Outside micrometer – its parts, principles, reading, uses and care, vernier height gauge. Marking tools – scriber. Marking out – Coordinates system, Rectangular – Polar – Rules for marking. Bevel protractor, combination set- their components, uses and cares. Pedestal grinder, star wheel dresser, safety precautions, care and maintenance.
		21. Grinding, centre punch, dot punch, flat chisel and scriber. 22. Drill grinding practice.	Marking media, special application. Surface plate and auxiliary marking equipment, 'V' block, angle plates, parallel block, description, types, uses, accuracy, care and maintenance. Drill, Tap, Die-types & application. Determination of tap drill size. Reamer- material, types (Hand and machine reamer), parts and their uses, determining hole size for reaming, Reaming procedure. Drilling machines-types and their application, construction of Pillar & Radial drilling machine. Countersunk, counter bore and spot facing tools and

			nomenclature. Cutting Speed, feed, depth of cut and Drilling time calculations.
		23. Drill Plate filing to an accuracy of ±0.05mm. 24. Marking for centre punching, drilling, reaming, tapping, counter boring, counter sinking. 25. Centre punching, drilling, reaming, tapping, counter boring, counter sinking on drill plate. 26. Die pass on standard material (M8). 27. Cutting tool filing and grinding on standard material.	Dial test indicator-its parts, types, construction and uses. Interchangeability: Necessity in Engineering. field, Limit-Definition, types, terminology of limits and fits-basic size, actual size, deviation, high and low limit, zero-line, tolerance zone, allowances. Different standard systems of fits and limits. Geometrical tolerance. British standard system, BIS system.
Professional Skill 110 Hrs.; Professional Knowledge 20 Hrs.	Make different fit of components for assembling as per required tolerance observing principle of interchange ability and check for functionality. [Different Fit – Open, Angular, & Square Fit; Required tolerance: ±0.05 mm, angular tolerance: 1 degree.]	28. Make Male & Female 'Open' fitting with accuracy ±0.05 mm.	Introduction about metals, difference between Metal and Non-Metal, properties of metal, Classification of metals and its applications, pig – iron, cast iron, wrought iron, steel-plain carbon steel (Low carbon steel, medium and high carbon steels, high speed steel, stainless steel, carbides, etc.)
		29. Make male & female for square fit with accuracy ± 0.05 mm.	Heat treatment of metals, process- such as annealing, nit riding, hardening, tempering, case hardening, carburizing, cyaniding, flame hardening, Induction hardening, purposes and its effects on the properties of steel. (08 Hrs.)
		30. Angular fitting with male & female. - Assembly fit with male & female by dowelling and screwing.	Getting to know the lathe with its main components, lever positions and various lubrication points as well. Definition of machine & machine tool and its classification.
Professional Skill 32 Hrs.;	Set different shaped jobs on different chuck and	31. Identify & function of different parts of lathe. Practice on operation of	Introduction to lathe. Centre lathe construction, detail function of parts, specification.

Professional Knowledge 07 Hrs.	demonstrate conventional lathe machine operation observing standard operation practice. *[Different chucks:3 jaws & 4 jaws, different shaped jobs: round, square, hexagonal]*	lathe (dry/idle run). 32. Setting lathe on different speed and feed. (02 hrs.) 33. Profile turning using hand tools-radius external and internal.	Safety points to be observed while working on a lathe.
Professional Skill 95 Hrs.; Professional Knowledge 21 Hrs.	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, internal recess, knurling.]*	34. Grinding of R.H. and L.H. tools, parting tool, Round nose tool. 35. Checking of angles with angle gauge / bevel protractor. 36. Grinding of "V" tools for threading of Metric/ British threads. 37. Plain turning (holding in 4 – jaw chuck), step turning and forming shoulder, chamfering in between centres as per dimensions. 38. Pillar turning between centres	Different types of Lathe operations - facing, turning, parting-off, grooving, chamfering, boring etc. Lathe cutting tool-different types, shapes and different angles (clearance, rake etc.), specification of lathe tools. Types of chips, chip breaker. Tool life, factors affecting tool life.
		39. Bush turning, drilling and boring/reaming. 40. Turning and die passing in a standard material. 41. Pin punch turning and knurling 42. Using 4 – jaw chuck; face both side of a plate thickness as per drawing.	Driving mechanism, speed and feed mechanism of Lathe. Concept of Orthogonal and Oblique Cutting. Chucks & different types of job holding devices on lathe and advantages of each type. Mounting and dismounting of chucks. Knurling-types, grade & its necessity. Vernier Bevel Protractor – parts, reading and uses.
		43. Taper turning male and female work pieces and assembly.	Various material for single point cutting tools, tip tools- their brazing and grinding process.
Professional Skill 25 Hrs.; Professional	Set the different machining parameters to produce threaded	44. External thread cutting on step turned work piece. (Metric, BSW & Square Thread)	Calculations of taper turning by off-setting tail stock. Sine Bar – description & uses Slip gauge –description and uses.

Knowledge 05 Hrs.	components applying method/ technique and test for proper assembly of the components with an accuracy of ± 0.05 mm. *[Different threads viz., metric/ BSW/ Square]*	45. Turn job for Internal thread and cut internal thread	
(Professional Skill 128 Hrs.; Professional Knowledge 18 Hrs.)	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, stepped, angular, dovetail, T-slot, contour, gear milling]*	46. Identification of milling machine. 47. Demonstrate working principle of Milling Machine. 48. Set vice & job on the table of Milling Machine. 49. Set arbor on the spindle of milling machine. 50. Set the cutter on arbor. 51. Safety points to be observed while working on a milling machine.	Milling Machine: importance, types, construction and specification. Driving and feed mechanism of Milling Machine Different milling cutter angles, Milling cutter materials.
		52. Demonstrate Up Milling and Down Milling Process. 53. Perform sequence of milling for six faces of a solid block 2 numbers. 54. Check the accuracy with the help of tri-square and vernier height gauge. 55. Perform Step milling using side and face cutter checking with depth micrometer.	Job holding devices-vice, clamps, V-block, parallel block etc. Milling cutter holding devices, milling process – Up milling and Down milling.
		56. Milling blank piece (plain milling). 57. Slot milling with side and face cutter 58. 90^0 angular milling with equal angle cutter. 59. Dove tail milling. 60. Tee slot milling.	Calculation of cutting speed, feed, machining time for milling machine. Milling machine operations. Milling machine attachments – vertical milling attachment,
		61. Concave and Convex milling.	Introduction to coolant & lubricant-difference between them, types and uses of each.

		62. Simple indexing practice	Dividing head – Introduction, construction, types. Simple and universal dividing head. Indexing methods – direct indexing, simple indexing, angular indexing, its calculations. (05 Hrs.)
Professional Skill 108 Hrs.; Professional Knowledge 09 Hrs.	Produce components of high accuracy by surface grinding operation. *[Accuracy of +/- 0.02 mm]*	63. Identification of different types of grinding machine. 64. Wheel balancing & truing. 65. Dressing of grinding wheel. 66. Grinding of block (six sides) in surface grinding machine with an accuracy of ±0.01 mm.	Grinding machine introduction, types, Surface & Cylindrical grinding Machine- their parts, functions, specification, and uses. Safety points to be observed while working on a Grinding machine.
		67. Grinding of step block in surface grinding machine with an accuracy of ± 0.01 mm. 68. Grinding of slot block in surface grinding machine with an accuracy of ± 0.01 mm. 69. Set and perform angular grinding using sine plate to stranded angle. 70. Make slide fit (male/female) 71. Perform form grinding. 72. Taper angle grinding fitting.	Grinding wheel shapes and sizes. Standard marking system. Selection of grinding wheel.
Professional Skill 66 Hrs.; Professional Knowledge 08 Hrs.	Produce components of high accuracy by cylindrical grinding operations. *[Accuracy of +/- 0.02mm.]*	**Cylindrical grinding:** 73. External Parallel grinding (Both holding in chuck/ collet and in between centres. 74. Plunge grinding.	Procedure for mounting of grinding wheels, balancing of grinding wheels. Dressing, types of dresser. Glazing and Loading of wheels – its Causes and remedies. Roughness values and their symbols. Explain the importance and necessity of quality.
		Cylindrical grinding: 75. Internal Parallel grinding	Abrasives - its types, Bond, Grade, Grit, structure.

		(Both holding in chuck/collet). 76. Grinding of step in Cylindrical grinding machine with an accuracy of ±0.01 mm 77. Grinding of external taper in Cylindrical grinding machine with an accuracy of ± 0.01 mm.	
Professional Skill 30 Hrs.; Professional Knowledge 04 Hrs.	Sharpen different cutter or multipoint cutting tool. [Different cutters – end mill cutter, side & face milling cutter, single angle cutter, Reamer]	78. Demonstrate and practice of grinding of end mill cutter of different sizes by using tool & cutter grinding machine.	Tool & cutter grinder- construction, use and specification.
Professional Skill 108 Hrs.; Professional Knowledge 28 Hrs.	Develop isometric drawing and solid modelling of mould using CAD & Pro-E.	79. Prepare simple mould design drawings with basics of AutoCAD viz., Basic and advanced 2D drafting, draw commands, Constraints, Modify commands, Layers, Line types block, Texts, Attribute, Table, Dimensioning, Isometric, Solid modelling, View port.	AutoCAD: Introduction to AutoCAD, creating first drawing, learning the tools trade, organizing the work, drawing the first mould.
		80. Prepare solid modelling of simple mould with Pro-E [Sketch, Part (solid, surface, free style, flexible modelling, sheet metal.), Assembly, Creo direct, Creo simulate]. 81. Creating (NC assembly and mould cavity) drawing. 82. Part drawing of the universal coupling assembled all the parts and solid modelling and denoted by coloured combination.	Pro-E: Familiarization of interface/ Windows, Sketching, basic modeling, advanced modeling, assembling, drawing, surface modeling, manufacturing – mould design awareness.
ENGINEERING DRAWING: (40 Hrs.)			
Professional Knowledge	Read and apply engineering	Introduction to Engineering Drawing and Drawing Instruments – ● Conventions	

ED- 40 Hrs.	drawing for different application in the field of work.	• 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: (40 Hrs)		
Professional Knowledge WCS- 40 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**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 • Ratio and proportion - Direct and indirect proportions • 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 and carbon steel • Properties of insulating materials **Mass, Weight, Volume and Density** • Mass, volume, density, weight and specific gravity **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 • Transmission of heat - Conduction, convection and radiation • Co-efficient of linear expansion **Basic Electricity** • Introduction and uses of electricity, molecule, atom, how electricity is produced, electric current AC, DC their comparison, voltage, resistance and their units **Mensuration** • Area and perimeter of square, rectangle and parallelogram • Area and perimeter of Triangles • Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse • Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder • Finding the lateral surface area, total surface area and capacity in litres of hexagonal, conical and cylindrical shaped vessels **Levers and Simple machines** • Lever & Simple machines - Lever and its types **Trigonometry** • Measurement of angles • Trigonometrical ratios • Trigonometrical tables
In-plant training/ Project work **Broad area** a) Tool Maker's Clamp b) Grinding Wheel Dressing Fixture		

SYLLABUS FOR TOOL & DIE MAKER (DIES & MOULDS) TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill 50 Hrs.; Professional Knowledge 06 Hrs.	Produce components of high accuracy by different operations using Electric Discharge machine (EDM) and Wire EDM with accuracy of ± 0.02mm.	83. EDM machining practice/ observation on EDM machine exercises. 84. Machining practice on Wire EDM machine.	Electrical discharge machine (EDM) introduction principle of operation, advantages and disadvantages and its applications. Introduction principle of operation advantaged and disadvantaged and applications.
Professional Skill 70 Hrs.; Professional Knowledge 10 Hrs.	Set (both job and tool) CNC lathe and produce components as per drawing by preparing part programme.	85. Study of CNC lathe, key board and specifications. 86. Machine starting & operating in Reference Point, JOG, and Incremental Modes. 87. Co-ordinate system points, assignments and simulations Absolute and incremental programming assignments and simulations. 88. Co-ordinate points, assignments and simulations. Identification of machine over travel limits and emergency stops. 89. Work and tool setting. Automatic Mode operation: facing, profile turning, drilling, tapping, reaming, thread cutting etc.	**Safety Precautions:** Safe handling of tools, equipment & CNC machines, CNC turning with FANUC CNC CONTROL- (Fanuc-Oi-T latest) CNC Machine and Control specifications. CNC system organization Fanuc-0i-T**.** Co-ordinate systems and Points. CNC lathe, Types, Machine axes.
Professional Skill 62 Hrs.; Professional Knowledge 10 Hrs.	Set (both job and tool) CNC machining centre and produce components as per drawing by preparing part	90. Study of CNC Machining centre, keyboard and specifications. 91. Machine starting & operating in Reference Point, JOG, and Incremental Modes.	**Safety Precautions:** Safe handling of tools, equipment & CNC machines, CNC Mill with FANUC CNC CONTROL- (Fanuc-0i-M latest) CNC Machine &Control specifications. CNC system organization Fanuc-0i-M**.**

	programme.	92. Co-ordinate system points, assignments and simulations Absolute and incremental programming assignments and simulations. 93. Polar co-ordinate points, assignments and simulations. Identification of machine over travel limits and emergency stops. 94. Work and tool setting. Automatic Mode operation: Face Milling, profile milling, drilling, tapping, reaming etc.	Co-ordinate systems and Points. CNC Machines Milling, Types, Machine axes.
Professional Skill 75 Hrs.; Professional Knowledge 18 Hrs.	Construct a Hand Injection Mould and try out/ test the mould assembly.	95. Manufacture hand injection mould. (May use the plates used in turning, milling and grinding exercise). 96. Try out and rectification.	Hand injection mould Introduction to plastic material: Types of plastics, differentiation of plastics, Properties, application, fillers and additives and reinforced plastics. Mould terminology: Core, cavity, impression, runner, gate, sprue bush, mould base etc. Parting line: Types of parting line, mould matching (Bedding down), vent and relief. Requirement for ejection: Types of ejector grids, ejector elements and ejector system. Feed System: Sprue, runner, gate, types, design and calculations, vent design, balancing, etc.
Professional Skill 150 Hrs.; Professional Knowledge 48 Hrs.	Construct two cavity injection mould and try out component.	97. Develop isometric drawing and manufacture 2 cavity injection moulds in a group of 5 trainees using various tool room machines (conventional and non-conventional machines). 98. Try out component and rectification.	Shrinkage: Introduction mould life, cavity/core dimensions, and various shrinkage values for different plastic materials. Temperature controlling of moulds: Introduction, factors effecting the cooling of moulds, layout and sizing of cooling channel, cooling integer type mould plate (core cavity,

			Bolster), cooling core and cavity inserts and sub inserts, mould cooling requirements and calculations. Injection moulding machines: Introduction, clamping system/ injection system terminologies and specifications, screw terminology construction of screw, types of moulding machines, and sequence in the moulding cycle. Selection of mould base, material and no. of cavities: Introduction, Selection of mould base and material, advantages and disadvantages of single/ multi-cavity mould, calculation of no. of cavities. Splits: External undercut components, methods of operation, split locking methods, splits safety arrangements. Side cores and side cavities: Introduction, moulding embedded side holes/ recess/slots, Design requirements for side core/ side cavities, internal side core/side cavities. Moulding internal under cuts/ threads: Definition, form pin/ split core/ side core, stripping internal under cuts purpose of threads in plastics, moulding internal threads, power and transmission system layout of impression, and moulding of external threads.
Professional Skill 100 Hrs.; Professional Knowledge 28 Hrs.	Construct single cavity mould (Compression mould/ plunger type transformer mould).	99. Manufacture single cavity plunger type transfer mould in a group of 5 trainees using various tools room machine (conventional and non-conventional)	Moulding of thermoset materials: Introduction, processing method, compression moulding, definition, pellet, compression moulding types, advantages and disadvantages of semi positive and fully positive

		OR Manufacture multi cavity compression mould construct a single cavity compression mould in a group of 5 trainees using various tool room machine (conventional and non-conventional)	mould, automatic compression mould, mould heaters and thermo couples, etc., Transfer moulding, types of transfer moulding, advantages and disadvantages of transfer moulding, Injection moulding of thermo set material, Advantages and disadvantages of injection moulding of thermo set material, Compression/ transfer moulding defects. Surface finish: Mould polishing, different types and appearance required after finishing, overview of the process, standard specification of finish, mechanical equipment of mould polishing, finishing process, problems in mould polishing and solutions, surface treatment method. Multi day light mould: Introduction, under feet mould with reverse tapered sprue, floating runner plate, working system for floating cavity plate, other standard designs, some non-standard latch/ locks, some sample multi-day light design. Introduction of blow moulding, types of blow moulding advantage and disadvantage of blow moulding. Material used in blow moulding, blow moulding fault & remedy.
Professional Skill 35 Hrs.; Professional Knowledge 08 Hrs.	Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect.	100. Identification and familiarisation of various types of hydraulic & pneumatic elements such as cylinder, valves, actuators and filters. 101. Study of simple hydraulic & pneumatic circuit.	Basic principles of hydraulics/ pneumatics system, advantages and disadvantages of hydraulics and pneumatics systems, theory of Pascal's law, Brahma's press, Pressure and flow, types of valves used in hydraulics and pneumatics system.
Professional Skill 43 Hrs.;	Plan and perform simple repair,	102. Perform Periodic maintenance of lubrication	Lubricating system-types and importance

Professional Knowledge 08 Hrs.	overhauling of different machines and check for functionality. *[Different Machines – Drill Machine, milling machine and Lathe]*	system on Machines. 103. Perform simple repair work. 104. Perform the routine maintenance with check list. 105. Inspection of Machine tools such as alignment, levelling etc. 106. Accuracy testing of machine tools such as geometrical parameters.	Maintenance: Definition, types and its necessity. System of symbol and colour coding. Possible causes for failure and remedies.
Professional Skill 255 Hrs.; Professional Knowledge 90 Hrs.	Develop isometric drawing and construct two cavity moulds with side core. OR Construct an injection mould with side cavities (with cam pin) (two cavities rounded square bobbin)	107. Develop isometric drawing and manufacture 2 cavity injection moulds with side cavities in a group of 5 trainees using various tool room machines (conventional and non-conventional) 108. Assemble all the parts of mould and try-out and find out fault of component and rectification. 109. Prepare different types of documentation as per industrial need by different methods of recording information for the project.	Hot runner mould: Definition, runner less mould, advantages and disadvantages of hot runner moulding system, type of hot runner system, valve system, selecting a hot runner system, advantages and disadvantages of insulated runner mould and modified insulated runner mould, starting/ restarting nozzles in a manifold application. Injection moulding defects**:** Introduction, common faults, possible problems and remedies, analysis of moulding problems and solutions. Other moulding processes: Blow moulding, Extrusion moulding, rotational moulding, thermo forming, sheet and film forming. Multi-color moulding: Introduction, multi-color moulding, multi-material moulding and multi-process moulding. Maintenance of mould: Introduction, upkeep and maintenance, types of maintenance of idle moulds, maintenance control, and frequency of maintenance. Die cast mould: Introduction to Die casting, Die casting, gating

			system design, force calculation, defects and remedies. Die and mould economics: Estimation and casting of mould raw material, machining hour rate, business transactions, cost of components, activity-based costing, estimation of moulds and standard items.
ENGINEERING DRAWING: (40 Hrs.)			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work.	**ENGINEERING DRAWING:** • 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: (34 Hrs)			
Professional Knowledge WCS- 34 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**WORKSHOP CALCULATION & SCIENCE:** **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 (Only overview required). Heat treatment - Different heat treatment process – Hardening, tempering, annealing, normalizing and case hardening (Only overview required) **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**.**
Project work (assembly of the mould and trail) document preparation The cavity injection moulding (Glass cover/ radio knob) [The candidates should develop the isometric drawing with solid modelling for the mentioned project]		

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

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

ANNEXURE-I

LIST OF TOOLS AND EQUIPMENT			
TOOL AND DIE MAKER (DIES AND MOULDS) (For Batch of 24 Candidates)			
S No.	**Name of the Tool & Equipments**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1.	Steel Rule	150 mm English and Metric combined	(24+1) Nos.
2.	Engineers Square	100 mm with knife edge	(24+1) Nos
3.	Hacksaw frame solid type	200-300 mm blade	(24+1) Nos
4.	Centre punch	100 mm	(24+1) Nos
5.	Dot punch	100 mm	(24+1) Nos
6.	File flat bastard	300 mm	(24+1) Nos
7.	File flat 2nd cut	250 mm	(24+1) Nos
8.	File flat safe edge	200 mm	(24+1) Nos
9.	File triangular smooth	150 mm	(24+1) Nos
10.	Hammer cross peen	0.5 kg	(24+1) Nos
B: TOOLS AND EQUIPMENT			
11.	Screwdriver	150 mm	4 nos.
12.	Screwdriver	200 mm	4 nos.
13.	File flat smooth	200 mm	5 nos.
14.	File flat Second cut with safe edge	200 mm	5 nos.
15.	File half round bastard	300 mm	5 nos.
16.	File half round second cut	250 mm	5 nos.
17.	File triangular bastard	250 mm	5 nos.
18.	File triangular second cut	200 mm	5 nos.
19.	File round bastard	250 mm	5 nos.
20.	File square bastard	300 mm	5 nos.
21.	File square second cut	250 mm	5 nos.
22.	Knife edge file	150 mm	5 nos.
23.	Needle file assorted (12 nos.)	150 mm	5 nos.
24.	Hammer Ball Peen	0.5 kg with handle	4 nos.
25.	Hammer Cross Peen	0.5 kg with handle	4 nos.
26.	Chisel cold flat	18 x 150 mm	10 nos.
27.	Scribing block universal	300 mm	2 nos.
28.	Granite Surface plate	600 x 600x80 mm	1 no.
29.	Taps and dies metric	5 mm to 12 mm complete set in a box	2 sets
30.	Twist Drill with St. Shank	Ø 1 to Ø 12 mm in steps of 0.5	3 set

		mm	
31.	Twist Drills	Dia. 3.2, 4.1, 4.2, 5.2, 6.8, 8.5, 3.8, 4.8, 5.8, 7.7, 9.7, 11.7	2 nos. each
32.	Taper shank drills	Ø 12 mm to Ø 20 mm in steps of 1 mm	1 set
33.	D.E spanners	3-4, 6-8, 10-12, 13-14, 15-16, 18-19, 20-22, 24-26 (8 spanners)	2 sets
34.	Letter punch	5 mm set	3 set
35.	Number punch	5 mm set	3 set
36.	Drill chuck	12 mm capacity with key	4 no.
37.	Allen key metric	3 to 12 mm set	1 sets
38.	Centre drills	No. 3, 4 & 5	5 each
39.	Parallel hand reamer	6 mm to 12 mm in steps of 2 mm with suitable wrench	2 set
40.	Star dresser		2 nos.
41.	Diamond dresser with holder		2 nos.
42.	Safety goggles (Personal Protective Equipments)		12 nos.
43.	Demagnetizer		1 no.
44.	Snips	200 mm	1 no.
45.	Workbench	150 cm x 80 cm x 75 cm with 150 mm vice (Each bench fitted with 2 vices)	12 nos.
46.	Bench Vice	150 mm	24nos.
47.	Steel lockers for 20 trainees (Pigeon Cup Board)		2 nos.
48.	Steel cupboard	180 cm x 60 cm x 45 cm	8 nos.
49.	Metal rack	180 cm x 60 cm x 45 cm	1 nos.
50.	Fire extinguisher	Arrange all proper NOCs and equipment from Municipal/Competent authorities.	
51.	Feeler gauge	0.05 mm to 0.3 mm by 0.05 and 0.4 mm to 1 mm by 0.1 mm (13 leaves)	2 set
52.	Metric Screw pitch gauge-Range	0.4 -6 mm pitch 600 (21 leaves)	2 set
53.	Radius gauge	1 - 3 mm by 0. 25 mm and 3.5-7mm by 0.5 mm (34 leaves)	2 nos.
54.	Vernier height gauge	Range 300 mm, with 0.02 mm least count	2 nos.
55.	Universal Vernier caliper	150 mm, with 0.02 mm least count	5 nos.
56.	Digital caliper	200 mm, with 0.01 mm least count	2 nos.
57.	Vernier caliper-Range	300 mm Vernier scale 0.02 mm	2 nos.
58.	Vernier bevel protractor-Blade range	150 / 300 mm, dial 1^0 , least count 5 (min.) with head, Acute Angle attachment	1 no.
59.	Outside micrometer	0-25 mm, with 0.01 mm least	4 nos.

		count	
60.	Outside micrometer	25-50 mm, with 0.01 mm least count	4 nos.
61.	Outside micrometer	50-75mm, with 0.01 mm least count	4 nos.
62.	Sine bar with stopper plate	150 mm	1 no.
63.	Sine table with magnetic bed	200 mm length	1 no.
64.	Slip Gauge Box (workshop grade) -	87 pieces per set	1 set
65.	V-Block-Approx.	32 x 32 x 41 mm with clamping capacity of 25 mm with clamps	2 pairs
66.	V-Block-Approx.	65x65x80 mm with clamping capacity of 50 mm with clamps	1 pair
67.	Magnetic V-Block	100x100x125 mm	2 pairs
68.	Angle plate	150 x 150 x 200 mm	2 no.
69.	Angle plate-adjustable	250x250x300 mm	1no.
70.	Inside micrometer Range	50-63 mm with std extension rods up to 200mm	1 set
71.	Depth micrometer	Range 0-25 mm, accuracy 0.01 mm with std set of extension rods.	1set
72.	Magnetic stand with magnetic base	60 x 47.5 mm and with universal swivel clamp, dial holding rod (150 mm) scriber	2 nos.
73.	Dial test indicator-Lever type- Range	0-0.8 mm Graduation 0.01mm, reading 0-50-0 with accessories	2 nos.
74.	Dial test indicator Plunger Type-Range	0-10 mm , Graduation 0.01 mm, Reading 0-100 with revolution counter	2 nos.
75.	Magnetic vice	200 m	2 nos.
C. CUTTING TOOLS			
76.	Side and face milling cutter	Ø 100 x 10 X Ø 27 mm	2 nos.
77.	Side and face cutter	Ø 80 x 10 X Ø 27mm	2 nos.
78.	Cylindrical milling cutter mm	Ø 63 x 70 x Ø 27	2 nos.
79.	Slitting Saw cutter	Ø 75 x 4 X Ø 27mm	2 nos.
80.	Single angle cutter	Ø 75 x 16 x Ø 27mm – 60^0	2 nos.
81.	Dovetail cutter	Dia. 20 X 8 mm shank x 60^0	2 nos.
82.	Single angle cutter	Ø 75 x 20 x Ø 27 – 45^0	2 nos.
83.	Equal angle cutter	Ø75x 30 x Ø 27 - 90^0	2 nos.
84.	Shell End Mill	Ø 50 x 36 x Ø 22 (Indaxable 6 inserted type)	2 nos.
85.	Shell End Mill	Ø 75 mm x 50 x Ø 22 (Indaxable 6 inserted type)	2 nos.
86.	Parallel shank end mills	Ø6, Ø10 and Ø 16 are (double fluted), Ø 20 mm & Ø 25mm (four fluted)	4 nos. each

87.	T slot cutter with parallel shank	Ø 17.5 x 8 mm width x dia. of shank 8 mm	2 nos.
88.	Concave Milling cutter	Ø 63 x 6 radius/10 radius x Ø 27 mm	1 no. each
89.	Convex Milling cutter	Ø 63 x 6 radius/ 10 radius x Ø 27 mm	1 no. each
90.	Knurling tool (straight & diamond)		2 nos. each
D. GENERAL MACHINERY & INSTALLATION:			
91.	Pillar/column type Drilling machine	25 mm capacity-motorized with drill chuck, key etc.	1no.
92.	Radial Drill machine	to drill up to 32 mm diameter	1no.
93.	Bend saw machine	to accommodate 21" or more length blade	1no.
94.	Double ended Pedestal Grinder	178 mm wheels(one fine and one rough wheel)	1 no.
95.	SS and SC centre lathe (all geared) with DRO	centre height 150 mm and centre distance 1000 mm along with 3 jaws, 4 jaw chuck, auto feed system, taper turning attachment, Coolant pump, safety guard and machine light arrangement.	3 nos.
96.	Shearing machine (lever type)hand operated	300 mm blade length	1 no.
97.	**Universal Milling Machine** With DRO (5 micron accuracy)	Longitudinal traverse 700 - 800 mm Cross traverse 250 - 400 mm Vertical traverse 200 - 350 mm Swivel of table on either side 45^0 Speed range rpm 30 to 1800 With universal dividing head, circular table, long arbors, slab arbor, slotting attachment, vertical indexing head, etc.	2 nos.
98.	**Vertical milling machine**	**Table** Length x width 1350x310 mm Longitudinal traverse 700 - 800 mm Cross traverse	1 no. each

		200 - 265 mm Vertical traverse 300 - 400 mm Speed range rpm 20 to 1800 or higher specification	
99.	Turret Ram Milling machine with DRO (5 micron accuracy)	as per the latest specification	1 no.
100.	**Hydraulic Surface Grinding Machine With DRO (5 micron accuracy)**	**Table** Clamping area 600 x 178 mm Grinding area 400 x 200 mm Distance table-centre of spindle 400 - 500 mm Table speed 1-25 m/min. With standard accessories like dust extractor with water separator, balancing device, table-mounted Radius-tangent wheel dresser, wheel flanges, etc.	2 nos.
101.	**Tool & Cutter Grinder** With DRO (5 micron accuracy)	Largest diameter of cutter that can be ground 10-100 mm Max. admit between centers 230 mm Max. length of cutting edges ground120 mm With standard equipment like adaptor bushes, cutter head holder assembly, adaptors, extension spindle, flanges for grinding wheel, etc.	1 no.
102.	**Universal cylindrical Grinding Machine** With DRO(5 micron accuracy)	Max. dia. ground (effective) 250 mm Max. grinding length 300 mm Height of centre 130 mm Max. distance between centers 340 mm With special accessories like face plate, steady, radius and face dressers, find hand	1 no.

		feed attachment etc.	
103.	Muffle Furnace	Heating Chamber 300 x 300 x 450 mm for 10500 C Quenching tank- approx. 600 x600 x 600 mm/ approx. Dia. 600mm x 600mm ht.	1 no.
104.	Rockwell Hardness Testing Machine with standard accessories(Digital type)		1 no.
105.	Spark erosion EDM with standard accessories with DRO		1no.
106.	Polishing kit		1 no.
107.	Hand Injection Moulding Machine	approx. 50 g capacity	1 no.
108.	Hand Compression Moulds type machine	Compression moulding process (Mechanical for 50 gms.) Minimum 25 Ton capacity.	1 no.
109.	Screw Type Injection Moulding Machine	(capacity 50 gms.) (Not required if plastic processing operator trade is available in the institute) Minimum 25 Ton capacity	1 no.
110.	Simulator	[specification as per Annex-A &A (II)]	As per Annex-A &A (II)
111.	Desktop computers with latest configuration with necessary furniture	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.	As per Annex-A
112.	CAD/CAM software	Latest version/Free version available	As required
113.	CNC milling machine/ Vertical machining centre (VMC)	[specification as per Annex-A]	As per Annex-A& A (II)
114.	CNC lathe/CNC turn Centre	[specification as per Annex-A & A (I)]	As per Annex-A & A (I)
115.	Co-ordinate measuring machine (optional)		01
116.	Profile projector (Optional)		01
117.	Auto CAD software	Latest Version	25 license
118.	Creo (Pro-E) software	Latest Version	25 license
119.	Smart touch screen panel for smart class		01 no.

	room		

NOTE:

1. No additional items are required to be provided to the batch working in the second and third shift except the items under trainee's toolkit.
2. Institute having centralized computer lab may use the existing infrastructure to impart simulation training and, in that case, not required to procure item No. 148.
3. Internet facility is desired to be provided in the classroom.

CNC LAB						
Space and Power Requirement						
1	Space Required (in Sq. Meter):	40 (For below 8 (4+4) units) 65 (For above 8 (4+4) units)				
2	Power Required (in KW):	6 (For below 4 (2+2) units) 12.5 (For 4 (2+2) & above units)				
CNC Lab Infrastructure						
S.N.	**Name of Item**	**Category**	**Quantity**		**Unit**	**Remark**
			4 (2+2) units & Above	**Below 4 (2+2) units**		
1	CNC turn Centre [specification as per Annex-A (I)]	Machine	1	NIL	No.	Refer Instructions
2	CNC Vertical Machining Centre [specification as per Annex-A (II)]	Machine	1	NIL	No.	Refer Instructions
3	Multimedia based simulator for CNC technology and interactive CNC part programming software for turning & milling with virtual machine operation and simulation using popular operation control system such as Fanuc, Siemens, etc. (Web-based or licensed based) (24 trainees + 1faculty) ***With help of this software the trainees should be able to Write, Edit, Verify & Simulate***	Software	12	12	users	
4	Desktop Computers compatible to run simulation software with LAN facility	Machine	12	12	No.	
5	Printer - (Laser/ Inkjet)	Machine	1	1	No.	Optional
6	Air Conditioner - Split - 2.0 Ton	Machine	1	1	No.	Optional
7	UPS				No.	As required
Instructions						

a)	**For units less than 4(2+2), ITI can enter into MoU with Facilitator who will provide the Training to Trainees admitted and undergoing training in above Trades.** The Facilitator should be Government ITI, Engineering/ Polytechnic College, Recognized Training Institute, Industry, Private ITI (Facilitators are arranged in descending preference order). The Facilitator should have all the above training infrastructure. (Including CNC Machines and Multimedia software for CNC). If any of the facility is not available with facilitator then the same should be provided in the ITI. The facilities of CNC should be made available to ITI trainees at the time of examination. This clause should be part of MoU to be signed. The training provider must be within the range of 15 Km or within city whichever is less.
b)	**NOTE: -** "*It is on the discretion of the ITI that it may procure CNC simulation software with extra features in addition to the specification defined against CNC simulator*".

DETAILED SPECIFICATION FOR CNC LATHE			
1.	**MACHINE CAPACITY**	**Units**	**Size**
a	Max. load on Chuck	kg	Maximum 40
b	Machine weight net	kg	1500 or higher
2.	**SPINDLE**		
a	Maximum spindle speed	RPM	4000 or higher
b	Type of drive	AC servo spindle motor (digital)	
c	Front Bearing Dia. (ID)	mm	60 or higher
3.	**AXES**		
a	X - axis Travel	mm	200 or higher
b	Z - axis Travel	mm	290 or higher
c	Rapid traverse - X	m/min	10/15 or higher
d	Minimum programmable command- X/ Z	mm	0.001
e	Programmable feed range - X, Z axes	mm/min	10 - 10000
f	Type of drive	AC servo motor	
g	Motor Torque - X axes	Nm	3 or higher
h	Motor torque - Z axis	Nm	6 or higher with brake
5.	**ACCURACY as per ISO 230-2**		
a	Positioning accuracy for X,Y & Z axes	mm	0.012
b	Repeatability for X,Y & Z axes	mm	±0.007
6.	**CNC SYSTEM**		
a	Control System	FANUC/Siemens	
b	Machine control panel	Feed rate, spindle speed override knob	
c	MPG (Manual pulse generator)	On machine operator panel	
d	CNC Features	Tool Offsets MDI	
7.	**COOLANT/LUBRICATION**		
a	Coolant tank Capacity	Litres	100 or higher
b	Coolant pump motor	kW	0.25
c	Coolant pump output	lpm	20 or higher
8.	**POWER SOURCE**		
a	Mains supply (± 10 %)		415 V, 3 Ph., 50Hz
b	Total connected load requirement		Approx. 15 kVA
9.	**STANDARD EQUIPMENT**		
a	Voltage Stabilizer	15 kVA	
b	Backup CD for PLC Ladder Logic	1 no.	
c	Machine lightning	1 no.	
d	Levelling pads and jacking screws	4 nos.	
e	Operation manual	1 no.	
f	Maintenance manual	1 no.	
g	Installation kit	1 no.	
h	Maintenance tool kit	1 no.	

10.	MAKES OF CRITICAL COMPONENTS	
a	LM Guideways	HIWIN/THK/PMI/STAR
b	Ball Screws	HIWIN/THK/TSUBAKI/PMI/STAR/HMT/NSK
c	Spindle Bearings	RHP/NSK/FAG/SKF/NRB
d	Stabilizer	NEEL/SE RVOMAX/CONSUL/FARMAX
e	Lubrication	CENLUBE/DROPCO
f	Coolant Pump	RAJAMANE/GRU NDFOS

11.	Cutting Tools & Tool Holders (for BT30 or BT40 as per machine supplied)					
S No.	Item	Quantity		Inserts	Quantity	
		1 year	3 years		1 year	3yrs
a.	OD turning tool	2	4	Suitable inserts	5 sets	15
b.	OD grooving tool	2	4	Suitable inserts	5 sets	15
c.	Thread cutting tool	2	4		20	60
d.	ID turning tool	2	4		20	60
e.	ID threading tool	2	4	Suitable inserts	10	30
f.	C spanner for tightening tools in holder	1	2			
g.	Magnetic dial stand	1	2			
h.	Mallet	2	4			
i.	Tap wrench	1	2			
j.	Hands tools set (spanners, Allen keys, etc.,)	1 box				
k.	T Nuts, Strap clamps, Clamping Nuts and studs	1 set				
l.	Hands tools set (spanners, Allen keys, etc.,)	1 box				
m.	T Nuts, Strap clamps, Clamping Nuts and studs	1 set				

DETAILED SPECIFICATION FOR CNC VERTICAL MACHINING CENTRE			
1.	**MACHINE CAPACITY**	**Units**	**Size**
a	Table size	mm	500x250 or higher
b	Max. load on table	Kg	150 or higher
c	T slot dimension (N x W x P)	mm	3 x 14 x 100 or higher
d	Table height from floor	mm	800 ~ 900
e	Cast Iron grade for bed and saddle	Grade 25 or equivalent	
f	Machine net weight	kg	1500 or higher
2.	**SPINDLE**		
a	Spindle nose	BT30 / BT40	
b	Minimum distance (spindle nose to table)	mm	100 - 150
d	Maximum spindle speed	RPM	6000 or higher
e	Spindle power, continuous	kW	3.7 or higher
f	Type of drive	AC servo spindle motor (digital)	
g	Spindle bearing class	P4	
h	Front Bearing Dia. (ID)	mm	50 or higher
3.	**AXES**		
a	X - axis Travel	mm	300 or higher
b	Y - axis Travel	mm	250 or higher
c	Z - axis Travel	mm	250 or higher
d	Rapid traverse - X/Y/Z	m/min	20/20/20 or higher
e	Minimum programmable command- X/Y/ Z	mm	0.001
f	Programmable feed range - X, Y & Z axes	mm/min	10 - 10000
g	Type of drive	AC servo motor	
h	Motor Torque - X & Y axes	Nm	3 or higher
i	Motor torque - Z axis	Nm	6 or higher with brake
j	Ball screw - X, Y & Z axes (diameter x pitch)	mm	25 x 10 or higher
k	Ball screw finish - X, Y & Z axes	Ground and hardened	
l	Ball screw class - X, Y & Z axes	Pre-loaded with C3 or better	
m	Guideways - X, Y & Z axes	Antifriction linear motion guideway	
n	Guideways size - X, Y & Z axes	mm	25 or higher
o	Guideway precision - X, Y, & Z axes	P Class	
4.	**AUTOMATIC TOOL CHANGER**		
a	Number of tool pockets	nos.	8 or higher
b	Max tool diameter	mm	80 or higher
c	Tool selection	Bi-directional	
d	Tool shank type	BT30 / BT40	
e	Tool weight max	kg	2.5 for BT30 / 6 for BT40
f	Tool length max	mm	100 ~150 for BT30 / 150~200 for BT40
g	Tool change time (chip to chip)	sec	5 or lower

h	Tool clamp & unclamp	Disc Spring & Hydro-Pneumatic	
5.	**ACCURACY as per ISO 230-2**		
a	Positioning accuracy for X,Y & Z axes	mm	0.012
b	Repeatability for X,Y & Z axes	mm	±0.007
c	Geometrical Alignment		ISO 10791-Part 1
d	Accuracy of finish test piece		ISO 10791-Part 7
6.	**CNC SYSTEM**		
a	Control System	FANUC/Siemens	
b	Motors & Drives	Compatible with CNC controllers as mentioned above	
c	System resolution	0.001 mm	
d	Tool number display	On machine operator panel	
e	Machine control panel	Feed rate, spindle speed override knob	
f	MPG (Manual pulse generator)	On machine operator panel	
g	CNC Features	Graphic Simulation, Programming help, Tool Offsets MDI	
		Absolute/Incremental Positioning, Pitch error compensation	
7.	**COOLANT/LUBRICATION**		
a	Coolant tank Capacity	Litres	100 or higher
b	Coolant pump motor	kW	0.37
c	Coolant pump output	lpm	20 or higher
d	Lubrication type		Automatic centralized lubrication
e	Lubrication tank capacity	Litres	3 or higher
8.	**AIR COMPRESSOR FOR TOOL UNCLAMP**		
a	Compressor Type		Screw type with dryer, filter & air receiver
b	Tank capacity	litres	200 or higher
c	Air Flow	CFM	10 or higher
d	Pressure	bar	7 max.
9.	**POWER SOURCE**		
a	Mains supply (± 10 %)		415 V, 3 Ph., 50Hz
b	Total connected load requirement		Approx. 15 kVA
10.	**STANDARD EQUIPMENT**		
a	Voltage Stabilizer	15 kVA	
b	Air conditioning unit for electrical cabinet	As required	
c	Backup CD for PLC Ladder Logic	1 no.	
d	Machine lightning	1 no.	
e	Levelling pads and jacking screws	4 nos.	
f	Operation manual	1 no.	
g	Maintenance manual	1 no.	
h	Installation kit	1 no.	
i	Maintenance tool kit	1 no.	
j	6 rack tool trolley (Size 25"x22"x45") with lock	1 no.	

h	Machine guarding with safety compliance	1 no.	
11.	**MAKES OF CRITICAL COMPONENTS**		
a	LM Guideways	HIWIN/THK/PMI/STAR	
b	Ball Screws	HIWIN/THK/TSUBAKI/PMI/STAR/HMT/NSK	
c	Spindle Bearings	RHP/NSK/FAG/SKF/NRB	
d	ATC	PRAGATI/GIFU	
e	Panel AC	WERNER FINLEY/RITTAL/LEXTECNOID	
f	Stabilizer	NEEL/SE RVOMAX/CONSUL/FARMAX	
g	Lubrication	CENLUBE/DROPCO	
h	Coolant Pump	RAJAMANE/GRU NDFOS	
i	Cutting tools and holders	SANDVIK/TAEGUTEC/KEN NAMETAL/SECO/MITSUBISHI	
j	Air compressor (capacity: 6 kg/cm2 - 300 lpm min.)	GODREJ/ELGI/KAESER/ATLASCOPCO	

12.	**Cutting Tools & Tool Holders (for BT30 or BT40 as per machine supplied)**					
S No.	**Item**	**Quantity**		**Inserts**	**Quantity**	
		1 year	**3 years**		**1 year**	**3yrs**
a.	Face mill 45-degree 63 mm., insert type	2	4	Suitable inserts	5 sets	15
b.	Face mill square shoulder 50 mm., insert type	2	4	Suitable inserts	5 sets	15
c.	Twist drill HSS straight shank 6, 6.7, 8.5, 9.7	2	4		20	60
d.	Spot drill Carbide, dia. 8 mm X 90°	2	4		20	60
e.	Drill insert type - 16 mm	2	4	Suitable inserts	10	30
f.	Solid carbide Twist drill straight shank - 8 mm	2	4			
g.	Solid carbide End mill straight shank - 10, 12 mm dia.	2	4			
h.	End mill insert type straight shank - 16 mm dia.	2	4	Suitable inserts	10	30
i.	Machine Taps HSS - M8, M10	2	4		10	30
j.	Solid carbide Reamer straight shank - 10 mm	2	4		10	30
k.	Finish boring bar dia. 20 to 25 mm	1	3	Suitable inserts	10	30
l.	Holder for face mills (Adapter)	2	4		20	60
m.	Collets for above drills, reamers, end mills	2 sets	4 sets			
n.	Collet holder suitable for collets	4	4			
o.	Side lock holder for 16 mm insert drill	1	2			
p.	Machine vice 0-150 mm range - Mechanical type	1	1			
q.	C spanner for tightening tools in holder	1	2			
r.	Magnetic dial stand	1	2			
s.	Mallet	2	4			
t.	Tap wrench	1	2			
u.	Hands tools set (spanners, Allen keys, etc.)	1 box				
v.	T Nuts, Strap clamps, Clamping Nuts and studs	1 set				
w.	Hands tools set (spanners, Allen keys, etc.)	1 box				
x.	T Nuts, Strap clamps, Clamping Nuts and studs	1 set				

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 curriculum of TDM (Dies &Moulds) trade held on 16.05.17 at Govt. ITI- Aundh, Pune			
S No.	**Name & Designation Shri/Mr./Ms.**	**Organization**	**Remarks**
Industry Experts			
1.	Dr. K C Vora,Sr. Dy. Director & Head, Arai Academy	The Automotive Research Association of India, S.No.102, Vetal Hill, Off Paud Road, Kothrud, Pune	Chairman
2.	JayantaPatra,Sr. Manager	Micromatic Machine Tools (P) Ltd. 240/241,11th Main, 3rd Phase, Peenya Industrial Area, Bangalore	Member
3.	Kashinath M. Patnasetty, Head - Application Support Group	Ace Designers Ltd. Plot No. 7&8, IIPhasePeenya Industrial Area, Bangalore	Member
4.	Sunil Khodke, Training Manager	Bobst India Pvt Ltd Pirangut, Mulashi, Pune	Member
5.	Lokesh Kumar, Manager, Training Academy	Volkswagen India Pvt Ltd Pune	Member
6.	ShriramTatyabaKhaire, Executive Engineering	Sulzer India Pvt Ltd. Kondhapuri, Shirur, Pune	Member
7.	Milind P Desai, Sr. Shift Engineer	Atlas Copco (I) Ltd Dapodi, Pune	Member
8.	ShrikantMujumdar, DGM	John Deere India Pvt Ltd. Pune - Nagar Road, Sanaswadi, Pune	Member
9.	G.D. Rajkumar, Director	GTTI, Coimbatore	Expert
10.	MilindSanghai, Team Manager	Alfa Laval India Ltd. Dapodi, Pune.	Member
11.	Rajesh Menon, Unit Manager	Alfa Laval India Ltd. Dapodi, Pune.	Member
12.	N K A Madhuubalan,DGM - QC, QA & SMPS	Sandvik Asia Pvt.Ltd. Dapodi, Pune.	Member
13.	IrkarBalaji, Sr. Engineer Mfg.	Premium Transmission Ltd. Chinchwad, Pune.	Member

14.	RajendraShelke, Sr. Engineer Mfg.	Premium Transmission Ltd. Chinchwad, Pune - 19	Member
15.	BhagirathKulkarni, Manager Maintenance	Tata Ficosa Auto Sys Ltd Hinjawadi, Pune	Member
16.	Rohan More,Hr& Admin	Tata Ficosa Auto Sys Ltd Hinjawadi, Pune	Member
17.	G. Venkateshwaran, TEC Manager- Corporate Responsibility	Cummins India Ltd.	Member
18.	Mahesh Dhokale, Engineer	Tata Toyo Radiator Ltd.	Member
19.	Pankaj Gupta, DGM- HR & IR	Tata Toyo Radiator Ltd.	Member
20.	S K Joshi Head - Business Development	Radheya Machining Ltd Pune- Nagar Road, Sanaswadi, Pune	Member
21.	A L Kulkarni, DGM Mfg.	PMT Machines Ltd Pimpri, Pune	Member
22.	S V Karkhanis, DGM Planning	PMT Machines Ltd Pimpri, Pune	Member
23.	KiranShirsath,Asso. Manager M.E.	Burckhardt Compression Pvt. Ltd., Ranjangaon, Pune	Member
24.	Ajay Dhuri, Manager	Tata Motors Ltd Pimpri, Pune	Member
25.	Arnold Cyril Martin, DGM	Godrej & Boyce Mfg Co. Ltd., Mumbai	Member
26.	Ravindra L. More	Mahindra CIE Automotive Ind. Ltd. Ursc-Pune	Member
27.	Kushagra P. Patel	NRB Bearings Ltd., Chiklthana Aurangabad	Member
28.	M. M. Kulkarni, Sr. Manager - Tool Room	NRB Bearings Ltd., Chiklthana Aurangabad	Member
DGT & Training Institute			
29.	NirmalyaNath, Asst. Director of Trg.	CSTARI, Kolkata	Member cum Co-coordinator
30.	P K Vijayan,Sr Manager Training	Gedee Technical Training Institute, 734 Avinashi Road, Coimbatore	Member
31.	Rasal G.S., Instructor	ITI Aundh, Pune	Member
32.	T.P. Ramchandran, Sr. Counselor	GTTI, Coimbatore	Member
33.	Kutte R.J., Instructor	ITI Aundh, Pune	Member
34.	Saroj Kumar Mondal, Ex T.O.	MSME Tool Room, Kolkata	Expert
35.	DebabrataMondal, V.I.	ATI Kolkata	Expert

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