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

COMPETENCY BASED CURRICULUM

DRAUGHTSMAN MECHANICAL

(Duration: Two Years)
(Revised in July 2022)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

SECTOR – CAPITAL GOODS AND MANUFACTURING

Directorate General of Training

DRAUGHTSMAN MECHANICAL

(Engineering Trade)

(Revised in July 2022)

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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CONTENT

1. COURSE INFORMATION

During the two-year duration, a candidate is trained on subjects- Professional Skill, Professional Knowledge, Employability Skill srelated to job role. In addition to this, a candidate is entrusted to make/do project work and extracurricularactivities 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 practical part starts with basic freehand sketches and conventional drawing using instruments. At the end of the course,skillis developed with computer aided production drawing and detailing. The broad components covered under Professional Skill subject are as follows:

FIRST YEAR: This year includes construction of geometrical figures using drawing instruments, freehand drawing of machine components in correct proportions, procedure to prepare a drawing sheet as per BIS standard. After becoming familiar with basic drafting terminology, students begin to develop multi-view drawings and learning about projection methods, auxiliary views and section views. Lettering, tolerance, metric construction, technical sketching and orthographic projection, isometric drawing, oblique and perspective projection are also covered. Introduction of drawing of different fasteners, welds, and locking devices as per specification mentioned in SP-46:2003 and use of CAD technology in 2D environment.The candidate also imparted training on allied trades viz. Fitter, Turner, Machinist, Sheet Metal Worker, Welder, Foundryman, Electrician and Maintenance Motor Vehicles.The safety aspects covers components like OSH&E, PPE, Fire extinguisher, First Aid and in addition 5S being taught.

SECOND YEAR: To develop skill in CAD application practical assignments are given by using commands in various methods. Detail and assembly drawing of machine parts viz., Pulleys, Pipe fittings, Gears and Cams applying range of cognitive and practical skills. Construct production drawing applying quality concept in CAD. Creation of objects in 3D Modeling Space and generate views, print preview to plot in drawing and pdf format.Individual skill is developed by preparing production drawing of machine parts applying conventional sign and symbol by taking measurement. Impart knowledge to draw workshop layout of a production industry considering process path and human ergonomics. In SolidWorks/AutoCAD Inventor/ 3D modeling environment the assignment is to create and plot assembly and detailed views of machine parts with dimensions, annotations, title block and bill of materials.

Professional Knowledge subject is simultaneously taught in the same fashion to apply cognitive knowledge while executing task. In addition components like physical properties of engineering materials, interchangeability, method of expressing tolerance as per BIS Fits, different types of iron, properties and uses, special files, honing, metallurgical and metal working processes such as heat treatment, the various coatings used to protect metals, different

bearing, working material with finished surface as aluminium, duralumin and stainless steel, topics related to non-ferrous metals, method of lubrication are also covered under theory part.

At the end part of each year, the trainees should express their skills by presenting project works. In addition to abovecomponents the core skills components viz., workshop calculation & science, employability skills are also covered. These core 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 variantsand Apprenticeship Training Scheme (ATS) are two pioneer schemes of DGT for strengthening vocational training.

Draughtsman Mechanical trade under CTS is one of the most 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 (Employability Skills) impart requisite core skill, knowledge and life skills.After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognizedworldwide.

Candidates broadly needs to demonstrate that they are able to:

- Read & interpret technical parameters/document, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules and standard procedure.
- Apply professional skill, knowledge, core skills & employability skills while performing/ drawing the job.
- Check the various parameters of the drawing for correctness identify and rectify errors in job/ assembly drawing.
- 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 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 conducted by DGT.

2.3 COURSE STRUCTURE:

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

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

Every year 150 hours of mandatory OJT (On the Job Training) of industry opportunity not available the group project is mandatory.

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

Trainees of one-year or two-year trade can also opt for optional courses 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 have 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 NTCwill 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 the basis for setting question papers for final assessment. The examiner during final examination will also check** the individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS 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 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 / drawing 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 / drawing equipment. • 70-80% accuracyachieved 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/ drawing equipment. • Above 80% accuracyachieved 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 ROLES

Draughtsman Mechanical; Prepares drawings of machines, plants, mechanical components, equipments etc. from sketches, notes, data or sample for purposes of manufacture or repairs. Takes instructions from Mechanical Engineerand calculates dimensions as required, from available materials (notes, data etc.) or sample. Draws to scale detailed drawings, assembly drawings,showing plan, elevations, sectional views etc.according to nature of work and operations required. Prints (writes) dimensions, tolerances, material to be used and other details to give clear picture and facilitate understanding. Maintains copies of drawings and makes prints. They may trace drawings and may design simple mechanical parts. Mayprepare estimates for materials and labour required. May specialize in making drawings of jigs and tools and be designated accordingly.Create component parts on Drawing Space using toolbars,commands and menus in CAD application software and also creating objects on 3D modeling space in CAD viewing printable drawing and plotting them.

Draughtsman Mechanical selects the appropriate equipment and drawing software to use based on the type and complexity of the drawing functions to be carried out and the use of a CAD system linked bills of material, file management and associated customization of installed software including the use of macros, menus and default settings.

In addition, Draughtsman Mechanical has the ability to visualize the job, goodcoordination, mechanical attitude, manual dexterity and perform work related mathematical calculations.

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.

Reference NCO - 2015:

i) 3118.0401–Draughtperson, Mechanical
ii) 3118.0402– Draughtsman – Mechanical

Reference NOS: CSC/NO402

4. GENERAL INFORMATION

Name of the Trade	**DRAUGHTSMAN MECHANICAL**
Trade Code	DGT/1015
N.C.O - 2015	3118.0401, 13118.0402
NOS Covered	CSC/NO402
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,CP,LC,DW,AA, LV,DEAF,AUTISM,SLD,MD
Unit Strength (No. of Students)	20 (There is no separate provision of supernumerary seats)
Space Norms	64 Sq. m
Power Norms	3.7 KW
Instructors Qualification for:	
1. Draughtsman Mechanical 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 Mechanical Engineering from AICTE/ recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/NAC passed in the Trade of "Tool & Die Maker (PT,J&E) or Tool & Die Maker (Die and Mould)" **OR** NTC/NAC passed in the Trade of "Draughtsman Mechanical" with three-year 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.

	(Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in ITIs with ToT course in Employability skills.
5. Minimum age for instructor	21 years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

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

5.1 LEARNING OUTCOMES

FIRST YEAR:

1. Construct different Geometrical figures using drawing Instruments following safety precautions. (CSC/NO402)
2. Draw orthographic Projectionsgiving proper dimensioning with title block and heading using appropriate line type and scale. (CSC/NO402)
3. Construct free hand sketches of simple machine parts with correct proportions. (CSC/NO402)
4. Construct plain scale, comparative scale, diagonal scale and vernier scale. (CSC/NO402)
5. Draw Sectional views showing orthographic projections. (CSC/NO402)
6. Develop surface and interpenetration of solid in orthographic projection. (CSC/NO402)
7. Draw isometric projection from orthographic views (and vice-versa) anddraw oblique projection from orthographic views. (CSC/NO402)
8. Draw and indicate the specification of different types of fasteners, welds and locking devices as per SP-46:2003(CSC/NO402)
9. Acquire basic knowledge on tools and equipment of Allied trades viz. Fitter, Turner, Machinist, Sheet Metal Worker, Welder, Foundry man, Electrician and Maintenance Motor Vehicles. (CSC/NO402)
10. Construct different types of gears, couplings and bearings with tolerance dimension and indicating surface finish symbol. (CSC/NO402)
11. Perform computer application and Create 2D objects on CAD drawing space using commands from ribbon, menu bar, toolbars and by typing in command prompt. (CSC/NO402)
12. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (CSC/NO402)

SECOND YEAR:

13. Construct projection views of geometrical figures with dimension and annotation on CAD in model space and viewport in layout space. (CSC/NO402)
14. Draw in CAD detail and assembly drawing of machine parts viz., Pulleys, Pipe fittings, Gears and Cams applying range of cognitive and practical skills. (CSC/NO402)

15. Construct drawing of engine parts with detailed and assembly in template layout applying quality concept in CAD. (CSC/NO402)
16. Create 3D solid by switching to 3D modeling workspace in CAD, generate views, Print Preview and Plotting. (CSC/NO402)
17. Construct detailed and assembled drawing applying conventional sign & symbolsusing CAD. (CSC/NO402)
18. Prepare drawing of machinepart by measuring with gauges and measuring instruments. (CSC/NO402)
19. Draw a machine shop layout considering process path and ergonomics (human factor). (CSC/NO402)
20. Create and plot assembly and detail views of machine part with Dimensions, Annotations, Title Block and Bill of materials in SolidWorks/AutoCAD Inventor/ 3D Modeling. (CSC/NO402)
21. Create production drawing of machine part. (CSC/NO402)
22. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study (CSC/NO402)

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Construct different Geometrical figures using drawing Instruments following safety precautions. (CSC/NO402)	Perform assignment using drawing instruments:Draw straight and parallel lines, triangles, polygons, circles, parallelogram, angle bi-sector and line bi-sector.
	Construct regular polygons (up to 8 sides) on equal base.
	Layout a A3 drawing sheet as per Sp -46 : 2003 with margin and name plate.
	Fold a sheet of A0 size for filing Cabinets or binding as per SP: 46-2003.
	Write block letters & numerals in single & double stroke.
	Write name of the drawing title on heading at centre alignment in double stroke 5:4 block letter.
	Draw a sample title block as used in industry.
	Label a drawing views showing the types of line are used.
	Construct ellipse, parabola & hyperbola.
	Construct involutes, cycloid curves, helix & spiral.
2. Draw Orthographic Projections giving proper dimensioning with title block using appropriate line type and scale. (CSC/NO402)	Generate views in orthographic projection by placing object between horizontal and vertical plane of axes.
	Generate side view of laminar objects in different inclination on VP and HP by auxiliary vertical plane.
	Provide dimension on object as per SP-46:2003
	Draw orthographic projection of points, lines and plain laminar figures.
	Draw orthographic projection of solids viz. prism, cones, pyramids and their frustums in 1st angle and 3rd angle method.
3. Construct free hand sketches of simple machine parts with correct proportions. (CSC/NO402)	Sketch Free hand drawing viz. straight lines, curved lines polygons, circles, elliptical figures with irregular contour.
	Sketch free hand of a machine part such as tool post of a Lathe, Bench Vice, Cutting Tools, Bolts, Studs & Nuts, gland, Pipe Flange, Hand Wheel, Crane hook, Steel bracket.
	Give dimensions of machine parts in accordance with as specified proportion.

4. Construct plain scale, comparative scale, diagonal scale and vernier scale. (CSC/NO402)	Draw different types of scales.
	Find out R.F of the scale; calculate the length of scale on drawing.
	Construct Scale- plain scales, diagonal scales. Comparative scales, vernier scale & scale of chords and apply RF indrawing.
5. Draw sectional views showing orthographic projections. (CSC/NO402)	Sketch Conventional signs and symbols for section.
	Draw sectional views with adjacent object showing cutting plane and direction of view.
	Sketch different types of section lines and abbreviations for different materials as per SP-46:2003.
	Draw Orthographic drawing of solids (viz., cube, prisms, cone and pyramids) finding out the true shape surfaces cut by oblique planes.
6. Develop surface and interpenetration of solid in orthographic projection. (CSC/NO402)	Develop the surface of cylinder, prisms, cone, pyramidsand their frustum.
	Draw development of an oblique cone with elliptical base.
	Draw the development of a 45°single cut pipe elbow, 3-pieces pipe elbow, a pipe hole through it, bucket and a funnel.
	Draw development of solids intersecting each other.
	Draw orthographic projection of interpenetrated two prisms with their axes intersecting at different angles.
	Draw orthographic projection of interpenetrated cone, cylinder & pyramids intersecting each other.
	Draw the curves of intersection of cylinder penetrating in a sphere and a cylinder offset from their center.
7. Draw isometric projection from orthographic views (and vice-versa) and draw oblique projection from orthographic views. (CSC/NO402)	Construct an Isometric scale to a given length.
	Draw the isometric projection of regular solids.
	Draw the isometric views for the given solids with hollow and cut sections.
	Draw the orthographic views of hanger, bracket & support from their isometric view.
	Draw isometric view of machine elements (viz. V-block, Angle plate, Sliding block, Journal bearing.

	Draw oblique projection of circular lamina in receding axis at 30° & 45°.
	Draw oblique projection of crank lever and V-block.
8. Draw and indicate the specification of different types of fasteners, welds and locking devices as per SP-46:2003. (CSC/NO402)	Draw different Screw threads with SP-46:2003conventions.
	Draw bolts, studs, nuts, washers and other fasteners as per SP-46:2003 conventions.
	Draw different locking arrangement of nuts, machine screws, caps screw set screw as per convention.
	Draw a half sectional view of a coupler nut.
	Draw eye foundation bolt, rag foundation bolt and Lewis foundation bolt.
	Draw welded joints giving welding symbols in welded structures.
	Draw section of welded steel structural column & bracket fabricated by plate.
	Draw keys, cotters, circlips and pins as per convention.
	Draw different types of pipe fittings and pipe joints (flanged, welded, threaded, socket and spigot).
	Draw structural steel sections with dimension as per ISspecification.
	Draw rivets and riveted joints with conventional specification.
	Draw a double strap, double riveted zig-zag butt joint.
9. Acquire basic knowledge on tools and equipments and their application in Allied trades viz. Fitter, Turner, Machinist, Sheet Metal Worker, Welder, Foundry man, Electrician and Maintenance Motor Vehicles. (CSC/NO402)	Identify different types of fitters hand tools, use centre punch different types of files, calipers, hacksaws, chisels and hammers.
	Identify Plain turning , stepped turning ,Taper turning with different method.
	Identify and use of jigs and fixtures Simple operations on milling machine such as plain milling and key waycutting.
	Check how to mark out castings and forgings, setting up and operation of shaping, slotting and planning machines.
	Identify anduse of hand tools such as planishing hammers, stakes, mallet, bricks prick punch etc. evaluatedevelopment of surfaces.
	Identify the hand tools used in gas and electric welding of object according to drawing.
	Acquaint with different types of mould, cores and coredressing and use of moulding tools.

	Identify the measuring instruments, machinery and panels used in electrician trade. Electrical and electronic symbols used in simple wiring diagrams.
	Identify different parts of IC Engines (Both spark ignition &compressionignition in 2 stroke & 4 stroke engines).
10. Construct different types of gears, couplings and bearings with tolerance dimension and indicating surface finish symbol. (CSC/NO402)	Draw the diagram illustrating basic size deviations and tolerances.
	Draw symbols for machining and surface finishes(grades and micron values).
	Draw the system of indication of geometrical tolerancesof form and position as per standard.
	Draw muff coupling, flanged coupling, friction grip coupling, pin type flexible coupling, universal coupling, Oldham's coupling, claw coupling, cone friction clutch.
	Draw details and assembly of simple bearing and foot step bearing, Plummer Block and self-aligning bearing (swivelbearing).
	Construct tooth profile of a spur gear above 30 teeth.
	Draw two spur gears and bevel gears in mesh.
11. Perform computer application and create 2D objects on CAD drawing space using commands from ribbon, menu bar, toolbars and by typing in command prompt. (CSC/NO402)	Perform file management in Windows operating system.
	Create, save and print a document, worksheet and pdf file.
	Start drawing in CAD from: new, template wizard and existing drawing file.
	Select Drawing limit of the CAD drawing space.
	Select proper setting of ribbon and toolbars, choice of workspace, scale.
	Draw object in CAD drawing space using commandsfrom icons in the ribbon, from menu bar, from floatingtoolbar and by typing command at the command prompt.
	Use functional keys to access certain commands.
	Input or locate point by Absolute Coordinate system, PolarCo-ordinate System and Relative Co-ordinate System.
	Create geometrical figures using draw tools.
12. Demonstrate basic mathematical concept and principles to perform practical operations.	Solve different mathematical problems
	Explain concept of basic science related to the field of study

Understand and explain basic science in the field of study. (CSC/NO402)	
SECOND YEAR	
13. Construct projection views of geometrical figures with dimension and annotation on CAD in model space and viewport in layout space. (CSC/NO402)	Draw object CAD drawing space using line, polyline,polygon, circle, rectangle, arc, ellipse commands.
	Modify object using Break, Erase, Trim, Offset, Fillet, Chamfer, Commands.
	Manage object using Move, Copy, Array, Insert Block, Make Block, Scale, Rotate, Hatch Commands.
	Create templates, Insert drawings, Layers, Modify Layer properties.
	Provide dimension, annotation on object and customizedifferent Dimension and Text styles.
	Construct orthographic drawing using shortcut keyboard command.
	Construct isometric drawing of machine blocks.
	Create viewports in layout space to view drawings in model space.
14. Draw in CAD detail and assembly Drawing of machine parts viz., Pulleys, Pipe fittings, Gears and Cams applying range of cognitive and practical skills. (CSC/NO402)	Draw Pulleys-solid, stepped built up and pulley with different types of arms, rope pulleys, belt pulleys.
	Draw Pipe fittings: tee, flanges, unions, valves. Different types of pipes layout systems. Different types of pipe joints.
	Draw gears such as spurs helical, bevel & worm, worm and worm wheel.
	Draw Cams with different motions to followers, different types of follower and involute tooth profile of a gear.
15. Construct drawing of engine parts with detailed and assembly in template layout applying quality concept in CAD. (CSC/NO402)	Draw Eccentrics, Piston, Cross Head, Connecting rod of I.C. Engines with the application of tolerances using CAD.
	Construct detailed drawing of an air valve and a fuel injector of IC engine.
16. Create 3D solid by switching to 3D modeling	Identify 3D toolbars, menus, co-ordinate system by switching 3D modeling workspace.

workspace in CAD, generate views, Print Preview and Plotting(CSC/NO402)	Identify three axes of the object.
	Change origin to create aligned objects under supervision.
	Create 3D solid objects using command from 3D primitives, Extrude, Revolve, subtract, union. Create 3D drawing by changing User co-ordinate systems.
	Annotate and dimension of the 3D model.
	Generate orthographic views from model space tolayout space.
	Generate Print preview and Plotting.
	Customize page set up, Print preview and Plotting of 3D drawing.
17. Construct detailed and assembled drawing applying conventional sign & symbols using CAD. (CSC/NO402)	Construct detailed drawing of a lever safety valve.
	Construct detailed drawing of a gate valve.
	Construct detailed drawing of a blow off cock.
	Create library folder containing blocks of Hydraulic andpneumatic conventional signs and symbols.
	Draw a sectional view of a hydraulic jack and a pneumatic valve actuator.
	Draw detailed view of a volute casing centrifugal pump.
	Draw assembled and detailed drawing of tool post of a lathe.
	Construct detailed & assembly drawing of tail stock and revolving centre.
	Construct detailed drawing of a milling fixture.
	Construct detailed & assembly drawing of shaper tool head slide.
	Draw a simple drilling jig for drilling holes in a given component.
	Draw Press Tool giving nomenclature of each part and dies & punches.
	Construct detailed drawing of a simple carburetor.
	Construct detailed and assembly drawing of a simple pressure vessel.
18. Prepare drawing of machinepart by measuring with gauges and measuring instruments. (CSC/NO402)	Identify proper measuring tools and gauges to measure the part.
	Check the accuracy of the instruments.
	Measure with the help of different types of gauges, suchas plug, snap, thread, taper, measuring instruments etc.
	Prepare detailed drawing of a C-clamp or machine vice.

19. Draw a machine shop layout considering process path and ergonomics (human factor). (CSC/NO402)	Draw a machine shop layout of small production industry showing process path from raw material inflow to finished product store.
	Draw walk-way inside the workshop.
20. Create and plot assembly and detail views of machine part with Dimensions, Annotations, Title Block and Bill of materials in SolidWorks/AutoCAD Inventor/ 3D Modeling. (CSC/NO402)	Draw 3D solid figures by Sketching features & applied features.
	Sketch an angle plate and a block – Create / Modify constraints.
	Create a sketch of a new part.
	Create 3D solid and edit solid.
	Create a new assembly, Insert components into an assembly,Add mates (degree of freedom) and perform components configuration in an assembly.
	Create a 3D model putting: Driving dimensions, Bill of materials, Driven (Reference)Dimensions and Annotations.
	Prepare drawings & detailing: Named views, standard 3views, auxiliary views, section views and detail views.
	Create a 3D transition figure.
	Create 3D model by annotating Holes and Threads, centerlines, symbols and leaders.
	Create simulation.
	Plot the 3D model.
21. Create production drawing of machine part. (CSC/NO402)	Create a simple Drill jig with Part model and assembly-detailing.
	Create a screw jack with Part model and assembly-detailing.
	Create a check list by self-assessment and provide Revision mark by noting in the Revision table.
22. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (CSC/NO402)	Solve different mathematical problems
	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS FOR DRAUGHTSMAN MECHANICAL TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skill (Trade Practical) (with indicative hour)**	**ProfessionalKnowledge (Trade Theory)**
Professional Skill 120 Hrs; Professional Knowledge 26 Hrs	Construct different Geometrical figures using drawing Instruments following safety precautions. (Mapped NOS: CSC/NO402)	1. Importance of trade training, List of tools & Machinery used in the trade. (02 hrs) 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). (05 hrs) 3. First Aid Method and basic training. (03 hrs) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (02 hrs) 5. Hazard identification and avoidance. (02 hrs) 6. Safety signs for Danger, Warning, caution & personal safety message. (02 hrs) 7. Preventive measures for electrical accidents & steps to be taken in such accidents. (05 hrs) 8. Use of Fire extinguishers. (07 hrs)	Importance of safety and general precautions observed in the industry/shop floor. All necessary guidance to be provided to the newcomers to become familiar with the working of Industrial Training Institute system including stores procedures. Soft Skills: its importance and Job area after completion of training. Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept & its application. Response to emergencies e.g. power failure, fire, and system failure. (04 hrs.)
		Perform assignment using drawing instruments: 9. Draw straight lines of a	Nomenclature, description and use of drawing instruments & various equipments used in

		given length. (01hr) 10. Draw perpendicular, inclined (given angle) and parallel lines. Draw triangles with given sides and angles. (03hrs) 11. Construct regular polygons (up to 8 sides) on equal base. (04hrs) 12. Draw inscribed and circumscribed circles of triangle, pentagon and hexagon. (04hrs) 13. Draw a parallelogram with a given length included angle. (02hrs) 14. Draw an angle bi-sector and a line bi-sector. (08hrs) 15. Divide a line into given equal divisions. (06hrs)	drawing office. Their care and maintenance.(04 hrs.)
		16. Layout a A3 drawing sheet as per Sp -46 : 2003 with margin and name plate. (05hrs) 17. Draw a sample title block providing details as: (*i*) Title of the drawing (*ii*) Sheet number (*iii*)Scale (*iv*)Symbol, denoting the method of projection (*v*) Revision with sign (*vi*) Name of the firm (*vii*) Initials of staff drawn, checked and approved. (05hrs) 18. Draw different types of lines & write their uses in	Lay out and designation of a drawing sheet as per Sp -46 : 2003 Recommended scale of engineering drawing as per Sp -46 : 2003 Types of Lines and their application. Folding of prints for filing Cabinets or binding as per SP: 46-2003. (06 hrs.)

		drawing. (05hrs) 19. Label a drawing views showing most of the types of line.(13hrs)	
		20. Write Block letters & numerals in single & double stroke of ratio 7:4 and 5:4 in drawing sheet. (18hrs)	Type of lettering proportion and spacing of letters and words.(06 hrs.)
		21. Construction of ellipse, parabola & hyperbola in different methods. (10hrs) 22. Construction of involutes, cycloid curves, helix & spiral. 08hrs)	Definition of ellipse, parabola, hyperbola,different methods of their construction. Definition & method of drawing involutes cycloid curves, helix & spiral.(06 hrs.)
Professional Skill 60 Hrs; Professional Knowledge 15Hrs	Draw orthographic Projections giving proper dimensioning with title block using appropriate line type and scale. (Mapped NOS:CSC/NO402)	23. Construct object drawing with dimensioning in different alignment as per SP-46. (03hrs) 24. Create dimensions in previous assignments. (15hrs)	Terminology – feature, functional feature, functional dimension, datum dimension, principles. Units of dimensioning, System of dimensioning, Method of dimensioning & common features. (05 hrs.)
		25. Draw orthographic projection of points and lines. (08 hrs) 26. Draw projection of plane figures (lamina). (12 hrs)	Methods of obtaining orthographic view. Position of the object, selection of the views, three views of drawing. Planes and their normal projections.(05 hrs.)
		27. Draw orthographic projection of solids- prisms, cylinders, cones, pyramids. (10 hrs) 28. Draw orthographic projection of cut section/ frustums of solids- prism, cylinders, cones, pyramids.	Orthographic projection. First angle and third angle projection. Principal of orthographic projection. Projection of solids like prism, cones, pyramids and their frustums. (05 hrs.)

		(12hrs)	
Professional Skill 15Hrs; Professional Knowledge 06Hrs	Construct free hand sketches of simple machine parts with correct proportions. (Mapped NOS:CSC/NO402)	29. Free hand sketch (in proper proportion) of tool post of a Lathe, Bench Vice, Cutting Tools, Bolts, Stud & Nut, gland, Pipe Flange, Hand Wheel, Crane hook, Steel bracket. (15hrs)	Methods of free hand sketching for machine parts.(06 hrs.)
Professional Skill 15Hrs; Professional Knowledge 06Hrs	Construct plain scale, comparative scale, diagonal scale and vernier scale. (Mapped NOS:CSC/NO402)	30. Draw plain scales, diagonal scales, comparative scales, venire scale & scale of chords. (15hrs)	Knowledge of different types of scales, scale of cords, their appropriate uses, Principle of R.F, diagonal &vernier. (06 hrs.)
Professional Skill 30Hrs; Professional Knowledge 12Hrs	Draw Sectional views of orthographic projections. (Mapped NOS:CSC/NO402)	31. Sketch Conventional sings and symbols. (05hrs) 32. Sketch different types of section lines and abbreviations for different materials as per SP-46:2003. (05hrs) 33. Draw Orthographic drawing of solids (viz., cube, prisms, cone and pyramids) finding out the true shape surfaces cut by oblique planes. (20hrs)	Knowledge of solid section. Types of sectional views & their uses. Cutting plane and its representation. Parts not shown in section. Conventional signs, symbols, abbreviations & hatching for different materials. Solution of problems to find out the true shape of surfaces when solids are cut by different cutting planes.(12 hrs.)
Professional Skill 82Hrs; Professional Knowledge 20Hrs	Develop surface and interpenetration of solid in orthographic projection. (Mapped NOS:CSC/NO402)	34. Construct the development of surface of cylinder, prisms, Cone, pyramids and their frustum. (18hrs) 35. Draw development of an oblique cone with elliptical base. (05hrs) 36. Draw the development of a 3-pieces pipe elbow, a pipe hole through it, a bucket	Definition of development, its need in industry & different method of developing the surfaces. Development of surfaces bounded by plane of revolution intersecting each other. Development of an oblique cone with elliptical base etc.

		and a funnel. (13hrs)	Calculation of developed lengths of geometrical solids.(10 hrs.)
		37. Construct orthographic projection of interpenetrating solids (cylinder, cones, prism & pyramid) of axes right angle to each other and axes inclined to each other. (26hrs) 38. Generate the curves of intersection of cylinder penetrating through a sphere, cone and a cylinder. (20hrs)	Definition of Intersection & interpenetration curves. Common method to find out the curve of interpenetration. Solution of problems on interpenetration of prism, cones, & pyramids with their axes intersecting at an angle. Intersection of cylinder.(10 hrs.)
Professional Skill 82 Hrs; Professional Knowledge 20Hrs	Draw isometric projection from orthographic views (and vice-versa) and draw oblique projection from orthographic views. (Mapped NOS:CSC/NO402)	39. Construct the isometric view of Polygons and circular lamina. (08 hrs) 40. Draw isometric view of solid geometrical figures from orthographic views with dimension. (08 hrs) 41. Draw isometric views of truncated cone and pyramid. (08hrs)	Principle of isometric projection and Isometric drawing. Methods of isometric projection and dimensioning. Isometric scale. Difference between Isometric drawing & Isometric projection. (04 hrs.)
		42. Construct orthographic views from isometric drawing of solid blocks with holes, grooves, notches, dove-tail cut, square cut, round cut, stepped, etc. (10hrs) 43. Construct orthographic views of hanger, bracket & support (08 hrs) 44. Draw isometric view of V-block, Angle plate, sliding	Principles of making orthographic views from isometric drawing. Selection of views for construction of orthographic drawings for clear description of the object. (10 hrs.)

		block. (10 hrs) 45. Draw isometric drawing of a simple Journal Bearing. (08 hrs.)	
		46. Draw oblique projection of circular lamina in receding axis at 30° & 45°. (05hrs) 47. Draw oblique projection of levers and hollow blocks. (17 hrs)	Principle and types of oblique projection. Advantage of oblique projection over isometric. Projection. (06 hrs.)
Professional Skill 130 Hrs; Professional Knowledge 30Hrs	Draw and indicate the specification of different types of fasteners, welds and locking devices as per SP-46:2003 (Mapped NOS:CSC/NO402)	48. Draw Screw threads with SP-46:2003 conventions. (08hrs) 49. Draw different types of bolts, studs, nuts and washers as per SP-46:2003 conventions. (08hrs) 50. Draw different locking arrangement of nuts, machine screws, caps screw set screw as per convention. (08hrs) 51. Draw a half sectional view of a coupler nut. (04hrs) 52. Draw four different types of foundation bolt. (16hrs)	Screw threads, terms nomenclature, types of screw thread, proportion and their uses, threads as per SP-46:2003 conventions. Types of bolts, nuts and studs, and their proportion, uses. Different types of locking devices. Different types of machine screws, cap screws, set screws as per specification. Different types of foundation bolts and their uses.(10 hrs.)
		53. Draw fillet weld and butt weld joint specifying the basic term of the joint. (05hrs) 54. Draw a weld joint representing the position and dimensioning of the weld with conventional symbols on the drawing. (06hrs) 55. Draw section of welded steel structural column & bracket	Description of Welded Joints and their representation (Actual and Symbolic) Indication of Welding Symbol on drawing as per SP-46. (04 hrs.)

		fabricated by plate. (10hrs)	
		56. Draw a half-sectional view of Cotter joint with socket and spigot ends. (12hrs) 57. Draw different types of Keys, splined shaft, circlips and pins as per convention. (08 hrs)	Different types of keys (Heavy duty and Light duty) cotters, splined shaft, pins and circlips. Calculation of sizes and proportions of keys. (06 hrs.)
		58. Draw the different types of pipe fittings. (06 hrs) 59. Draw pipe joints: flanged joint, welded joint, threaded joint, socket and spigot joint.(18hrs)	Pipe Joints: selection of materials as per carrying fluid and conditions. Description of different pipe joints fitted on pipe. Expansion joint, loop and other pipe fittings. (04 hrs.)
		60. Draw rolled steel sections as per IS specification. (05hrs) 61. Draw the different types of rivet heads indicating the dimensions related to diameter of the rivet as per convention. (08hrs) 62. Draw riveted joints of lap and butt with covers in chain and zig-zag orientation. (08hrs)	Types of rivets, their size proportions and uses. Types of riveted joints, terms and proportions of riveted joints. Conventional representation. Relation between rivet size and thickness of plates and calculation for arrangement of rivets position. Causes of failure of riveted joint efficiency of riveted joints. (06 hrs.)
Professional Skill 130Hrs; Professional Knowledge 30Hrs	Acquire basic knowledge on tools and equipments and their application in Allied trades viz. Fitter, Turner, Machinist, Sheet Metal Worker, Welder, Foundry man, Electrician	Allied Trade- Fitting 63. Use of different types of fitters hand tools. (06hrs) 64. Work on MS plate by filing, hack sawing, check dimensions, mark the plate, punch centre mark, cut a v-notch by chisel, drill a hole on the center mark. (16hrs)	Description and application of simple measuring tools. Description of vices, hammers, cold chisel, files, drills, etc.- proper method of using them. Method of using precision measuring instrument. Maintaining sequence of operation in fitting shop and safety precaution.(04 hrs.)
		Allied Trade Turning	Safety precaution for lathes.

	and Maintenance Motor Vehicles. (Mapped NOS:CSC/NO402)	65. Cut a round bar in power saw, centering and facing the bar, perform the turning, grooving, stepped and taper operation on the bar. (20hrs)	Description of parts of Lathe & its accessories. Method of using precision measuring instrument such as inside & outside micrometers, depth gauges, verniercallipers, dial indicators, slip gauges, sine bars, universal bevel protractor, etc. (04 hrs.)
		Allied Trade Machinist: 66. Use of jigs and fixtures Simple operations on milling machine such as plain-milling and key way cutting.(10 hrs) 67. Mark out on castings and forgings work piece, set up and perform operation of shaping, slotting and planning machines. (10 hrs)	Brief Description of milling, shaping, slotting and planning machines. Quick return mechanism of these machines. Maintaining sequence of operation in machine shop and safety precaution. (06 hrs.)
		68. Allied Trade: Sheet Metal Use of hand tools such as planishing,hammers stakes, mallet, bricks prick punch etc. Mark and cut a sheet to make a container. (20hrs)	Brief description of common equipment required for sheet metal work. Different types of joints used in sheet metal work. (04 hrs.)
		Allied Trade: Welding 69. Use of hand tools used in gas and in electric arc welding Weld an object according to drawing. (12 hrs) 70. Foudryman/Moulder Different types of mould, cores and core dressing, use of moulding tools. (12 hrs)	Maintaining sequence of operation in machine shop and safety precaution. Brief description of the hand tools used gas & arc welding. Different types of welded joints and necessary preparation required for these. Safety precautions, Hand tools used for molding. The description, use and care of

			hand tools.(06 hrs.)
		Allied Trade: Electrician 71. Prepare a simple wiring for residential room. Identify the electrical equipment and measuring instruments.(12hrs) Allied Trade: MMV- IC Engine 72. Identify different parts of IC Engines (Both spark ignition & compression ignition-2 stroke & 4 stroke engines). (12hrs)	Safety precaution maintained in electrician shop. A.C & D.C Motors Generators of common types and their uses and brief description of common equipment necessary for sheet metal work. Electrical units and quantities. Laws of electricity. Simple examples of calculation of current voltage, resistance in series and parallel connection (D.C.Circuit). Brief description of internal combustion engines, such as cylinder block piston, carburettor spark plug, camshaft, crank shaft, injector fuel pump etc. (06 hrs.)
Professional Skill 120Hrs; Professional Knowledge 26Hrs	Construct different types of gears, couplings and bearings with tolerance dimension and indicating surface finish symbol. (Mapped NOS: CSC/NO402)	73. Draw the diagram illustrating basic size deviations and tolerances. (03hrs) 74. Draw symbols for machining and surface finishes (grades and micron values) (03hrs) 75. Draw the system of indication of geometrical tolerances of form and position as per standard: Straightness, flatness, circularity, cylindricity, parallelism, perpendicularity, angularity, concentricity, coaxiality, symmetry, radial run-out,	Limits, fit, tolerance. Toleranced dimensioning, geometrical tolerance. Indications of symbols for machining and surface finishes on drawing(grades and micron values) Production of interchangeable parts, geometrical tolerance. Familiarization with IS: 919, IS:2709.(06 hrs.)

		axial run-out. (10hrs) 76. Construct a machine part indicating geometrical tolerance. (08hrs)	
		Construct the sectional view of: 77. Muff coupling, (06hrs) 78. Flanged coupling, (10hrs) 79. Friction grip coupling. (10hrs) 80. Pin type flexible coupling, (10hrs) 81. Universal coupling. (10hrs) (conventional method)	Couplings, necessity of coupling, classification of couplings. Uses and proportion of different types of couplings. Materials used for couplings. (10 hrs.)
		Draw detailed and assembly drawing of: 82. Simple bearing (03hrs) 83. Foot step bearing. (03hrs) 84. Plummer block. (08hrs) 85. Self-aligning bearing (swivel bearing). (08hrs)	Knowledge of bearing to reduce friction, types of bearing, frictional and anti-frictional bearings. Material used for frictional bearings. Properties of frictional bearing (sliding bearing) materials. Parts of anti-frictional bearings (ball, roller, thrust ball, needle & taper roller). Materials and proportion of parts. Difference between frictional and anti-frictional bearings. Advantages of anti-frictional bearings. (05hrs.)
		86. Construct tooth profile of a spur gear above 30 teeth. (10hrs) 87. Draw two spur gears in mesh (08hrs) 88. Draw two bevel gears in mesh (10hrs)	Gears and gear drives- uses, types, nomenclature and tooth profiles. (05 hrs.)
Professional	Perform computer application and	89. **Perform Computer operation**: (05 hrs)	Introduction to computer, Windows operating system,

Skill 56 Hrs; Professional Knowledge 15Hrs	create 2D objects on CAD drawing space using commands from ribbon, menu bar, toolbars and by typing in command prompt. (Mapped NOS: CSC/NO402)	i) create new folder, ii) add subfolders, iii) create application files, iv) change appearance of windows, v) search for files, vi) sort files, vii) copy files, viii) create shortcut folder, ix) create shortcut icon in desktop and taskbar x) move files to and from removable disk/ flash drive. xi) install a printer from driver software in operating system. 90. Create, save and print a document, worksheet and pdf (portable document format) files.(10hrs)	file management system. Computer hardware and software specification. Knowledge of installation of application software. (04 hrs.)
		91. Perform application in CAD: i) Change the Workspace dropdown menu in CAD screen and follow the ribbon and toolbar settings. ii) Locate origin and the graphical limit of drawing space from co-ordinate display. iii) Use buttons of mouse for pan,zoom in and zoom out. iv) Use functional keys to access certain commands.	Introduction to CAD Advantages of using CAD, CAD main Menu, screen menu, command line, model space, layout space. Drawing layouts, Tool bars, File creation, Save, Open existing drawings, creation of Drawing Sheet as per ISO. (05 hrs.)

		v) Use commands from icons in the ribbon, from menu bar and from floating toolbar. vi) Drag and drop figures from tool palettes. vii) Type the command at the command prompt and invoke. viii) Open existing drawings ix) Create of drawing Sheet layout x) Open drawing sheet layout from template. (21hrs.)	
		92. Create 2D objects using Absolute Co-ordinate system, Polar Co-ordinate System and Relative Co-ordinate System. (10hrs) 93. Create geometrical figures using draw tools. (10hrs)	Absolute Co-ordinate system , Polar Co-ordinate System and Relative Co-ordinate System Create Line, Break, Erase, Undo. (06 hrs.)
WORKSHOP CALCULATION & SCIENCE: (34Hrs)			
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.	**<u>WORKSHOP CALCULATION & SCIENCE:</u>** **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, substraction, multiplication & division Decimal fractions - Addition, subtraction, multilipication& division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and suare root Simple problems using calculator Applications of pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Precentage - 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 and uses of rubber, timber and insulating materials **Mass, Weight, Volume and Density** Mass, volume, density, weight and specific gravity **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 **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 **Trigonometry** Measurement of angles Trigonometrical ratios Trigonometrical tables
In-plant training/ Project work **Broad area:** a. Prepare model of square threaded bolt (by thermocole). b. Prepare models of different riveted joints (by thermocole). c. Prepare models of different welding joints (by thermocole). d. Prepare a poster of illustrating basic size deviations and tolerances. e. Prepare model of a spur gear (by thermocole).		

SYLLABUS FOR DRAUGHTSMAN MECHANICAL TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skill (Trade Practical) With Indicative Hour**	**ProfessionalKnowledge (Trade Theory)**
Professional Skill 110 Hrs; Professional Knowledge 34 Hrs	Construct projection views of geometrical figures with dimension and annotation on CAD in model space and viewport in layout space. (Mapped NOS: CSC/NO402)	94. CAD: draw 2D object using line, polyline, ray, polygon, circle, rectangle, arc, ellipse commands. (20 hrs)	Drawing of Line, polyline, ray, polygon, circle, rectangle, arc, ellipse using different options. (07 hrs.)
		95. CAD: modify 2D objects using Break, Erase, Trim, Offset, Fillet, Chamfer Commands. (10 hrs) 96. CAD: manage 2D objects using Move, Copy, Array, Insert Block, Make Block, Scale, Rotate, Hatch Commands. (12 hrs)	Trim, Offset, Fillet, Chamfer, Arc and Circle under modify commands. Move, Copy, Array, Insert Block, Make Block, Scale, Rotate, Hatch Commands. (07 hrs.)
		97. CAD: Create templates, Insert drawings. Create objects in different Layers and Modify Layer properties. (20 hrs)	Creating templates, Inserting drawings, Layers, Modify Layers. (07 hrs.)
		98. CAD: Provide dimension on object. Create dimension by customizing dimension styles (lines, arrows, text, unit and alignment) Put dimension with scale factor. (20 hrs)	Format dimension style, creating new dimension style, Modifying styles in dimensioning. Writing text on dimension line and on leader. Edit text dimension. (07 hrs.)
		99. CAD: Construct orthographic sectional view of a steel bracket with dimension using shortcut keyboard	Knowledge of shortcut keyboard command. Customization of keyboard command. Customization of drafting

		command.(10 hrs) 100. Construct isometric view of machine blocks. (10 hrs) 101. Create viewports in layout space and place views for model space in different scale. (08 hrs)	settings, changing orthographic snap to isometric snap. Procedure to create viewport in layout space in zooming scale. (06 hrs.)
Professional Skill 140Hrs; Professional Knowledge 50 Hrs	Draw in CAD detail and assembly Drawing of machine parts viz., Pulleys, Pipe fittings, Gears and Cams applying range of cognitive and practical skills. (Mapped NOS: CSC/NO402)	102. Construct Pulleys: solid, stepped and built up pulleys. (10 hrs) 103. Construct pulley with different types of arms. (10 hrs) 104. Draw rope pulley and v-belt pulley using CAD. (10 hrs)	Belt-drive. Materials of belts, slip and creep, Velocity of belt. Arc of contact. Simple exercise in calculation of belt speeds, nos. of belts needed in V-belt drive, velocity, pulley ratio etc. Standard pulleys width of pulley face, velocity ratio chain drive. (07 hrs.)
		105. Draw pipe fittings: tee, elbow (90° & 45°), flange, union and valve. (10 hrs) 106. Draw conventional symbols of different types of valves and joints used in pipe line diagram. (10 hrs) 107. Draw a piping layout systems from a sump to an overhead tank through a pump with possible fittings and valves. (10 hrs) 108. Draw sectional views of different types of pipe joints using CAD. (10 hrs)	Knowledge of different pipe materials and specifications of Steel, W.I. & PVC pipes. Brief description of different types of pipe joints. Pipe threads. Pipe fittings (threaded, welded and pressed). Specifications of pipe fittings. Different types of valves. (14 hrs.)
		109. Draw: i) spur gear, (08 hrs) ii) helical gear, (08 hrs) iii) bevel gear, (08 hrs) iv) worm and worm wheel.	Gear drive- Different types of gears. Cast gears and machined gears. Knowledge of profile of gears etc. (14 hrs.)

		(08 hrs) 110. Construct involute tooth profile of a gear (using CAD). (08 hrs)	
		111. Draw a symmetrical cam profile. (15 hrs) 112. Draw different types of follower (using CAD).(15 hrs)	Use of Cams in industry. Types of cam, kinds of motion in cam, displacement diagrams. Terms used in cam. Types of follower. (15 hrs.)
Professional Skill 110Hrs; Professional Knowledge 35 Hrs	Construct drawing of engine parts with detailed and assembly in template layout applying quality concept in CAD. (Mapped NOS: CSC/NO402)	113. Construct detailed and assembly drawing (using CAD) of i) Eccentrics (10 hrs), ii) Stuffing box (12 hrs) iii) Piston assembly of a petrol engine (20 hrs), iv) IC engine connecting rod. (20 hrs)	Knowledge of engine mechanism. Transmission of motion from reciprocating to circular through eccentric, crank and connecting rod. (21 hrs.)
		114. Construct detailed drawing of an air valve. (28 hrs) 115. Construct detailed drawing of a fuel injector of a diesel engine. (20 hrs) (using CAD)	Knowledge of fuel injection system in petrol and diesel engine. (14 hrs.)
Professional Skill 46Hrs; Professional Knowledge 12Hrs	Create 3D solid by switching to 3D modeling workspace in CAD, generate views, Print Preview and Plotting. (Mapped NOS: CSC/NO402)	116. **3D Modeling**: i) Create 3D solid objects using command from 3D primitive (viz. box, sphere, cylinder and poly-solids) , from solid (extrude, revolve, sweep and loft), from Boolean (union, subtract and intersect) (20 hrs) ii) Create 3D drawing using User co-ordinate systems.	Introduction to 3D modeling, 3D primitives (viz. box, sphere, cylinder, mesh and poly-solids), solid figure by extrude, revolve, sweep and loft command, solid editing: fillet, offset, taper, shell and slice command. Setting of User co-ordinate Systems, Rotating, Print preview and Plotting. (12

		(13 hrs) iii) Annotate and dimension of the 3D model. (05 hrs) iv) Generate views from model space to layout space. (05 hrs) v) Generate Print preview and Plotting. (03 hrs)	hrs.)
Professional Skill 260 Hrs; Professional Knowledge 90 Hrs	Construct detailed and assembled drawing applying conventional sign & symbols using CAD. (Mapped NOS: CSC/NO402)	117. Construct detailed drawing of a lever safety valve.(20 hrs) 118. Construct detailed drawing of a gate valve.(20 hrs)(using CAD)	Working principle of valves and their description. (13 hrs.)
		119. Construct detailed drawing of a steam stop valve and blow off cock. (20 hrs) (using CAD)	Knowledge of simple stationary fire tube boiler, boiler mountings. Function and purpose of blow off cock. (07 hrs.)
		120. Create library folder containingblocks of hydraulic and pneumatic conventional signs and symbols. (10 hrs) 121. Draw a sectional view of a hydraulic jack and a pneumatic valve actuator. (10 hrs)(using CAD)	Brief description of a typical hydraulic system, components, working principle and function of hydraulic jack. Different types of hydraulic actuator. Symbol and working of hydraulic DC valve, non-return valve and throttle valve. Knowledge of typical pneumatic system, FRL or air service unit and pneumatic actuator. (07 hrs.)
		122. Draw detail and full sectional view of a volute casing centrifugal pump(using CAD). (20 hrs)	Different types of pump systems.Characteristics of a pump system: pressure, friction and flow.Energy and head in pump systems. (07

			hrs.)
		123. Draw assembly and detailed drawing of tool post of a lathe. (using CAD) (20 hrs)	Different clamping devices on lathe. (07 hrs.)
		124. Construct detailed &assembly drawing of tail stock and revolving centre. (using CAD) (20 hrs)	Description of different job holding devices in lathe operation. (07 hrs.)
		125. Construct detailed drawing of a milling fixture. (using CAD) (20 hrs)	Different clamping devices on milling operation. (07 hrs.)
		126. Construct detailed & assembly drawing of shaper tool head slide. (using CAD) (20 hrs)	Different clamping devices on shaping operation. (07 hrs.)
		127. Draw a simple drilling jig for drilling holes in a given component. (using CAD) (20 hrs)	Knowledge of accuracy and interchangeabilityinthe manufacturing of products. (07 hrs.)
		128. Draw a Press Tool giving nomenclature of each part. (08 hrs) 129. Draw dies & punches for the production of simple work pieces. (using CAD) (06 hrs) 130. Develop isometric drawing for manufacturing 2 cavity injection moulds with side cavities. (using CAD)(06 hrs)	Knowledge of various parts of press tools and their function. Knowledge of different moulding processes. Introduction to Die casting, gating system design, force calculation, defects and remedies and estimation. (07 hrs.)
		131. Construct detailed drawing of a simple carburetor.(using CAD) (20 hrs)	Description of different parts of petrol engine. (07 hrs.)
		132. Construct detailed and	Knowledge of design,

		assembly drawing of a simple pressure vessel. (using CAD) (20 hrs)	manufacture, and operation of pressure vessels. (07 hrs.)
Professional Skill 20Hrs; Professional Knowledge 08Hrs	Prepare drawing of machineparts by measuring with gauges and measuring instruments. (Mapped NOS: CSC/NO402)	133. Prepare detailed drawing of a C-clamp and a machine vice by taking measurement using gauges and measuring instrument. (using CAD) (20 hrs)	Proper measurement practice in workshop. Principles of good measurement result: right measurement, right tools, right sketching, review and right procedures.(08 hrs.)
Professional Skill 20Hrs; Professional Knowledge 06Hrs	Draw a machine shop layout considering process path and ergonomics (human factor). (Mapped NOS: CSC/NO402)	134. Draw a machine shop layout of small production industry showing material inflow to finished product stock. (using CAD) (20 hrs)	Lay out of Machine foundations. Brief treatment of the principle Involved and the precautions to be observed. Lay out of machine Foundation. Consideration of ergonomics (human factor) for shop layout. (06 hrs.)
Professional Skill 110 Hrs; Professional Knowledge 35 Hrs	Create and plot assembly and detail views of machine part with Dimensions, Annotations, Title Block and Bill of materials in SolidWorks/AutoCAD Inventor/ 3D Modeling. (Mapped NOS: CSC/NO402)	**SolidWorks/AutoCAD Inventor/ 3D Modeling:** 135. Draw 3D solid figures by Sketching features & applied features. (08 hrs) 136. Sketch an angle plate and a block – Create/ Modify constraints. (06 hrs) 137. Create a sketch of a new part. (08 hrs)	Introduction to SolidWorks/ AutoCAD Inventor/ 3D Modeling User interface - Menu Bar – Command manager – Feature manager – Design Tree – settings on the Default options – suggested settings – key board short cuts. Create the best profile – create a sketch – create a new part. (07 hrs.)
		138. Create 3D solid and edit using: i) Copy & Paste, (03 hrs) ii) Filleting, (03 hrs) iii) Chamfering, (03 hrs)	Extrude bosses and cuts, add fillets, and chamfer changing dimensions. Revolved features using axes, circular patterning

		iv) Editing a feature definition. (03 hrs) v) Create ribs, mirror pattern, the Hole wizard, (03 hrs) vi) Create part configurations, Part design tables, (03 hrs) vii) Inset Design Table, Inset new design table. (03 hrs)	changes and Rebuild problems. (07 hrs.)
		139. Create New assembly part: i) Create a new assembly (06 hrs) ii) Insert components into an assembly, (03 hrs) iii) Add mates (degree of freedom). (03 hrs) iv) Perform components configuration in an assembly, (03 hrs) v) Insert subassemblies, (03 hrs) vi) Perform Interference detection. (03 hrs)	Bottom up assembly modeling Components configuration in an assembly, Insert subassemblies, Interference detection. (07 hrs.)
		140. Create a 3D model putting: i) Driving dimensions, (02 hrs) ii) Bill of materials, (02 hrs) iii) Driven (Reference) Dimensions, (02 hrs) iv) Annotations, (02 hrs) v) Alternate position view. (02 hrs) 141. Prepare drawings & detailing: i) Create drawing sheets, (02 hrs) ii) Add drawing items, (02 hrs) iii) Named views, standard 3 views, auxiliary views,	Drawings & Detailing, create drawing sheets, Add drawing items, Named views, std. 3 views, auxiliary views, section views, detail views. Drawings & Detailing, create drawing sheets, Add drawing items, Named views, standard 3 views, auxiliary views, section views, detail views. (07 hrs.)

		section views, detail views. (02 hrs) iv) Reattach and replace dimensions, (02 hrs) v) Edit sketch, (02 hrs) vi) Edit sketch plane, (02 hrs) vii) Edit definition. (02 hrs)	
		142. Create a 3D transition figure • using loft feature. (03 hrs) • using sweep feature. (03 hrs) • using library features.(03 hrs) i) Create 3D model by annotating Holes and Threads, (03 hrs) ii) Create Centerlines, symbols and leaders, (03 hrs) iii) Create Simulation. (03 hrs) iv) Plot the model. (01 hr) 143. Convert or save as Solid Works and Inventor file into .dwg format. (03 hrs)	Difference between sweep and loft. Exploded views – Configuration manager, Animation controller. Annotating Holes and Threads, Creating Centerlines, symbols and leaders, Simulation. Introduction to plot & Different ways of plotting. (07 hrs.)
Professional Skill 24 Hrs; Professional Knowledge 06 Hrs	Create production drawing of machine part. (Mapped NOS: CSC/NO402)	144. Create production drawing of a simple Drill jig – Part model – assembly-detailing (using CAD). (12 hrs) 145. Create production drawing of a Screw jack – Part model – assembly-detailing. (10 hrs) (using CAD) 146. Create a check list by self-assessment and provide Revision mark by noting in the Revision table. (02 hrs)	Knowledgeof production drawing, name plate and bill of materials, etc. Study of production drawing. Procedure of preparing Revision Drawing: putting revision mark, writing remarks in the table as per check list. (06 hrs.)

WORKSHOP CALCULATION & SCIENCE: (24Hrs)		
Professional Knowledge WCS- 24 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**<u>WORKSHOP CALCULATION & SCIENCE:</u>** **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 **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade Estimation and costing - Problems on estimation and costing
In-plant training / Project work (work in a team) a. Prepare a model of a drill jig. b. Prepare a chart of exploded view of a centrifugal pump. c. Prepare a model of pipeline layout with necessary fittings.		

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS 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

DRAUGHTSMAN MECHANICAL			
LIST OF TOOLS AND EQUIPMENT (For batch of 20 candidates)			
S No.	**Name of the items**	**Specification**	**Quantity**
A :TRAINEESTOOL KIT:			
1.	Draughtsman drawing instrument box containing Compasses with pencil point, point driver, interchangeable, Divider pen point interchangeable, divider spring bow, pen Spring bow lengthening bar, pen drawing liner, screw driver Instrument, tube with lead.		3 set
2.	Set square celluloid 45°	250 X 1.5 mm	3 set
3.	Set square celluloid 30°-60°	250 X 1.5 mm	3 set
4.	French-curves (set of 12 celluloid)		7 nos.
5.	Mini drafter		20+1 set
6.	Drawing boardIS: 1444	700mm x500 mm	20+1 set
B: GENERAL MACHINERY & SHOP OUTFIT			
7.	Chest of drawer 8 drawers(Standard)		2 nos.
8.	Draughtsmantable		20 nos.
9.	Draughtsmanstool		20 nos.
10.	Desktop Computer, for running CAD software, preloaded with windows.	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.	20+1 nos.
11.	Sever (True dedicated sever)		1 no.
12.	Software: MS- office latest version, CAD with latest Licensedversion,[Optional: Latest Version of SOLIDWOKS, AUTODESK INVENTOR, CATIA & PRO-E		20+1users

	(CREO-2)]		
13.	Plotter (Max. A0 size)		1 no.
14.	Laser Jet printer latest model		1 no.
15.	UPS		As required
16.	White Board for using LCD projector(optional)		1 no.
17.	Instructor Table		1 no.
18.	Instructor Chair		2 nos.
19.	Almirah steel		1 no.
20.	Computer table		20+1 nos.
21.	Computer chairs		20+1 nos.
22.	LCD projector/interactive smart board		1 no.
23.	External storage device (8 GB)		2 nos.

Note: -

1. Internet facility is desired to be provided in the class room.
2. No additional items are required to be provided for the batch working in the second shift exceptthe items from Sl. No. 1 to 6 under trainee's tool kit.

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