READING OF DRAWING AND ARITHMETIC

NSQF LEVEL – 4.5

SECTOR- EDUCATION, TRAINING & RESEARCH

COMPETENCY BASED CURRICULUM

CRAFT INSTRUCTOR TRAINING SCHEME (CITS)

GOVERNMENT OF INDIA
Ministry of Skill Development & Entrepreneurship
Directorate General of Training
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
EN-81, Sector-V, Salt Lake City, Kolkata – 700091

READING OF DRAWING AND ARITHMETIC

(Engineering Trade)

SECTOR – EDUCATION, TRAINING & RESEARCH

(Revised in 2024)

Version 2.1

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Developed By
Government of India
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1. COURSEOVERVIEW

The Craft Instructor Training Scheme is operational since inception of the Craftsmen Training Scheme. The first Craft Instructor Training Institute was established in 1948. Subsequently, 6 more institutes namely, Central Training Institute for Instructors (now called as National Skill Training Institute (NSTI)), NSTI at Ludhiana, Kanpur, Howrah, Mumbai, Chennai and Hyderabad were established in 1960 by DGT. Since then the CITS course is successfully running in all the NSTIs across India as well as in DGT affiliated institutes viz. Institutes for Training of Trainers (ITOT). This is a competency based course for instructors of one year duration. “Reading of Drawing and Arithmetic (RoDA)” CITS trade is applicable for Instructors of “Workshop calculation Science and Engineering Drawing” of CTS Trades.

The main objective of Craft Instructor training program is to enable Instructors explore different aspects of the techniques in pedagogy and transferring of hands-on skills so as to develop a pool of skilled manpower for industries, also leading to their career growth & benefiting society at large. Thus promoting a holistic learning experience where trainee acquires specialized knowledge, skills & develops attitude towards learning & contributing in vocational training ecosystem.

This course also enables the instructors to develop instructional skills for mentoring the trainees, engaging all trainees in learning process and managing effective utilization of resources. It emphasizes on the importance of collaborative learning & innovative ways of doing things. All trainees will be able to understand and interpret the course content in right perspective, so that they are engaged in & empowered by their learning experiences and above all, ensure quality delivery.

2. TRAINING SYSTEM

2.1 GENERAL

CITS courses are delivered in National Skill Training Institutes (NSTIs) & DGT affiliated institutes viz., Institutes for Training of Trainers (IToT). For detailed guidelines regarding admission on CITS, instructions issued by DGT from time to time are to be observed. Further complete admission details are made available on NIMI web portal http://www.nimionlineadmission.in. The course is of one-year duration. It consists of Trade Technology (Professional skills and Professional knowledge), Training Methodology and Engineering Technology/ Soft skills. After successful completion of the training programme, the trainees appear in All India Trade Test for Craft Instructor. The successful trainee is awarded NCIC certificate by DGT.

2.2 COURSE STRUCTURE

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

S No.	Course Element	Notional Training Hours
1.	**Trade Technology**	
	Professional Skill (Trade Practical)	480
	Professional Knowledge (Trade Theory)	270
2.	**Training Methodology**	
	TM Practical	270
	TM Theory	180
	Total	**1200**

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

3	On the Job Training (OJT)/ Group Project	150
4	Optional Course	240

Trainees can also opt for optional courses of 240 hours duration.

2.3 PROGRESSION PATHWAYS

- Can join asan Instructor in a vocational training Institute/ technical Institute.
- Can join as a supervisor in Industries.

2.4 ASSESSMENT & CERTIFICATION

The CITS trainee will be assessed for his/her Instructional skills, knowledge and attitude towards learning throughout the course span and also at the end of the training program.

a) The Continuous Assessment (Internal) during the period of training will be done by **Formative Assessment Method** to test competency of instructor with respect to assessment criteria set against each learning outcomes. The training institute has to maintain an individual trainee portfolio in line with assessment guidelines. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in
b) The **Final Assessment** will be in the form of **Summative Assessment Method**. The All India Trade Test for awarding National Craft Instructor Certificate will be conducted by DGT at the end of the year as per the guidelines of DGT. The learning outcome and assessment criteria will be the basis for setting question papers for final assessment**.** The external examiner during final examination will also check the individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS CRITERIA

Allotment of Marks among the subjects for Examination:

The minimum pass percent for Trade Practical, TM practical Examinations and Formative assessment is 60% & for all other subjects is 40%.There will be no Grace marks.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking the assessment. While assessing, the major factors to be considered are approaches to generate solutions to specific problems by involving standard/non-standard practices.

Due consideration should also be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral attitude, sensitivity to the environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising of the following:

- Demonstration of Instructional Skills (Lesson Plan, Demonstration Plan)
- Record book/daily diary
- Assessment Sheet
- Progress chart
- Video Recording
- Attendance and punctuality
- Viva-voce
- Practical work done/Models
- Assignments
- Project work

Evidences and records of internal (Formative) assessmentsare to be preserved until

forthcoming yearly examination for audit and verification by examining body. The following marking pattern to be adopted while assessing:

Performance Level	Evidence
(a) Weightage in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of an **acceptable standard** of crafts instructorship with **occasional guidance** and engage students by demonstrating good attributes of a trainer.	• Demonstration of **fairly good** skill to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field. • Averageengagement of students for learning and achievement of goals while undertaking the training on specific topic. • A fairly good level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson. • Occasional support in imparting effective training.
(b) Weightage in the range of 75%-90% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of a **reasonable standard** of crafts instructorship with **little guidance** and engage students by demonstrating good attributes of a trainer.	• Demonstration of **good** skill to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field. • Above average in engagement of students for learning and achievement of goals while undertaking the training on specific topic. • Agood level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson. • Little support in imparting effective training.
(c) Weightage in the range of more than 90% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of a **high standard** of crafts instructorship with **minimal or no support** and engage students by demonstrating good attributes of a trainer.	• Demonstration of **high** skill level to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field. • Goodengagement of students for learning and achievement of goals while undertaking the training on specific topic. • Ahigh level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson. • Minimal or no support in imparting effective training.

3. GENERAL INFORMATION

Name of the Trade	**Reading of Drawing & Arithmetic-CITS**
Trade code	DGT/4001
Reference NCO 2015	2356.0100, 3118.0401, 3118.0402
NOS Covered	MEP/N9466, MEP/N9459, CON/N9447, MEP/N9460, MEP/N9461, MEP/N9462, MEP/N9463, CON/N9458, CSC/N9432, CON/N9423, MEP/N9465, CSC/N9430, CSC/N9431, MEP/N9464, ASC/N9411
NSQF Level	Level-4.5
Duration of Craft Instructor Training	One Year
Unit Strength (No. Of Student)	25
Entry Qualification	Degree in Engineering from AICTE/ UGC recognized Engineering College/ University. OR 03 years Diploma in Engineering after class 10th from AICTE/ recognized board of technical education. OR Ex-serviceman from Indian Armed forces with 15 years of service in related field as per equivalency through DGR. OR 10th Class with 02 years NTC/NAC passed in 'any Engineering Trade'
Minimum Age	16 years as on first day of academic session.
Space Norms	100 Sq. m
Power Norms	1 KW
Instructors Qualification for	
1. Reading of Drawing and Arithmetic-CITS Trade	B.Voc/Degree in any Engineering from AICTE/UGC recognized University with two years experience in the field of teaching/ industries. OR 03 years Diploma in any Engineering from AICTE/ recognized Board/ University with five years experience in the field of teaching/ industries. OR Ex-serviceman from Indian Armed forces with 15 years of service in related filed as per equivalency through DGR. Candidate should have undergone methods of instruction course or minimum 02 years of experience in technical training institute of Indian armed forces. OR NTC/ NAC passed in any Engineering trade with seven years

	experience in relevant field. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in RoDA trade, in any of the variants under DGT.
2. Workshop Calculation &Workshop Science	B.Voc/Degree in any Engineering disciplinefrom AICTE/ UGC recognized Engineering College/ university with two years experience in relevant field. **OR** 03 years Diploma in any Engineering disciplinefrom AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with five years experience in relevant field. **OR** NTC/ NAC in any Engineering trade with seven years experience in relevant field. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in relevant trade OR NCIC in RoDA or any of its variants under DGT
3. Training Methodology	B.Voc/Degree in any discipline from AICTE/ UGC recognized College/ university with two years experience in training/teaching field. OR Diploma in any discipline from recognized board / University with five years experience in training/teaching field. OR NTC/ NAC passed in any trade with seven years experience in training/teaching field. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in any of the variants under DGT/ B.Ed /ToT from NITTTR or equivalent.

4. JOB ROLE

Brief description of job roles:

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

Draughtsperson, Mechanical; prepares drawings of machines, plants, mechanical components, equipment, etc. from sketches, notes, data or sample for purposes of manufacture or repairs. Takes instructions from Mechanical Engineer and 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 gives clear picture and facilitate understanding. Maintains copies of drawings and makes blue prints. May trace drawings. May design simple mechanical parts. May prepare estimates for materials and labour required. May specialize in making drawings of jigs and tools and be designated accordingly.

Draughtsman, Mechanical; prepares drawings of machines, plants, mechanical components, equipment, etc. from sketches, notes, data or sample for purposes of manufacture or repairs. Takes instructions from Mechanical Engineer and 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 gives clear picture and facilitate understanding. Maintains copies of drawings and makes blue prints. May trace drawings. May design simple mechanical parts. May prepare estimates for materials and labour required. May specialize in making drawings of jigs and tools and be designated accordingly, 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.

Reference NCO – 2015 with respective QP/NOS:

i) 2356.0100 - Manual Training Teacher/Craft Instructor
ii) 3118.0401 -Draughtsperson, Mechanical
iii) 3118.0402 - Draughtsman, Mechanical

Reference NOS:

(i) MEP/N9466	(vi) MEP/N9462	(xi) MEP/N9465
(ii) MEP/N9459	(vii) MEP/N9463	(xii) CSC/N9430
(iii) CON/N9447	(viii) CON/N9458	(xiii) CSC/N9431
(iv) MEP/N9460	(ix) CSC/N9432	(xiv) MEP/N9464
(v) MEP/N9461	(x) CSC/N9423	(xv) ASC/N9411

5. LEARNING OUTCOMES

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

5.1 TRADE TECHNOLOGY

1. Demonstrate the percentage of correctness for conventional symbols of machine parts and free hand sketch of basic hand tools as per standards and ensuring safety measures. (NOS: MEP/N9466)
2. Explain the methodology for scale factor determination and dimensioning of an object in relevant drawing sheet. (NOS: MEP/N9459)
3. Demonstrate construction of orthographic projection with proper dimensioning. (NOS: CON/N9447)
4. Construct two-dimensional shape of the developed surfaces of conventional solids. (NOS: MEP/N9460)
5. Demonstrate the process for drawing of different fasteners and joints. (NOS: MEP/N9461)
6. Explain the symbolic representation of electrical or electronic circuit along with its wiring layout and hydraulic, pneumatic and mechanical components along with mechanical joints. (NOS: MEP/N9462)
7. Assess the correctness of final dimensions and graphical symbols of different surface finishes, as per Indian Standard. (NOS: MEP/N9463)
8. Justify the perfection of a 2D drawing using CAD software. (NOS: CON/N9458)
9. Demonstrate drawing of machine parts by measuring with gauges & measuring instruments. (NOS: CSC/N9432)
10. Illustrate assembly drawing of all types of bearings, carpentry joints, piping, machine parts etc. using conventional signs& symbols used for production drawing. (NOS: CSC/N9423)
11. Demonstrate working drawing with tolerance dimension, indicating machining parameters. (NOS: MEP/9465)
12. Demonstrate basic knowledge on tools, equipment & their application in allied trade, Viz. Fitter, Turner, Electrician etc. (NOS: CSC/N9430)
13. Explain the advance features of the latest version of CAD software along with advanced method for the development of two- or three-dimensional drawing with the help of it. (NOS: CSC/N9431)
14. Demonstrate the method of official communication via internet. (NOS: MEP/N9464)
15. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: ASC/N9411)

6. COURSE CONTENT

SYLLABUS FORREADING OF DRAWING AND ARITHMETIC – CITS TRADE			
TRADE TECHNOLOGY			
Duration	**Reference Learning Outcome**	**Professional Skill (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Practical 10 Hrs. Theory 05 Hrs.	Demonstrate the percentage of correctness for conventional symbols of machine parts and free hand sketch of basic hand tools as per standards and ensuring safety measures.	1. Conventional Representation signs and symbols of machine parts, practising free hand sketches on hand tools, simple machine parts & equipments.	Importance of trade, Environmental, occupation & safety hazards specific to the trade like electrical, computer & related shop floor hazards. Introduction to BIS & ISO & their function.
Practical 20 Hrs. Theory 10 Hrs.	Explain the methodology for scale factor determination and dimensioning of an object in relevant drawing sheet.	2. Construction of scales. Types of lines, Dimensioning practice on technical drawing.	Scales: Principles, types, and applications. Dimensioning: - Introduction, Importance, system of dimensioning Conversion.
		3. Geometrical drawing & Practice.	Pictorial views: types, methods of representation & function.
Practical 20 Hrs. Theory 10 Hrs.	Demonstrate construction of orthographic projection with proper dimensioning.	4. Construct 1st angle projection and 3rd angle projection methods.	Orthographic projection: General principles of projection.
		5. Exercises on sectional views on the given models /actual objects. Exercise s on true shapes of different sectional views.	Sectioning: basic concept, types, importance
Practical 10 Hrs. Theory 05 Hrs.	Construct two-dimensional shape of the developed surfaces of conventional solids.	6. Exercises on development of surface of simple objects like cube, cone, pyramid, cylinder, prism etc.	Development of surfaces: principles, types, importance and application.
Practical 20 Hrs. Theory 10 Hrs.	Demonstrate the process for drawing of different fasteners and joints.	7. Drawing on fasteners-screw threads, nuts & bolts, studs and other locking devices.	Fasteners & fastening: Nut & Bolt, Keys, Cotter – types, uses, symbols & applications
		8. Drawing of butt joint and lap joint, single plate, & double plate rivet joints maintaining relation between plate thickness, rivet diameter and pitch etc.	Rivet – its types and different types of rivet joints & symbols.

Practical 90 Hrs. Theory 30 Hrs.	Explain the symbolic representation of electrical or electronic circuit along with its wiring layout and hydraulic, pneumatic and mechanical components along with mechanical joints.	9. Drawing of symbols for electrical, electronics, and basic electrical, electronic circuits.	Symbols of Electrical, Electronics, and their basic application on circuits.
		10. Hydraulics & pneumatics components and Drawing of basic hydraulics & pneumatics circuits used in machine tools.	Hydraulics & pneumatics components and their basic application on circuits.
		11. Drawing of Gears: spur, bevel, helical, worm & worm wheel, rack & pinion.	Introduction to gear – its tooth profile. Types of gears and their uses. Calculation of gear data for spur, helical, worm & worm wheel, rack & pinion
		12. Drawing of welding joints, their symbols, representation of welding symbols used on drawing.	Introduction to Welding. Principle of common welding process and its defects. Types of welded joints. Types of electrodes and wires used in weld joints. Edge preparation and its use.
Practical 30 Hrs. Theory 15 Hrs.	Assess the correctness of final dimensions and graphical symbols of different surface finishes, as per Indian Standard.	13. Practice on tolerance dimensioning.	Limits, fits, tolerance
		14. Indication of surface finish symbols used as per IS on working drawing.	Surface Finish: Introduction, representation, importance, symbols & applications on drawing.
Practical 20 Hrs. Theory 10 Hrs.	Justify the perfection of a 2D drawing using CAD software.	15. Exercises on 2D drafting using CAD (specially AUTO-CAD) software.	Concepts of 2D Drafting using CAD (specially AUTO-CAD) software.
Practical 20 Hrs. Theory 10 Hrs.	Demonstrate drawing of machine parts by measuring with gauges & measuring instruments.	16. Exercises with precision measuring / gauging instruments on real object and comparison with working drawing. Measurement practice for taper angle using sine bar, slip gauge, dial testindicator, and roller.	Introduction to vernier calipers, micrometer, bevel protector, sine bar, dial test indicator,slip gauge, rollers - its calculation of least countand measurement procedures. Their principles, reading and precautions.
Practical 120 Hrs. Theory 45 Hrs.	Illustrate assembly drawing of all types of bearings, carpentry joints, piping, machine parts etc. using conventional signs& symbols used for production drawing.	17. Drawing of bearings application – bush bearing, foot step bearing, ball, roller, Tapper roller and needle bearing use onassembly.	Bearing: Different Types & symbols Applications of bearing
		18. Drawing of carpentry joints: angle, framing,	Carpentry: joints, symbols Applications of joints

		broadening and lengthening joints and their different types.	
		19. Isometric view of pipe joints & drawing of flanged, socket and spigot joint etc. 20. Drawing on various types of shaft couplings, flanged, cone, universal and muff.	Pipe & Pipe joints – types, symbols & Applications of pipe joints
		21. Practice on detailed drawing of simple machine components.	Concept of assembly & detailed drawing; relation, importance & application.
		22. Practice on Assembly & detailed drawing of simple machine components. Different Machine Vice, Head stock, tailstock, milling arbour.	Mechanical properties of metal, Properties of steel by adding alloying element like cobalt, vanadium, magnesium, tungsten etc.
		23. Practice on Production drawing, indicating all features related toproduction.	Calculation and definition of Ratio, Proportion, Percentage, work, power, energy, its application in workshop.
		24. Detailed drawing of simple Jigs & Fixtures.	Jigs & Fixtures:- Introduction, types, use and advantages.
Practical 40 Hrs. Theory 20 Hrs.	Demonstrate working drawing with tolerance dimension, indicating machining parameters.	25. Drawing of ellipse, parabola, hyperbola, cycloid, epicycloids and hypocycloid Helix and Involutes etc.	Calculation related to cutting speed, feed, r.p.m. depth of cut, machining time for drilling, turning, shaping, milling etc.
Practical 35 Hrs. Theory 10 Hrs.	Demonstrate basic knowledge on tools, equipment & their application in allied trade, Viz. Fitter, Turner, and Electrician etc.	26. Allied Trades: - Overview Fitter, Turner, Electrician, carpenter, machinist Hand on practice related to trade work and preparation of drawings from real objects anD circuits.	Allied Trades: - Overview Fitter, Turner, Electrician, carpenter, machinist Hand on practice related to trade work and preparation of drawings from real objects and circuits.
Practical 35 Hrs. Theory 10 Hrs.	Explain the advance features of the latest version of CAD software along with advanced method for the development of two or three dimensional	27. Practices latest version of CAD (specially AUTO-CAD) software & use of different menus and different tool bars. Drawing of Isometric and 3 Dimensions objects	Practices latest version of CAD (specially AUTO-CAD) software & use of different menus and different tool bars. Drawing of Isometric and 3 Dimensions objects using CAD (specially AUTO-CAD) software.

	drawing with the help of it.	using CAD (specially AUTO-CAD) software.	
Practical 10 Hrs. Theory 05 Hrs.	Demonstrate the method of official communication via internet.	28. Use of Internet in accessing and sending drawing. Project work and Industrial-cum- study tour.	Use of Internet in accessing and sending drawing.
WORKSHOP CALCULATION& SCIENCE: 75 Hrs.			
Professional Knowledge WCS- 75 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**WORKSHOP CALCULATION** Concept of Fraction, Numbers, Variable, Constant, percentage, ratio proportion. Fundamental Algebraic formulae for multiplication and factorization. Algebraic equations, simple & simultaneous equations, quadratic equations and their applications. Concept on progressions. Mensuration: - Concept on basic geometrical definitions, basic geometrical theorems. Determination of areas, perimeters of triangles, quadrilaterals, polygons, circle, sector etc. Areas of irregular shaped surfaces. Simpson's rule, trapezoidal rule, applications. Determination of volumes ,surface areas of cylinders, prisms, pyramids cone spheres, frustums, Volume estimate related to civil work. Calculation related to swept volume, clearance volume. Trigonometry: Ratios, tables, degree, grade and radian. Calculation of height and distance with the help of trigonometric formulae. Application of trigonometry in determining the areas of polygons and solution of triangle. Trigonometric ratios of compound, multiple and sub-multiple angle and their uses. Related problems on stress, strain, factor of safety, torsion strength of different shafts. Determination of CG, MI of different solid sections. Problems on power transmission of shaft. Calculations involving Shear Force and Bending Moments diagrams of simply supported beams, cantilevers with point load and uniformly distributed load. Calculation of machining time for different turning, shaping, drilling, milling, grinding, etc. Graphs: basic concept, importance. Plotting of graphs of simple linear equation. Related problems on ohm's law, series-parallel combination. Statistics: Frequency tables, normal distribution, measure of central	

		tendency – Mean, Median & Mode. Concept of probability. Charts like pie chart, bar chart, line diagram, Histogram and frequency polygon. **WORKSHOP SCIENCE (40 Hrs.)** Fundamental units, Scalar & Vector quantity. Difference system of units: F.P.S., C.G.S., M.K.S & S.I. Multiplication factors such as giga, mega, kilo, milli, micro etc. interrelation, calculation and applications. Dimensioning of physical quantities (MLT). **Engineering Materials:** – Classification properties and uses of ferrous metals, non-ferrous metals, alloys etc. Properties and uses of non-metals such as wood, plastic, rubber, ceramics industrial adhesives. **Heat & Temperature**: - Concepts, differences, effects of heat, different units, relation, specific heat, thermal capacity, latent heat, water equivalent, mechanical equivalent of heat. Different Temperature measuring scales and their relation. Transference of heat, conduction, convection and radiation. Thermal Expansion related calculations. **Force and Motion**: - Newton's laws of motion, displacement, velocity, acceleration, retardation, rest & motion such as linear, angular. Force – units, different laws for composition and resolution of forces. Concept on centre of gravity and equilibrium of forces in plane. Concept of moment of inertia and torque. **Work, power & energy**: – Definitions, units, calculation & application. Concept of HP, IHP, BHP and FHP – related calculations with mechanical efficiency. S.I. unit of power and their relations. Vector representation of work. **Friction: -** Definitions, effects of friction, Laws of static & dynamic friction, types of friction problems on horizontal and inclined applied forces. Angle of repose. Bodies on rough inclined plane: Explanation and related problems. Introduction on corrosion, causes and prevention. Lubrication process: Types of Lubricants, etc. **Stress & Strain: -** Concepts of stress, strain, modulus of elasticity. Stress- strain curve. Hook's law, different module of elasticity like Young's modulus, modulus of rigidity, bulk modulus and their relations. Poisson's ratio. Principle of super position, stresses in varying cross-sections stress in composite bars.

		Simple machines: - Concept of Mechanical Advantage, Velocity Ratio, Efficiency and their relations. Working principles of inclined plane, lever, screw jack, wheel and axle, differential wheel and axle, worm and worm wheel, rack and pinion. Gear train. **Heat Treatment: -** Introduction, different methods of Heat Treatment and their purposes. Iron-carbon diagram and **T**ime-**T**emperature-**T**ransformation (TTT) diagram. **Electricity:-** Basic definitions like emf, current, resistance, potential difference, etc. Uses of electricity. Difference between ac and dc. Safety devices. Difference between conductors and semiconductors and resistors, Materials used for conductors, semiconductors and resistors. Ohm's Law. Series, parallel and series-parallel combination of resistances. Concept, definitions and units of electrical work, power and energy with related problems.

SYLLABUS FOR CORE SKILLS
1. Training Methodology (TM) (Common for all CITS trades) (270 Hrs + 180 Hrs.)

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

7. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENT CRITERIA
TRADE TECHNOLOGY (TT)	
1. Demonstrate the percentage of correctness for conventional symbols of machine parts and free hand sketch of basic hand tools as per standards and ensuring safety measures. (NOS:MEP/N9466)	Demonstrate the basic knowledge of Personal Protective Equipment (PPE).
	Demonstrate basic life support training method.
	Prepare various documents for industrial requirements using the methods of recording information.
	Explain health, safety and environment guidelines, legislations & regulations.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner.
	Demonstrate drawing skill of all dimensions in accordance with standard specification.
2. Explain the methodology for scale factor determination and dimensioning of an object in relevant drawing sheet. (NOS:MEP/N9459)	Evaluate the length of an object in drawing paper as per scale factor.
	Demonstrate necessary calculation or spacing to drawing sheet dimensions of various components / parts of drawing.
	Demonstrate creation of objects to accommodate their views in a drawing sheet without reducing the scale
	Illustrate the conventional representation of common features.
	Evaluate creation of different types of section lines as per standard practices.
	Observe safety precautions while working on drawing sheet.
3. Demonstrate construction of orthographic projection with proper dimensioning. (NOS: CON/N9447)	Illustrate convention of the dimension in required scale to drawing in drawing sheet.
	Interpret drawing requirement such as types of orthographic projection symbol.
	Evaluate drafting principal to produce drawing sheet showing elevations, plans and end views.
	Assess appropriate dimension system rule to draw the required drawing as per the standard practices.
	Check the different types of line uniformly.
	Demonstrate dimension placing system and other reference that follow the required conventions.
	Observe safety normswhile working on drawing sheet.
4. Construct two-dimensional shape of the developed surfaces of conventional solids. (NOS: MEP/N9460)	Explain the method of development of the surfaces of a cube & cone.
	Assess the method of development of the surfaces of a Cylinder.
	Evaluate the surface of a hexagonal pyramid cut by a plane at a certain height from its base at a certain angle.

	Evaluate the surface of an oblique cone angularly penetrated by a solid circular rod.
	Explain the method of development of the surface of a prism.
5. Demonstrate the process for drawing of different fasteners and joints. (NOS: MEP/N9461)	Develop a neat sketch of a hexagonal nut.
	Illustrate the conventional representation of common features viz. internal thread, external thread, slotted hole, butt thread etc.
	Sketch the symbol of V butt joint and rivet joint. .
	List types of joint implemented in pipe line and show the symbols of those.
6. Explain the symbolic representation of electrical or electronic circuit along with its wiring layout and hydraulic, pneumatic and mechanical components along with mechanical joints. (NOS: MEP/N9462)	Demonstrate a layout drawing for an electrical wiring.
	Demonstratea layout diagram of piping line for water supply system of a plant indicating all necessary hydraulic equipments.
	Explain a detailed drawing of a spur gear indicating all of its numerical parameters.
	Formulate the numerical relationship between numerical parameters of a helical gear
	Demonstrate the welded spot by IS symbols in a drawing of piping layout.
7. Assess the correctness of final dimensions and graphical symbols of different surface finishes, as per Indian Standard. (NOS:MEP/N9463)	Evaluate appropriate denotations for continual & details on drawing.
	Demonstrate working drawing dimension within tolerance limit, indicating the machine& surface symbol.
	Ensure that all details for preparation of drawing are available and in order.
	Assess appropriate dimension system rule to draw the required drawing of surface finish symbols as per the standard practices.
	Assess the project sheets as per drawing and maintain for future references.
	Ensure safety precautions while working on drawing sheet.
8. Justify the perfection of a 2D drawing using CAD software. (NOS:CON/N9458)	Explain brief details of CAD 2D software.
	Create simple 2D drawings through CAD.
	Explain basic commands for drawing and modification.
	Set up the command icons on two sides of the screen.
	Evaluate two dimensional geometrical figure of pre determined dimension.
	Assess all dimensions on that figure with zero precision.
	Monitor main drawing and the dimensions in two different layers.
	Check Fit of this drawing on page layout as per necessary scale.
	Make a marginal box including a title block at right bottom corner.
	Make the specified parts of the drawing bold and thick
	Differentiate the colors of several portion of the drawing.
	Plot the drawing in proper size of plotting paper.

9. Demonstrate drawing of machine parts by measuring with gauges & measuring instruments. (NOS:CSC/N9432)	Assess List of basic metrological instruments for measurement.
	Evaluate measurement methodology by venire calliper.
	Assess differentiation between internal and external micro meter.
	Analyse the final dimension of outside diameter of a circular rod.
	Evaluate use a venire height gauge.
	Assess determination of angle of inclination of an inclined plane
	Demonstrate the actual function of a bevel protector.
	Assess differentiation betweenthe measurement method by micrometer and slide calliper.
	Check the least count of basic metrological instruments used in industries.
10. Illustrate assemblydrawing of all types of bearings, carpentry joints, piping, machine parts etc. using conventional sign & symbol used for production drawing. (NOS:CSC/N9423)	Demonstrate necessary calculation or spacing to drawing sheet dimensions of machine part detail & assembly drawing.
	Demonstrate drafting principal to produce drawing sheet showing sectional elevations plans and different types of views.
	Explain all types of bearing, engine parts, carpentry joints, pipe joints details & assembly drawing.
	Explain all types of simple machine components in details & assembly drawing.
	Explain all types of production features and simple jigs & fixtures in details & assembly drawing.
	Analyse table to denote the name, dimensions, materials, quantity, remarks of various parts or components as per drawing requirement.
	Demonstrate appropriate dimension system rule to draw the required drawing as per the standard practices.
	Check the drawing by different types of line use as per SP-46: 2003.
11. Demonstrate working drawing with tolerance dimension, indicating machining parameters. (NOS:MEP/N9465)	Explain the factors affecting the machining parameters.
	Evaluate appropriate dimension system rule to draw the required drawing related to cutting speed, feed, r.p.m. depth of cut, machining time for drilling etc. as per the standard practices.
	Assess mathematical relationship between the parameters.
	Evaluate graphical representation between the parameters referring to the given data.
12. Demonstrate basic knowledge on tools, equipment & their application in allied trade, Viz. Fitter, Turner, Electrician etc. (NOS:CSC/N9430)	Demonstrate different types of tool , equipment & functional application viz. Fitter, Turner, Electrician etc.
	Check functionality of machine.
	Identify different works and tool holding devices for functional application.
	Perform the job as per set standard limits & tolerance.
	Observe safety norms.
13. Explain the advance	Explain application of advanced CAD commands for 2D &3D

features of the latest version of CAD software along with advanced method for the development of two- or three-dimensional drawing with the help of it. (NOS:CSC/N9431)	drawings.
	Generate line segment in AutoCAD importing data from Excel worksheet.
	Generate assemble of parts through 2D &3D modelling workspace.
	Generate 3 views of 3D models.
	Evaluate relevant and appropriate symbol as per drawing requirement to provide details in the drawings.
14. Demonstrate the method of official communication via internet. (NOS:MEP/N9464)	Convert drawing file(dwg.) to (pdf) file and send thru e-mail as attachment.
	Manage set of drawings for digital communication.
15. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:ASC/N9411)	Solve different mathematical problems
	Explain concept of basic science related to the field of study

8. INFRASTRUCTURE

LIST OF TOOLS AND EQUIPMENT -Reading of Drawing & Arithmetic (CITS)			
for batch of 25 candidates			
S No.	**Name of the Tool & Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1.	Drawing Instrument Box	With accessories.	26 sets
2.	Set square celluloid 45	250x1.5mm	26 sets
3.	Set square celluloid 60	250x1.5mm	26 sets
4.	French-curves	Set of 20 celluloid	26 sets
5.	Drawing Board	(700 x 500) IS:1444	26 sets
6.	Tee-Square	(700 mm blade) IS:1360	26 sets
7.	Mini Drafter		26 sets
B. TOOLS, MEASURING INSTRUMENTS AND GENERAL SHOP OUTFIT			
8.	A. Computer	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.	14 nos.
	B. Software	MS-Office latest version of operating software Auto-CADwith power pack or latest version.	14 users licenced
	C. Laser Jet printer	Latest model – Print, Copy and Scan 1200x1200dpi, 16MB	1 no.
	D. UPS		As required
9.	Chest of drawers	8 drawers	2 nos.
10.	Trainees Locker	8 drawers	3 nos.
11.	Book Self		2 nos.
12.	Steel tape	2 meters (Pull type)	1 nos.
13.	Drawing table	for A1 sheet	26 nos.
14.	Stools	(Revolving type) Adjustable height	26 nos.
15.	T.O's Table	6ftX4ft	1 no.
16.	T.O's Chair	Armed chair – Revolving	1 no.
17.	Almirah Steel	6ft. height or higher	2 nos.
18.	Computer table		14 nos.
19.	Computer chairs	Revolving	26 nos.
20.	Table for printers		1 no.
21.	D.L.P Projector	2000 LUMEN OR HIGHER	1 no.
22.	Motorised Screen forv Projector		1 no.

23.	White board	6FT. x 4FT.	1 no.
24.	Fire Fighting Equipments		As required
25.	First Aid Box		1 no.
C. CLASS ROOM FURNITURE			
26.	Class Room Chairs / Dual desk may also be allowed	Armless	25 /13 nos.
27.	Class Room Tables / Dual desk may also be allowed	3ft X 2ft	25 /13 nos.
28.	Chair for Trainer	(Armed) movable	01 no.
29.	Table for Trainer	(4 ½ ft X 2 ½ ft) with Drawer and cupboard	01 no.
30.	LCD / LED Projector		01 no.
31.	Multimedia Computer System	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.	01 set
32.	Computer Table		01 no.
33.	White Board	6ft X 4 ft.	01 no.
34.	LCD Projector Screen		
35.	Air Conditioner (OPTIONAL)		As required
36.	Wall Clock		01 no.
37.	Wall charts, Transparencies and DVDs related to the trade		As required
38.	Laser Printer with scanner		01 no.
39.	Steel Cupboard	With 8 pigeon lockers	3 nos.
40.	Work bench for fitters	With two vices of 100mm	2 nos.
41.	Steel cupboard	180x90x45cm	2 nos.
42.	Steel cupboard	120x60x45cm	2 nos.
43.	Multi drawer tool rack trolley	With minimum 4 drawers and 20 tool capacity	04 nos.
44.	First aid box.		1 no.


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