

Syllabus for the subject

of

WORKSHOP CALCULATION & SCIENCE

Under

CRAFT INSTRUCTOR TRAINING SCHEME (CITS)

(For Engineering Trades under Group IV)

Re-Designed in

- 2014 -

By

**Government of India
Ministry of Labour & Employment
Directorate General of Employment & Training**

CONTENTS

SECTION	DESCRIPTION	PAGE NO.
A	Rationale	3
B	General Information	4
C	Grouping of Trades in Craft Instructor Training Scheme	5
D	Semester wise Allotment of Time & Marks among the Subjects	6
E	Details of Syllabus	7
F	List of Tools & Equipments	8

A. RATIONALE

Success & Sustainability of any Training System depends upon given other things, availability of good quality instructors. An Instructor should possess, besides trade skills, **“Skills to Transfer Skills”**. To cope up this quality possession of core skills is imperative.

Ability to read Engineering Drawing is essential to perform a job / task of Engineering Trades. It is the skills set which enables comprehending the given job and subsequent planning to complete the task/job. Thus it is regarded as core skills for all Engineering trades.

Similarly, knowledge of basic scientific principles creates the foundation for acquiring hard skills. It is the initial/inherent knowledge set which enables analyzing the given job and subsequent detail planning; Such as selecting proper physical conditions e.g. Temperature for a heat treatment process, Material of cutting tool etc.

Similarly, ability to perform simple calculations also creates the foundation for proper hard skills. It is the inherent knowledge set which enables to analyse the given job - Quantitatively and subsequent detail planning; Such as selecting the physical conditions quantitatively e.g. speed and feed of a cutting operation.

Thus Engineering Drawing, Workshop Calculation & Science are regarded as a core skills set which supplements hard skills in all Engineering Trades.

Recognizing this importance of the core skills, the subjects of Engineering Drawing and Workshop Calculation & Science are made integral part of all Engineering Trades for Craft Instructors Training Scheme (CITS) under NCVT.

B. GENERAL INFORMATION

1. Name of the Course : Craft Instructor Training Scheme
2. Duration of Instructor Training : 1 Year (Two semesters each of six months duration).
3. Subjects covered in the Semesters : Detailed in Section - D
4. Name of the Subject : **WORKSHOP CALCULATION & SCIENCE**
5. Applicability : For all Engineering Trades of Group IV (Fitter, Turner, Machinist, Machinist (Grinder), Tool & Die Maker, MMTM, Operator Adv. M/c Tool)
6. Examination : AITT to be held at the end of each semester.
7. Space Norms : One Class Room of minimum 30sq.m. area having Minimum width of 5 m. with minimum Illumination of 6000 lumen will be reqd..
The electrical equipments of Drawing Hall should conform to minimum 3 star Building energy rating as per Bureau of Energy Efficiency (B.E.E.)
8. Power Norms : 1 Kw
9. Unit strength(Batch Size) : 20
10. Entry qualification : NTC / NAC from NCVT in any one of the trades of Gr.-IV **OR** Diploma/Degree in Mechanical/Production Industrial Engineering from AICTE recognized Board / University.
11. Trainers' Qualification : Diploma or Degree in Mechanical / Production / Industrial Engineering from AICTE recognized Board / University with five / two years experience respectively.

Desirable: Craft Instructor Certificate in RoD & A course under NCVT.

12. Trainer:

- At least one full time instructor is required for two batches.
- For one batch, the instructor may be out sourced/ hired on contract basis.

C. GROUPING OF TRADES IN CRAFT INSTRUCTOR TRAINING SCHEME

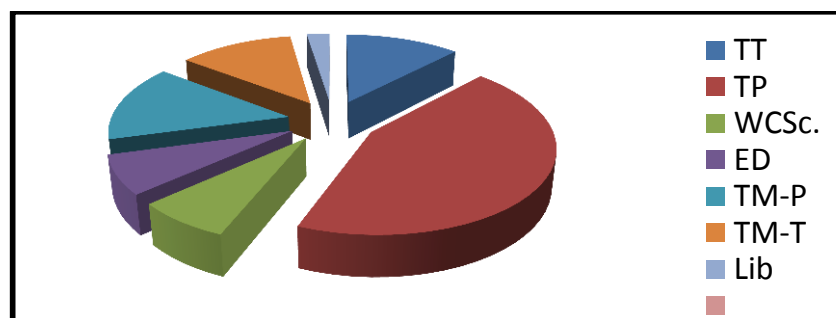
GROUP NO.	TRADE NAME
I	Forger & Heat Treater, Carpenter, Foundry man, Pattern Maker Sheet Metal Worker, ALL WELDER TRADES {Welder, Welder (GMAW >AW), Welder (Pipe), Welder (Structural), Welder (Fabrication & Fitting) and Welder (Welding & Inspection)}, Plumber.
II	Mechanic Motor Vehicle, Mech. Ref. & Air Conditioning, Farm Mech. & Mech. Agricultural Machineries
III	Draughtsman (Mechanical), Draughtsman (Civil), Reading of Drawing & Arithmetic (RoD&A), Surveyor , Draughtsman (Architect)
IV	Fitter, Turner, Machinist, Machinist (Grinder), Tool & Die Maker, MMTM, Operator Adv. M/C Tool, Refractory Technician.
V	Electrician, Wireman
VI	Maintenance Mech. (CP), Attendant Operator(CP), Instrument Mechanic(CP), Laboratory Attendant(CP), Instrument Mechanic
VII	Electronics Mechanic, Mechanic Radio TV, IT&ESM, Computer Hardware & Networking Maintenance.

D. SEMESTER WISE ALLOTMENT OF TIME & MARKS AMONG THE SUBJECTS FOR CITS

	SUBJECTS	Hrs. / Week	% of time allotted	Marks	Sessional	Full Marks	Pass Marks		
							Exam.	Sessional	Total
First semester	Trade Practical – 1	20	50	200	30	230	120	18	138
	Trade Theory - 1	6	15	100	20	120	60	12	72
	Workshop Cal. & Sc.	6	15	50	-	50	30	-	30
	Engineering Drawing	6	15	100	-	100	60	-	60
	Library	2	5	-	-				
	TOTAL for Sem. - I	40		450	50	500	270	30	300
Second semester	Trade Practical – 2	16	40	200	30	230	120	18	138
	Trade Theory - 2	4	10	100	20	120	60	12	72
	Training Methodology - Practical	12	30	200	30	230	120	18	138
	Training Methodology - Theory + IT	8	20	100	20	120	60	12	72
	TOTAL	40		600	100	700	360	60	420
	GRAND TOTAL	80		1050	150	1200	630	90	720

Hourly Distribution

TOTAL: 1200 marks for 2 semesters Pass marks: 720



Subject	Time in %	Marks in %
Trade Practical	45	38
Trade Theory	12.5	20
Total for Trade	57.5	58
Training Methodology (Practical)	15	19
Training Methodology (Theory) + IT	12.5	10
Total for Training Methodology & IT	27.5	29
Engineering Drawing	7.5	12
Workshop Cal. & Sc.	7.5	4
Library	2.5	-

E. Details of WORKSHOP CALCULATION & SCIENCE syllabus
Under Craft Instructor Training Scheme (CITS)

Group-IV

Sl. No.	Topics	Hours	Marks
1.	UNITS AND DIMENSIONS Fundamental and derived units in SI System, Dimensions of Physical Quantities (MLT)-Fundamental & Derived, Dimensionless Groups (Reynolds No., Mach. No etc. their uses), Accuracy, Precision and errors; Measuring Instruments-repeatability & simple concepts of calibration; Error analysis of measurements.	5	2
2.	FORCE AND MOTION Displacement, Velocity acceleration, & momentum. Equations of motion, Newton's law of motion, Force & its derivation from Newton's laws of motion – constant and variable mass situations. Coplanar concurrent and non-concurrent forces. Resultant and components; concept of equilibrium; Parallelogram law of forces. Triangle of forces, Lami's theorem. Simple Problems. Concept of moment, Definition of moment of inertia, Moment of inertia of disc, ring & sphere, Torque and angular momentum and their inter relation, Concept of couple. Centripetal and centrifugal forces Free body diagrams. Simple problems. Kinematics of a wrench.	12	4
3.	CENTRE OF GRAVITY Concept of gravity, gravitational force, centroid and center of gravity, centroid for regular lamina and center of gravity for regular solids. Examples of Gravity paradox. Simple problems.	5	2
4.	FRICTION Concept of friction, laws of friction, limiting friction and coefficient of friction, sliding friction. Friction on inclined surfaces.	5	2
5.	WORK, POWER AND ENERGY Work and its Units, Measurement of work – $F.S = FS \cos \theta$ Work done on bodies moving on horizontal and inclined planes (consider frictional forces also). Concept of Power and its units, Calculations of power (simple cases). Concept of Kinetic energy and potential energy Expressions for P.E and K.E, Principle of conservation of energy. Flywheel Energy and environment.	12	4
6.	SIMPLE MACHINES. Concept of machine, mechanical advantage, velocity ratio and efficiency of a machine their Relationship, law of machine, simple machines (lever, wheel	5	2

	and axle, pulleys, jacks& winch crabs only).		
7.	MOTION & POWER TRANSMISSION Link & Link motion – simple, complex, compound links; Degrees of Freedom Gear – simple, compound, epicyclic. Belt & Chain	5	2
8.	STRESS & STRAIN Concept of load stresses and strains. Tensile, compressive and shear stresses and strains. Concept of Elasticity, Elastic Limit and limit of proportionality. Hook’s Law, Young Modulus of Elasticity. Poisson ration, Bulk modulus, Modular of rigidity, Hoop stress.	11	4
9.	HEAT& TEMPERATURE Heat and temperature. Unit of heat; Different scales of Temperature including International Practical Temperature Scales (IPTS) conversions, problems Basic Principles of measurement of temperature, Specific Heat, water equivalent, Simple problems	10	4
10.	EXPANSION OF SOLIDS Coefficient of linear, Surface and cubical expansions and relation amongst them, Thermal stresses (qualitative only) and their applications.	5	2
11.	FLUID MECHANICS Properties of fluid (density, viscosity, specific weight, specific volume, specific gravity) with their units. Concept of static pressure, intensity of pressure and pressure head, Pascal’s law. Concept of atmospheric pressure, gauge pressure, absolute pressure, vacuum and differential pressure. Types of flow (laminar and turbulent). Rate of discharge. Reynolds No. Equation of continuity; Bernoulli’s theorem (without proof) and its applications. Losses in flows. Fluid moving machineries (construction and operation only). Pumps – positive displacement; centrifugal Fans, blowers and compressors – single stage multi-stage Specifications & ratings of Fluid Mechanics Machineries	8	3
12.	Electricity Ohm’s law, Kirchhoff’s law Simple Problems on series and parallel circuits. Concept of AC/DC. AC Induction Motors (Squirrel cage and slip ring) – uses, constructions and connections Starters – DOL, Star-delta, soft & VFD General safety measures while handling electrical machines	5	2
13.	AIGEBRA Indices, Concept and rules, Examples on indices. Application of Quadratic equations. Arithmetic Progression, its nth term and sum of n terms with their applications to engineering problems.	8	3

	Geometrical Progression, its nth term and sum of n terms and to infinity with application to engineering problems. Meaning of the terms n! (Factorial n), nC_r . Examples. Binomial theorem (expansion without proof) for positive integral index (expansion and general term).		
14.	MENSURETION: Area & Volume of different geometrical shapes (2D &3D). TRIGNOMETRY Concept of angles, measurement of angles in degrees, grades and radians and their conversions. Trigonometrical ratios and their relations. Review of ratios of some standard angles (0, 30,45,60,90 degrees), Compound angles, multiple angles, and sub-multiple angles (2A, 3A, A/2) inverse circular functions. Height & Distances, Simple problems.	18	7
15.	COORDINATE GEOMETRY Cartesian coordinates (two dimensions), Distance between two points. Application of equation of straight line in various standard forms, intersection of two straight lines, angle between two lines. Perpendicular distance formulae. General equation of a circle and its characteristics. To find the equation of a circle given (i) Center and radius (ii) Three points on it (iii) Coordinates of end points of a diameter. Plotting of curves $y = f(x)$, $f(x)$ being algebraic function of x. Standard equation of parabola, ellipse and hyperbola (standard equations without proof), Concept of Polar coordinates & their conversion to Cartesian coordinates & vice versa,	8	3
16.	MATRICES A brief idea of determinant of order three. Definition. Examples of expansion. Matrix of order m x n, Addition, subtraction & multiplication of matrix. VECTOR ALGEBRA Addition, subtraction & multiplications of vectors with applications.	5	2
17.	FUNCTIONS Concept of limit, continuity, derivatives (1st Order) interpretation as rate, tangent, etc. Maxima, minima STATISTICS Frequency tables, normal distribution; central tendencies – mean, median, mode Dispersion – range, Standard deviation, simple idea of probability.	5	2
Total Hours & Marks		132	50
Revision & Examination			

F. LIST OF TOOLS & EQUIPMENTS

Sl. No.	NAME OF TOOLS / EQUIPMENTS	QUANTITY
1.	Laptop with latest configuration	1 no.
2.	Almirah steels (Major)	2 nos.
3.	Table.	20 nos.
4.	Chair	20 nos.
5.	Instructor's table (big size full secretariat)	1 nos.
6.	Instructor chair.	1 nos.
7.	LCD projector with latest configuration	1 no.