Syllabus for the subject

Of

WORKSHOP CALCULATION & SCIENCE

Under

CRAFT INSTRUCTOR TRAINING SCHEME (CITS)

(For Engineering Trades under Group V)

Re-Designed in

– 2014 -

By

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

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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 analyze the given job - Quantitatively and subsequent detail planning. Such as selecting the physical conditions quantitatively e.g. speed, feed of a cutting operation.

Thus Engineering Drawing, Workshop Calculation & Science are regarded as a core skills set for acquiring 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. <u>GENERAL INFORMATION</u>

1. Name of the Course : Craft Instructor Training

2. Duration of Instructor Training : 1 Year (Two semesters each of six months duration).

3. Subjects covered in the Semester : Detailed in Section - D

4. Name of the Subject : **WORKSHOP CALCULATION & SCIENCE**

5. Applicability : For all Engineering Trades of Group V
(Electrician, Wireman)

6. Examination : To be held at the end of each semester.

7. Space Norms : Trade Theory Class room

8. Power Norms : As required in the Trade Theory Class room

9. Unit strength(Batch Size) : 20

10. Entry qualification : NTC / NAC from NCVT in the trades of Electrical Gr. – V **OR**
Diploma / Degree in Electrical/Mechanical from AICTE recognized Board / University.

11. Trainers' Qualification **:** Diploma / Degree in Electrical/Mechanical from AICTE recognized Board / University. with five/two year experience in the relevant field

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

12. Trainer **:** One full time instructor is required for two batches. For one batch, the instructor may be out sourced/ hired on contract basis.

# C. <u>GROUPING OF TRADES IN CRAFT INSTRUCTOR TRAINING SCHEME</u>

GROUP NO.	TRADE NAME
I	Forger & Heat Treater, Carpenter, Foundry man, Pattern Maker Sheet Metal Worker, ALL WELDER TRADES {Welder, Welder (GMAW &GTAW), 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	6+2	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

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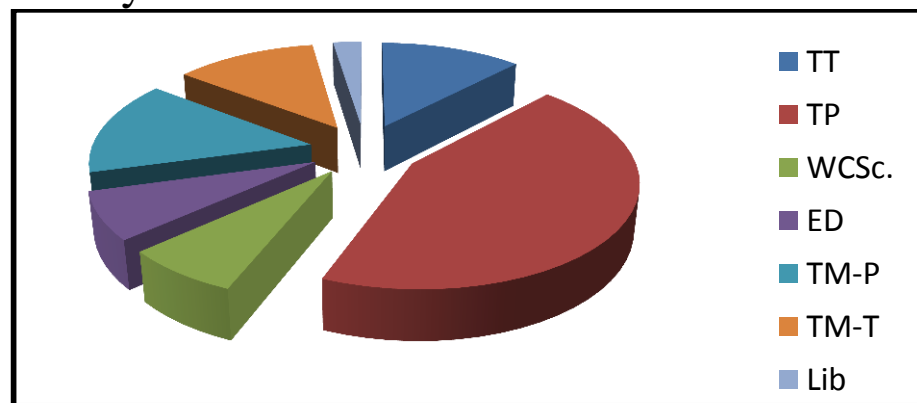
Subject	Time in %	Marks in %
Trade Practical	45	38
Trade Theory	12.5	20
Total for Trade	**57.5**	**58**
Training Methodology (Practical)	15	19
Training Methodology (Theory) + IT	12.5	10
Total for Training Methodology & IT	**27.5**	**29**
Engineering Drawing	7.5	12
Workshop Cal. & Sc.	7.5	4
Library	2.5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

E. DETAILS OF WORKSHOP CALCULATION & SCIENCE
Under Craft Instructor Training Scheme (CITS)

Group-V

Unit no.	Topics	Hours	Marks

1	Units - system of units, classification of units, S.I.Units, 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.
	
	    Metals – Mechanical properties of materials.
	    Ferrous and Non ferrous metals and their alloys – properties, composition and their uses.
		8	3

2	Ratio and Proportions – Shop problems. Percentage – shop problems & applications. Heat-treatment: critical temperatures, annealing, normalizing, tempering, hardening, case-hardening. Mass, speed, velocity, acceleration. **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 Equations of plane motion & motion under force of gravity-applications. Link & Link motion – simple, complex, compound links; Degrees of Freedom Gear – simple, compound, epicyclic. Belt & Chain	12	3
3	**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, Lemi'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,	8	2

	Concept of couple. Centripetal and centrifugal forces Free body diagrams. Simple problems. Kinematics of a wrench. Newton's three laws of motion-prove that P = m.a.		
4	Algebra – simplifications, different algebraic formulae & applications. Factorizations, shop problems. 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. 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), $^{n}C_{r}$. Examples. Binomial theorem (expansion without proof) for positive integral index (expansion and general term). **WORK, POWER AND ENERGY** Work and its Units, Measurement of work –F.S = FS cos Ø 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 Force & weight-their units, applications. Work-power-energy: definitions, units, B.H.P., I.H.P. & efficiency of an engine. Vector, complex algebraic. **UNIT TEST - I**	10	2
5	Solving equations-simple, quadratic & simultaneous equations, transpositions etc. Problems on algebra-shop problems. **VECTOR ALGEBRA :-** Addition, subtraction & multiplications of vectors with applications. Potential energy & kinetic energy-applications. Energy calculation in domestic & industrial circuits. Basic electricity-current, voltage, EMF, resistance,	12	4

	Ohm's Law, series & parallel circuits.		
6	Mensuration – area of different triangles, square, rectangle, trapezium, rhombus, parallelogram, circle, hollow circle, semi-circle, sector, segment etc. – shop problems. Hook's Law, Young's Modulus of electricity, Poission's ratio-shop problems. Lever – different types, working principle. Moment of a lever – technical problems.	8	4
7	Mensuration – area & perimeter of an ellipse, shop problems. Volume of solids & hollow bodies-prisms and pyramids. Volume of cube, cuboids, rectangular solids, hexagonal prism, triangular prism etc. shop problems. Compositions & resolution of forces. Law of parallelogram of forces. Lami's theorem-shop problems. Specific resistance, temperature co-efficient of resistance applications.	8	4
8	Volume & surface area of solid & hollow cylinders, hexagonal, triangular, square, pyramids etc., - applications & shop problem. Density, specific gravity & Archimedes principle-applications. Heat & temperature – their units, effects of heat, specific heat, latent 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 Heating effects of electric current-applications. **UNIT TEST - II**	10	5
9	Volume & surface area of a cone, taper cylinder, solid & hollow sphere, hemi-sphere – applications & technical problems. . 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 Kirchoff's Law – voltage law & current law, applications in different combinations, solving problems.	10	5

10	Trigonometry – properties of triangles & acute angles. Different system of units for measuring angles. Trigonometric ratios & functions – different formulae, trigonometric proof, height & distance problems, taper calculations – technical problems. Sensible heat, thermal capacity, water equivalent of heat – applications. Temperature – different thermometric scales & conversions between them, temperature measuring instruments. Difference between heat & temperature. Thermal contact & thermal expansion – co-efficient of linear, superficial & cubical expansions – shop problems.	8	4
11	A.C. circuits – resistance, capacitance, inductance, impedance, power, power factor in R-L, R-C & R-L-C circuits. RMS value, average value. Resonance circuit – solving related problems. Calculation of line current, phase current & line voltage, phase voltage & 3ϕ power in star & delta circuits. **<u>COORDINATE GEOMETRY :-</u>** 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,	14	8
12	Battery – battery charging, electrolysis, series & parallel group, reverse order group – related-problems. D.C. generator, D.C. motors, speed equations, alternators, polyphone induction motors-related problems. Network theory, star delta. **MATRICES:-** A brief idea of determinant of order three. Definition. Examples of expansion. Matrix of order m x n, Addition, subtraction &	12	6

	multiplication of matrix. **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.		
13	Review on general mathematics & sciences. Solving old question papers. Review on electrical trade base calculations & question papers. **REVISION & FINAL EXAMINATION**	12	
Total Hours & Marks		132	50
Revision & Examination			

F. <u>LIST OF TOOLS & EQUIPMENTS</u>

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.

<u>Same tool list as in the Trade Theory class room.</u>

List of the Trade Committee Members