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

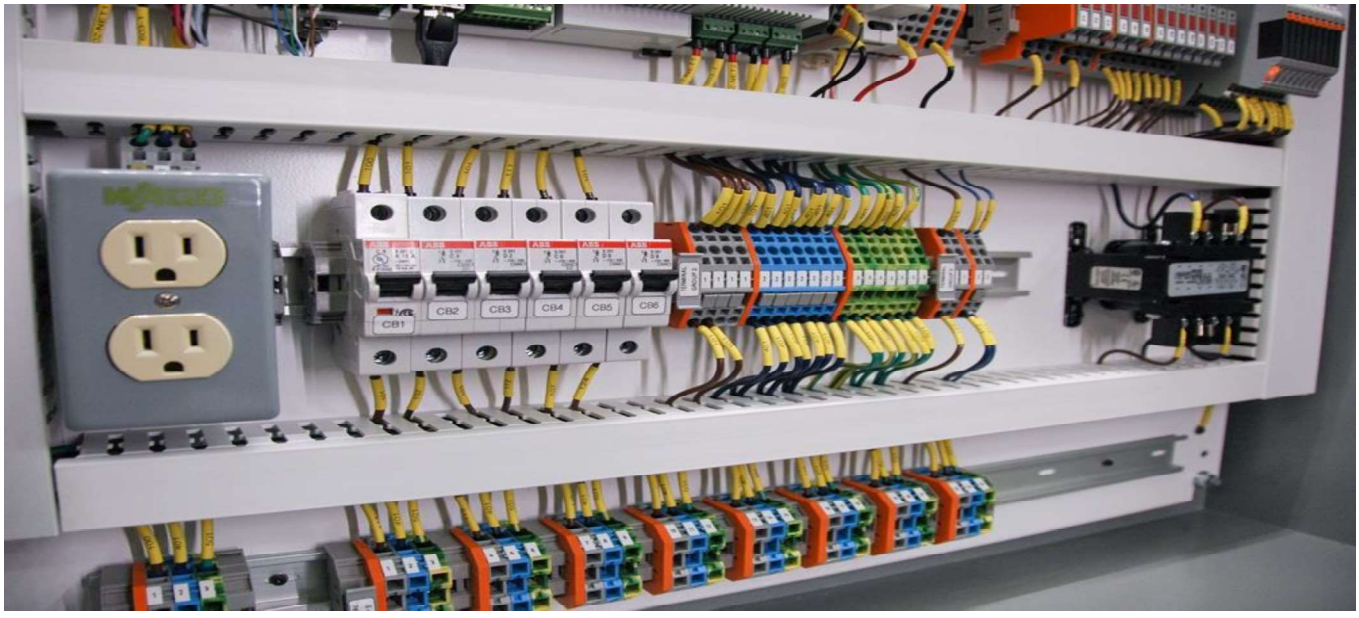
COMPETENCY BASED CURRICULUM

WIREMAN

(Duration: Two Years)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4



SECTOR – POWER

Directorate General of Training

WIREMAN

(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

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

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field of study.	

7. TRADE SYLLABUS

SYLLABUS FOR WIREMAN TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 110 Hrs; Professional Knowledge 20 Hrs	Apply safety precautions and prepare profile with an appropriate accuracy as per drawing using basic jobs of marking components, filing, drilling, riveting, fitting, joining etc. (Mapped NOS: PSS/N1707)	1. Visit various sections of the institutes and identify locations of different installations. (03 hrs) 2. Identify safety symbols and hazards. (04 hrs) 3. Practice elementary first aid. (04 hrs) 4. Practice safe methods of fire fighting in case of electrical fire. (04 hrs) 5. Demonstrate by visual aids to isolate electric supplies and rescue a person safely in contact with electricity. (7 hrs) 6. Demonstrate artificial respiration through visual aids. (04 hrs) 7. Identify trade tools and equipment. (03 hrs)	**Occupational Safety & Health:** Scope of the Wireman trade and career progression. Power sector scenario in India. Safety rules and safety signs for Danger, Warning, caution & personal safety messages. Basic injury prevention, Basic first aid, Hazard identification, avoidance and PPEs. Personal safety and factory safety. Effects of electric current on human being. Reasons for shock. Disposal procedure of waste materials. Response to emergencies e.g. power failure, fire, and system failure.

		8. Disposal procedure of waste materials. (03 hrs) 9. Use of personal protective equipment. (03 hrs) 10. Practice on filing and hacksawing and prepare T-joints, straight joints and dovetail joints on wooden blocks. (15 hrs) 11. Practice sawing, planing, drilling and assembling for making a wooden switchboard. (15 hrs) 12. Practice in marking and cutting of straight and curved pieces in metal sheets, making holes, securing by screw and riveting etc. (15 hrs) 13. Prepare a closed cabinet from metal sheet with holes for cables and various fittings. (15 hrs) 14. Workshop practice on drilling, chipping, internal and external threading of different sizes. (15 hrs)	Concept of Standards and advantages of BIS/ISI. Familiarization with signs and symbols of electrical accessories Introduction to 5S concept. Introduction to fitting tools, safety precautions. Description of files, hammers, chisels hacksaw frames, blades, their specification and grades. Marking tools description and use. Types of drills, description & drilling machines. Various wooden joints. Marking tools; calipers Dividers, Surface plates, angle plates, scribers, punches, surface gauges, Types, Uses, Care and maintenance. Sheet metal tools: Description of marking & cutting tools. Types of rivets and riveted joints. Use of thread gauge. Description of carpenter's tools Care and maintenance of tools. (20 hrs)
Professional Skill 60 Hrs; Professional Knowledge 10 Hrs	Prepare terminations, make good quality of electrical wire joints for single and multi-strand conductors and carry out crimping, soldering and brazing. (Mapped NOS: PSS/N2512, PSS/N1331)	15. Demonstrate and identify various types of cables used in domestic, commercial and industrial wiring systems. (9 hrs) 16. Practice stripping and skinning of different cables. Measure thickness of wire using SWG and micrometer. (9 hrs)	**Wire Joints:** Trade tools specifications. Properties of conductors, Fundamental of electricity. Electron theory; free electron, fundamental terms, definitions, units & effects of electric current. Types of wires & cables, standard wire gauge.

		17. Demonstrate and Practice bare conductor joints, viz. Rat tail, Duplex cross, Knotted type, Britannia, straight, Tee, Western union, fixture Joints, split bolt connector. (21 hrs) 18. Practice in soldering. (7 hrs) 19. Practice in brazing. (07 hrs) 20. Practice on crimping thimbles, lugs and fitting of a push fit co-axial plug and socket. (7 hrs)	Current carrying capacity of different conductors. Specification of wires & Cables- insulation & voltage grades -Low, medium & high voltage Precautions in using various types of cables / Ferrules. Types of Wire joints & their application. Insulators, semi-conductors and resistors. Voltage grading of different types of Insulators, permissible temperature rise. Solders, flux and soldering techniques. (10 hrs)
Professional Skill 130 Hrs; Professional Knowledge 30 Hrs	Draw and set up DC and AC circuits, involving R-L-C components, perform measurement of various electrical parameters with due care and safety. Carry out Sealing of energy meters and Monitor meter readings using MRI. (Mapped NOS: PSS/N1707)	21. Measure resistance using voltage drop method. (05 hrs) 22. Measure resistance using wheatstone bridge method. (06 hrs) 23. Verify thermal effect of electric current and change in resistance due to temperature. (06 hrs) 24. Verify Ohm's law in electrical circuit. (05 hrs) 25. Measure current and voltage in electrical circuits to verify Kirchhoff's Law. (9 hrs) 26. Verify the characteristics of series-parallel combination of resistors. (05 hrs) 27. Determine the poles and plot the field of a magnet bar. (05 hrs)	**Basic Electricity:** Introduction of National Electrical Code 2011. Ohm's Law, Kirchoff's Laws Series and parallel circuits. Open and short circuits in series and parallel networks. Laws of Resistance and various types of resistors. Series and parallel combinations of resistors. Wheatstone bridge; principle and its applications. Different methods of measuring the values of resistance. **Magnetism**; Magnetic terms, magnetic materials and properties of magnet. Principles and laws of electro-magnetism.

		28. Wind a solenoid and determine the magnetic effect of electric current. (05 hrs) 29. Demonstrate generation of mutually induced emf. (05 hrs) 30. Identify various types of capacitors, charging / discharging and testing. Group the given capacitors to get the required capacity and voltage rating. (06 hrs) 31. Measure power, energy for lagging and leading power factors in three phase circuits. Verify relationship between line and phase values in 3 phase star and delta connection. (12 hrs) 32. Ascertain use of neutral by identifying wires of a 3-phase 4 wire system and find the phase sequence using phase sequence meter. (05 hrs) 33. Practice on using analog and digital multi-meter for measurement of various parameters. (05 hrs) 34. Determine the effect of broken neutral wire in three phase four wire system. (05 hrs) 35. Measure the Power of three phase circuit for balanced and unbalanced loads. (05 hrs) 36. Practice on measuring instruments in single and three phase circuits viz.,	Self and mutually induced EMFs. **Electrostatics:** Capacitor- Different types, functions, grouping and uses. Inductive and capacitive reactance, their effect on AC circuit and related vector concepts. Comparison and Advantages of DC and AC systems. Related terms frequency, Instantaneous value, R.M.S. value, Average value, Peak factor, form factor, power factor and Impedance etc. Sine wave, phase and phase difference. Active and Reactive power. Single Phase and three-phase system. Advantages of AC poly-phase system. Problems on A.C. circuits. Concept of three-phase Star and Delta connection. Line and phase voltage, current and power in a 3 phase circuits with balanced and unbalanced load. **Measuring instruments;** Classification of electrical instruments and essential forces required in indicating instruments. PMMC and Moving iron instruments.

		Wattmeter, Energy meter, Phase sequence meter and Frequency meter. (08 hrs) 37. Demonstrate improvement of PF by use of capacitors in AC three phase circuits. (06 hrs) 38. Measure current, voltage, power factor and determine the characteristics of RL, RC and RLC in AC series and parallel circuits. (12 hrs) 39. Measure electrical parameters using tong tester in three phase circuits. (05 hrs) 40. Practice installation and sealing of energy meters. (05 hrs) 41. Practice on collecting meter reading of various meters using MRI and study of MRI reports. (05 hrs)	Measurement of various electrical parameters using different analog and digital instruments viz., multi-meter, Wattmeter, Energy meter, Phase sequence meter, Frequency meter, etc. Measurement of energy in three phase circuit. Important common applicable IE rules. **Meter Reading;** - Description of MRI - Reading of Meter by MRI (30 hrs)
Professional Skill 50 Hrs; Professional Knowledge 10 Hrs	Explain basic concepts of generation, transmission and distribution of electrical power including renewable energy. (Mapped NOS: PSS/N7001)	42. Demonstrate Thermal & Nuclear power plants using visual aids. (05 hrs) 43. Demonstrate different transmission and distribution systems using visual aids. (06 hrs.) 44. Demonstrate different renewable energy power plants viz., Solar, wind, small, mini &micro hydro power plants using visual aids. (06 hrs.)	**Power system:** Generation, transmission and distribution of electrical power General idea about overhead transmission, distribution (LV, MV & HV) and their types and accessories used. Types of Distribution system Line protecting devices Types of substations - indoor, outdoor & Pole mounted, etc. **Substation Equipment** Switchgear; CBs – ACB, VCB, SF6, OCB etc. protection schemes,

		45. Identify different types of insulators. (Video demonstration/ charts). (03 hrs) 46. Visit to distribution sub-station to familiarize with equipment and various accessories. (08 Hrs) 47. Demonstrate operation of various circuit breakers viz., ACB, VCB, SF6, OCB. using visual aids. (10 hrs.) 48. Demonstrate different types of substations viz., outdoor, indoor, pole mounted. using visual aids. (06 hrs.) 49. Prepare a line diagram of the institute/ ITI supply system. (06 hrs.)	current transformer, Potential transformer, Protective relays, lightning arrestors, Different types of switches and switch gears, multi Range switches, rotary switches, cooker control panels, power circuit switches, thermostat, mercury switches etc. (10 hrs)
Professional Skill 40 Hrs; Professional Knowledge 7 Hrs	Plan and prepare Plate and Pipe earthing installations and ensure safe and effective earthing. (Mapped NOS: PSS/N6002)	50. Demonstrate and identify various components of earthing installation. (05 hrs) 51. Prepare pipe earthing and measure earth resistance by earth tester/ megger. (9 Hrs) 52. Prepare plate earthing and measure earth resistance by earth tester/ megger. (9 Hrs) 53. Demonstrate grid/ mesh earthing. (06 Hrs) 54. Practice grounding of equipment and systems. (06 Hrs) 55. Test earth leakage by ELCB and relay. (05 Hrs)	**Earthing:** Importance of Earthing. I. E. Rules for earthing conduits using earth clips and earth wire as per IS 732-1863. Plate earthing, pipe earthing grid/mesh earthing. Earth resistance, earth leakage current and circuit breaker. Difference between grounding and earthing. Awareness of circuit main earth (CME) and portable earth. (07 hrs)

Professional Skill 50 Hrs; Professional Knowledge 10 Hrs	Carry out wiring, testing, and maintenance of DC machines including DC motor starters.	56. Identify parts of DC machines and their terminals. (04 Hrs.) 57. Carry out wiring of different DC motors and generators. (8 Hrs.) 58. Dismantle and identify parts of three point and four-point DC motor starters. (05 Hrs.) 59. Assemble, Service and repair three point and four-point DC motor starters. (9 Hrs.) 60. Practice maintenance of carbon brushes, brush holders, Commutator and slip-rings. (9 Hrs.) 61. Perform speed control of DC motors - field and armature control method. (06 Hrs.) 62. Demonstrate overhauling/ routine maintenance of DC machines. (9 Hrs.)	**DC Machines;** General concept of rotating electrical machines. Principle of DC generator. Use of Armature, Field Coil, Polarity, Yoke, Cooling Fan, Commutator, slip ring and Brushes, Laminated core etc. E.M.F. equation Separately excited and self-excited generators. Series, shunt and compound generators. Armature reaction, Commutation, interpoles and connection of interpoles. Parallel Operation of DC Generators. Application, losses & efficiency of DC Generators. Principle and types of DC motors. Changing the direction of rotation. Methods of speed control of DC motors. (10 hrs)
Professional Skill 60 Hrs; Professional Knowledge 10 Hrs	Carry out wiring, testing, and maintenance of small transformers, 1ϕ& 3ϕ AC motors and Alternators including AC motor starters.	63. Verify terminals, identify components of various single phase and three phase transformers and carry out wiring. (05 hrs) 64. Carry out polarity, insulation, open circuit, short circuit test and voltage regulation of a transformer. (10 hrs) 65. Identify parts and terminals of three phase AC motors, test for continuity and	**Transformers, AC motors, starters and Alternators:** Working principle, construction and classification of transformers. Single phase and three phase transformers. Testing of transformers. General concept of rotating electrical machines. Principle of operation of AC motors and generators,

		insulation resistance. (10 hrs) 66. Identify parts and terminals of different types of single-phase AC motors. (10 hrs) 67. Identify parts and terminals of MG set, make connections and demonstrate conversion of electrical power to a different form. (10 Hrs) 68. Identify parts, service and troubleshoot/ repair & maintenance of AC motor starters viz., DOL, star-delta auto-transformer and rotor resistance starter. (15 Hrs)	components and various types. **Motor Starters:** Different types of starters for AC motors, its necessity, basic contactor circuit, parts and their functions. Basic knowledge of soft starter. (10 hrs)
Professional Skill 50 Hrs; Professional Knowledge 10 Hrs	Read, understand and draw electrical Schematic drawings of power and control circuits using industry standard symbols.	69. Identify and draw symbols used in the electrical circuit drawings. (08 hrs) 70. Interpret control and power circuits of various panel wiring drawings in simple to complex manner. (10 hrs) 71. Practice drawing of simple circuits viz. control of lamps, tube lights, fans and single - phase motors. (10 hrs) 72. Practice drawing of circuits using various control elements viz. timers, relays Circuit breakers, sensors, and sequential control of motors. (17 hrs) 73. Draw a circuit of fully automatic star-delta starter for starting a 3-ϕ induction motor. (05 hrs)	Different control elements and equipment, their symbols. Power and control schematic drawings with interlocks. Relay ladder logic. Relay and control panel wiring. Circuits of various electrical appliances and controls. Power Distribution network drawings. (10 hrs)
Professional Skill 175	Plan, draw, assemble and perform various	74. Wire up simple circuits and practice control of lamps in	**Domestic Wiring:** Introduction and explanation of

Hrs; Professional Knowledge 35 Hrs	domestic wiring. Carry out Testing, maintenance and repair/ replacement of domestic wiring.	different combinations using switching concept. (10 Hrs) 75. Calculate maximum connected load in a section of the institute. (10 hrs) 76. Demonstrate and draw electrical supply system from pole to main switch board including different components. (05 hrs.) 77. Prepare a list of typical energy consumption of electrical appliances. (05 hrs) 78. Identify various accessories used in domestic wiring of different ratings/sizes and list out their approximate cost. (10 hrs.) 79. Prepare test boards/ extension boards and mount accessories like lamp holders, switches, sockets, fuses, relays, MCB, ELCB, MCCB. (18 Hrs) 80. Graphical representation (Current Vs time) of MCB & ELCB. (05 hrs) 81. Demonstrate method of working with plum bob, sprit level, water level and wall chasing. (10 hrs) 82. Draw layouts and practice PVC Casing-capping wiring of minimum 20 meter length with minimum to more number of points. (12 Hrs) 83. Wire up PVC Casing-capping wiring to control one lamp	electrical wiring systems, cleat wiring, Casing-capping, CTS, Conduit and concealed etc. IE Rules related to wiring, National Building codes for house wiring, specification and types, rating & material. Minimum load capacities (W/m^2) of various buildings. Electrical load categories. Terms; Maximum demand, Load factor and Diversity factor, etc. Various wiring accessories/ electrical fittings e.g. switches, fuses, lamp holders, plugs, brackets, ceiling rose, cut out relays, sensors, voltage regulators, MCB, ELCB, MCCB etc. Grading of cables and current ratings. Principle of laying out of domestic wiring. Selection of switchgear. Voltage drop concept. IS 732-1863. Wiring materials used for PVC cables, Indian standards regarding the above wiring such as clip distance fixing of screws, cable bending etc. Introduction to estimation procedure, PVC casing and capping materials, sizes and

		from two different places (Staircase wiring). (12 Hrs) 84. Draw layouts and practice PVC Conduit wiring of minimum 20 mtr length with minimum to more number of points. (15 hrs) 85. Wire up PVC conduit wiring to control one lamp from three different places. (12 hrs) 86. Demonstrate process of concealed conduit wiring system using visual aids. (05 hrs) 87. Prepare main distribution board, mount the energy meter board. (10 hrs) 88. Wire up the consumers main board with ICDP switch and distribution fuse box. (05 Hrs) 89. Carry out polarity test and ensure correct connections of switches, fuses and accessories. (05 hrs) 90. Carry out earth continuity test and ensure resistance of earth conductor as per IE rule. (05 hrs) 91. Check line-earth and neutral-earth loop impedance and ensure effectiveness of earthing. (06 hrs) 92. Simulate faults and practice tracing of faults in different circuits. (10 Hrs)	grades etc. Conduit pipe wiring materials and accessories, types and sizes of conduit. Branching of circuits with respect to loads such as lighting and power. Layout of Light points, fan points, heating loads etc., their controls, main switches, distribution boards as per IE rules. Difference between MCCB, MCB, ELCB, RCCB, MPCB. Different types of wiring; PVC conduit; Surface and concealed (PVC Conduit;/ metal conduit) Casing-capping wiring system. Power, control, Communication and entertainment wiring. Wiring circuits planning, permissible load in sub-circuit and main circuit. (35 hrs)

		93. Video demonstration of various wiring accessories/ electrical fittings available in the market viz., switches, panels, fuses, plugs, brackets, cut out relays, sensors, voltage regulators, circuit breakers etc. (05 hrs)	
Professional Skill 80 Hrs; Professional Knowledge 18 Hrs	Carry out wiring of control panels, assemble accessories and equipment. (Mapped NOS: PSS/N1709)	94. Demonstrate various components of a control panel viz. DIN rails, plastic trunking, connector blocks, screw terminals, transformers/ toroidal inductors, resistors, capacitors, fuses, fuse holders, switches, push buttons, lamps their specifications and labelling. (05 hrs) 95. Demonstrate various components of different relays and contactors, their specifications, fittings in the control panel and labelling. (05 hrs) 96. Practice cable forming including template, binding, lacing, loop tie, lock stitch, breakouts, twisted pair. (10 hrs) 97. Practice use of sleeves, bootlace ferrule, passing cables through strain relief plate, correct method of connections in terminal blocks and routing of cables. (10 hrs)	**Control Panel Wiring;** Control panel components; DIN rails, trunking, connector blocks, screw terminals, relays, contactors, protective units, fuses, fuse holders; chassis mounted, fuse-links, resistors; fixed, variable, capacitors, switches, lamps, labelling grommets and clips etc. Cable forming; template, wiring schedule, run out sheet, binding, continuous lacing, loop tie, lock stitch, finish knot, breakouts, lacing breakouts, spot ties, laying of wires, twisted pair, Cable markers and colour codes etc. Connections and routing of cables. Consideration of EMI/EMC Conductors of different circuits. Symbols and use of relay contacts: NO, NC, changeover, make/break after delay. Testing of various control elements and circuits. (18 hrs)

		98. Pass cables through strain relief plate in an Electrical cabinet and secure the cables properly using cable tie/clamp. (05 hrs) 99. Mount various control elements e.g. circuit breakers, relays, contactors, measuring instruments, sensors and timers. (10 hrs) 100. Practice earthing and screening of cabinets as per IE rules and ensure proper earth continuity. (10 hrs) 101. Demonstrate electro-magnetic interference and electro-magnetic compatibility. (05 hrs) 102. Practice wiring of control panel for different operations/controls of motor using various accessories and test for its performance. (20 hrs)	
Professional Skill 35 Hrs; Professional Knowledge 10 Hrs	Install, test and carry out maintenance of batteries and solar cell with due care and safety. (Mapped NOS: PSS/N6003)	103. Demonstrate use of various types of cells and practice on grouping of cells for specified voltage/current under different conditions. (03 Hrs) 104. Prepare and practice on battery charging. (03 Hrs) 105. Practice on routine, care/ maintenance and testing of batteries. (07 Hrs) 106. Practice charging of a Lead acid cell, filling of electrolytes, testing of	**Battery and solar cell:** Chemical effects of electric current and Laws of electrolysis. Explanation of Anodes and cathodes. Types of cells, advantages/ disadvantages and their applications. Lead acid cell; Principle of operation and components. Types of battery charging, Safety precautions, test equipment and

		charging, checking of discharged and fully charged battery. (12 hrs) 107. Demonstrate different types of solar cell viz., a-Si, Cd-Te, c-Si, CI(G)S, CVP and HCVP. (05 hrs) 108. Determine the number of solar cells in series/ parallel for given power requirement. (05 Hrs)	maintenance. Grouping of cells for specified voltage and current. Principle and operation of solar cell, Types of solar cell. (10 Hrs)
Engineering Drawing: 40 Hrs.			
Professional Knowledge ED-40 Hrs.	Read and apply engineering drawing for different application in the field of work.	**Engineering Drawing:** Introduction to Engineering Drawing and Drawing Instruments– • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Freehand drawing of– • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches. • Free hand drawing of hand tools. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Lettering & Numbering – Single Stroke Dimensioning Practice • Types of arrowhead Symbolic representation– • Different electrical symbols used in the related trades	

		Reading of Electrical Circuit Diagram Reading of Electrical Layout drawing	
Workshop Calculation & Science: 30 Hrs.			
Professional Knowledge WCS-30 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**Workshop Calculation & Science:** **Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, subtraction, multiplication & division Decimal fractions - Addition, subtraction, multiplication& division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and square root Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non-ferrous metals Introduction of iron and cast iron **Mass, Weight, Volume and Density** Mass, volume, density, weight Related problems for mass, volume, density, weight Work, power, energy, HP, IHP, BHP and efficiency Potential energy, kinetic energy and related problems with assignment **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 Scales of temperature, Celsius, Fahrenheit, kelvin and conversion between scales of temperature Heat &Temperature - Temperature measuring instruments, types of thermometer, pyrometer and transmission of heat - Conduction, convection and radiation. **Mensuration** Area and perimeter of square, rectangle and parallelogram Area and perimeter of Triangles	