CURRICULUM

FOR THE TRADE OF

OPERATOR CUM MECHANIC POWER-PLANT

UNDER

APPRENTICESHIP TRAINING SCHEME

सत्यमेव जयते
Government of India

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

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Co-ordinator for the course: Sh. Nirmalya Nath., ADT

Sl. No.	Name & Designation Sh./Mr./Ms.	Organization	Expert Group Designation
1.	N. Nath, ADT	CSTARI, Kolkata	Expert
2.	R. N. Manna, T.O.	CSTARI, Kolkata	Expert
3.	S. Bandypadhyay, T.O.	ATI, Kolkata	Expert

2. BACKGROUND

2. 1. Apprenticeship Training Scheme under Apprentice Act 1961

The Apprentices Act, 1961 was enacted with the objective of regulating the programme of training of apprentices in the industry by utilizing the facilities available therein for imparting on-the-job training. The Act makes it obligatory for employers in specified industries to engage apprentices in designated trades to impart Apprenticeship Training on the job in industry to school leavers and person having National Trade Certificate(ITI pass-outs) issued by National Council for Vocational Training (NCVT) to develop skilled manpower for the industry**.** There are four categories of apprentices namely**; trade apprentice, graduate, technician and technician (vocational) apprentices.**

Qualifications and period of apprenticeship training of **trade apprentices** vary from trade to trade. The apprenticeship training for trade apprentices consists of basic training followed by practical training. At the end of the training, the apprentices are required to appear in a trade test conducted by NCVT and those successful in the trade tests are awarded the National Apprenticeship Certificate.

The period of apprenticeship training for graduate (engineers), technician (diploma holders and technician (vocational) apprentices is one year. Certificates are awarded on completion of training by the Department of Education, Ministry of Human Resource Development.

2. 2. Changes in Industrial Scenario

Recently we have seen huge changes in the Indian industry. The Indian Industry registered an impressive growth during the last decade and half. The number of industries in India have increased manifold in the last fifteen years especially in services and manufacturing sectors. It has been realized that India would become a prosperous and a modern state by raising skill levels, including by engaging a larger proportion of apprentices, will be critical to success; as will stronger collaboration between industry and the trainees to ensure the supply of skilled workforce and drive development through employment. Various initiatives to build up an adequate infrastructure for rapid industrialization and improve the industrial scenario in India have been taken.

2. 3. Reformation

The Apprentices Act, 1961 has been amended and brought into effect from 22nd December, 2014 to make it more responsive to industry and youth. Key amendments are as given below:

- Prescription of number of apprentices to be engaged at establishment level instead of trade-wise.

- Establishment can also engage apprentices in optional trades which are not designated, with the discretion of entry level qualification and syllabus.

- Scope has been extended also to non-engineering occupations.

- Establishments have been permitted to outsource basic training in an institute of their choice.

- The burden of compliance on industry has been reduced significantly.

3. RATIONALE

(Need for Apprenticeship in **Operator cum Mechanic Power-Plant** trade)

1) Adjust controls to generate specified electrical power, or to regulate the flow of power between generating stations and substations.

2) Control and maintain auxiliary equipment, such as pumps, fans, compressors, condensers, feed water heaters, filters, and chlorinators, to supply water, fuel, lubricants, air, and auxiliary power.

3) Control generator output to match the phase, frequency, and voltage of electricity supplied to panels.

4) Make adjustments or minor repairs, such as tightening leaking gland and pipe joints; report any needs for major repairs.

5) Monitor and inspect power plant equipment and indicators to detect evidence of operating problems.

6) Open and close valves and switches in sequence upon signals from other workers, in order to start or shut down auxiliary units.

7) Operate or control power generating equipment, including boilers, turbines, generators, and reactors, using control boards or semi-automatic equipment.

8) Place standby emergency electrical generators on line in emergencies and monitor the temperature, output, and lubrication of the system.

9) Regulate equipment operations and conditions such as water levels, based on data from recording and indicating instruments or from computers.

10) Replenish electrolytes in batteries and oil in voltage transformers, and reset tripped electric relays.

11) Start or stop generators, auxiliary pumping equipment, turbines, and other power plant equipment, and connect or disconnect equipment from circuits.

12) Take readings from charts, meters and gauges at established intervals, and take corrective steps as necessary.

13) Clean, lubricate, and maintain equipment such as generators, turbines, pumps, and compressors in order to prevent equipment failure or deterioration.

14) Collect oil, water, and electrolyte samples for laboratory analysis.

15) Communicate with systems operators to regulate and coordinate transmission loads and frequencies, and line voltages.

16) Examine and test electrical power distribution machinery and equipment, using testing devices.

17) Inspect records and log book entries, and communicate with other plant personnel, in order to assess equipment operating status.

18) Receive outage calls and call in necessary personnel during power outages and emergencies.

19) Record and compile operational data, completing and maintaining forms, logs, and reports.

4. JOB ROLES: REFERENCE NCO

Brief description of Job roles:

Power-Plant Operator operates boilers, turbines, generators, and auxiliary equipment at generating plant to produce electricity: Monitors control board and regulates equipment, according to procedures and information obtained from recording and indicating instruments. Adjusts controls of water and cold feed systems, blowers, and igniters to start up or shut down boilers. Controls operation of boiler auxiliary equipment, such as water and vacuum pumps, coal driers and pulverizes, steam condensers, and soot blowers, to ensure efficient operation of boilers. Adjusts boiler controls to provide steam at specified temperature and pressure for turbine loads according to power demands. Adjusts controls to regulate speed, voltage, and phase of incoming turbines to coincide with voltage and phase of power being generated. Synchronizes incoming generating units with units in operation and closes circuit breaker at exact instant of coincidence. Monitors gauges to determine effect of generator load on related equipment, such as bus bars and voltage regulators. Adjusts transformer controls to regulate flow of power between generating stations and substations. Operates switchgear to regulate and transfer power loads to protect maintenance workers engaged in repairing or cleaning equipment. Records malfunctions of equipment, instruments, or controls on log sheet.

Plan and organize assigned work and detect & resolve issues during execution. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

Perform TPM (Total Production Management), TQM (Total Quality Management) and record keeping system.

Reference NCO:

i) **NCO-2004 : 8161.45**

5. GENERAL INFORMATION

1. **Name of the Trade** **: OPERATOR CUM MECHANIC POWER -PLANT**

2. **N.C.O. Code No.** : **NCO-2004:** 8161.45

3. **Duration of Apprenticeship Training (Basic Training + Practical Training):**2years

3.1 **For Freshers: -** Duration of Basic Training: -

a) Block –I : 3 months

b) Block – II : 3 months

Total duration of Basic Training: **6 months**

Duration of Practical Training (On -job Training): -

a) Block–I: 9 months

b) Block–II : 9 months

Total duration of Practical Training: **18 months**

3.2 **For ITI Passed: -** Duration of Basic Training: **- NIL**

Duration of Practical Training (On -job Training): **12 months**

4. **Entry Qualification** : Passed in 10th class examination under 10+2 system of education with Science & Mathematics.

5. **Selection of Apprentices:** The apprentices will be selected as per Apprentices Act amended time to time.

6. **Rebate for ITI passed trainees** : NIL

Note: Industry may impart training as per above time schedule for different block, however this is not fixed. The industry may adjust the duration of training considering the fact that all the components under the syllabus must be covered. However the flexibility should be given keeping in view that no safety aspects is compromised.

6. COURSE STRUCTURE

Training duration details: -

Time (in months)	1-3	4-12	13-15	16-24
Basic Training	Block– I	-----	Block – II	------
Practical Training (On - job training)	----	Block – I	------	Block – II

Components of Training	Duration of Training in Months →																							
↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Basic Training Block - I																								
Practical Training Block - I																								
Basic Training Block - II																								
Practical Training Block - II																								

7. SYLLABUS

7.1 BASIC TRAINING
(BLOCK – I & II)
DURATION: 06 MONTHS

GENERAL INFORMATION

1) **Name of the Trade** : **OPERATOR CUM MECHANIC POWER -PLANT**
2) **Hours of Instruction** : 1000 Hrs. (500 hrs. in each block)
3) **Batch size** : 20
4) **Power Norms** : 17 KW for Workshop
5) **Space Norms** : 192 Sq. m.
6) **Examination** : The internal assessment will be held on completion of each Block.
7) **Instructor Qualification** :

i) Degree/Diploma in **Mechanical** Engg. from recognized university/Board with one/two year post qualification experience respectively in the relevant field.

OR

ii) NTC/NAC in the trade of **Operator cum Mechanic Power -Plant** with three year post qualification experience in the relevant field.

Preference will be given to a candidate with Craft Instructor Certificate (CIC)

8) **Tools, Equipments & Machinery required** : - As per Annexure – I

6.1.1 DETAIL SYLLABUS OF CORE SKILL

A. Block– I
Basic Training

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
1.	Engineering Drawing: Introduction and its importance Different types of standards used in engineering drawing. Drawing Instruments: their uses Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.	**30**	**Units & Measurements-** FPS, CGS, MKS/SI unit, unit of length, Mass and time. Fundamentals and derived units Conversion of units and applied problems.	**20**
2.	Lines : types and applications in Drawing as per BIS SP:46-2003 Drawing geometrical object using all types of lines. **Drawing of Geometrical Figures:** Angle, Triangle, Square, Rectangle and Circle. **Letters: -** Lettering styles, Single stroke letters and numbers as per IS standard. Lettering practice		**Material Science** : properties - Physical & Mechanical, Types - Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals	
3.	**Dimensioning-** Types of dimension, elements of dimensions, Methods of indicating Values, Arrangement, Alignment and indication of dimensions. **Scales**:-Types use and construction. Representative factor of scale.		**Mass .Weight and Density** : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density,	
4.	Method of presentation of Engineering Drawing - Pictorial View - Orthogonal View - Isometric view		**Speed and Velocity:** Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation. Average Velocity, Acceleration & Retardation. Related problems. Circular Motion: Relation between circular motion and Linear motion, Centrifugal	

			force, Centripetal force	
5.	**Constructions: -** Draw proportionate free hand sketches of plane figures. Sketch horizontal, vertical and inclined line by free hand, Draw circles by free hand using square and radial line method, Draw arcs and ellipse by free hand		**Ratio & Proportion** : Simple calculation on related problems. **Percentage:** Introduction, Simple calculation.	
6.	Projections: Concept of axes plane and quadrant. Orthographic projections Method of first angle and third angle projections (definition and difference) Symbol of 1^{st} angle and 3^{rd} angle projection as per IS specification. Free hand Drawing of Orthographic projection from isometric/3D view of geometrical blocks		**Work, Power and Energy:** work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy. Meaning of H.P., I.H.P., B.H.P., and F.H.P. and CC and Torque.	

B. Block- II
Basic Training

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
1.	**Screw :-** Its Types and Sizes, Screw thread, their standard forms as per BIS, external and internal thread.	**30**	**Algebra:** Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	**20**
2.	**Rivets and Joints:-** Prepare a drawing sheet on rivets nomenclature and Joints.		**Heat & Temperature:** Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation.	
3.	Free hand Sketches for simple pipe line with general fittings.		**Mensuration:** Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle, Volume of solids - cube, cuboid, cylinder and Sphere. Surface area of solids -cube, cuboid, cylinder and Sphere. Volume of cut-out solids: hollow cylinders, frustum of cone, block section. Volume of simple solid blocks.	
4.	Reading of drawing. Simple exercises related to missing lines, dimensions. How to make queries.		**Basic Electricity:** Introduction, use of electricity, how electricity is produced, Types of current_ AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Types of connections - series, parallel, electric power, Horse power, energy, unit of electrical energy. Concept of earthling.	
5.	Simple exercises related to trade related symbols. Basic electrical and electronic symbols		**Simple machines** **Transmission of power:** - Transmission of power by belt, pulleys & gear drive. **Heat treatment process:** - Heat treatment and advantages.	

			Annealing, Normalizing, Hardening, Tempering.	
6.	Free hand sketch of trade related components / parts /cutting tool indicating angles.		**Trigonometry:** Trigonometrical ratios, measurement of angles. Trigonometric tables. Finding the value of unknown sides and angles of a triangle by Trigonometrical method. Finding height and distance by trigonometry. Application of trigonometry in shop problems. (viz. taper angle calculation). Calculate the area of triangle by using trigonometry and application of Pythagoras theorem.	
7.			**Concept of pressure** - **Definition**:-Force, Pressure, and their units, atmospheric pressure, gauges used for measuring pressure, problems. Introduction to pneumatics & hydraulics systems.	
8.	**Simple exercises related to trade related Test Papers. Solution of NCVT test papers.**			

7.1.2 DETAIL SYLLABUS OF PROFESSIONAL SKILLS & PROFESSIONAL KNOWLEDGE

A. Block –I

Basic Training

Week No.	Professional Skills	Professional Knowledge
1.	Safety: - its importance, classification, personal, general, workshop and job safety. Occupational health and safety. Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution & personal safety message. Preventive measures for electrical accidents & steps to be taken in such accidents. Importance of housekeeping & good shop floor practices. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Fire& safety: Use of Fire extinguishers.	Importance of safety and general precautions observed in the in the industry/shop floor. All necessary guidance to be provided to the new comers to become familiar with the working of Institute system including stores procedures. Introduction of First aid. Safety attitude development of the trainee by educating him to use Personal Protective Equipment (PPE). Response to emergencies eg; power failure, fire, and system failure. Accidents- Definition types and causes. First-Aid, nature and causes of injury and utilization of first-aid. Introduction to 5S concept & its application. Fire: - Types, causes and prevention methods. Fire Extinguisher, its types. Define environment, environment Pollution, Pollutants, type of Pollution (Air pollution, water pollution, soil pollution noise pollution, thermal pollution, radiation. Global warming its causes and remedies. Industrial Waste its types, sources and waste Management.
2.	Identification of tools & equipments as per desired specifications for marking & sawing(Hand tools , Fitting tools & Measuring tools) Selection of material as per application Visual inspection of raw material for rusting, scaling, corrosion etc.	Hand tools and its importance, steel rule, Try square, chisel, surface gauge and care & maintenance, Hacksaw frame, blades. Classification and types of chisels, files & uses, vices - its constructions and uses. Hammers and its types. Related safety.

	Uses of marking tools, Punch, Try square & basic measuring tools, caliper, steel rule. Marking out lines, gripping suitably in vice jaws, hacksawing to given dimensions, sawing different types of metals of different sections.	Marking block, Steel rule, and calipers- different types and uses. Combination set- its components and uses. Hacksaw blade, Hacksaw frame and its types. Drill bits- parts, Types & uses.
3.	Understand and usage of different measuring instruments e.g. bore gauge, dial indicator, edge finder. Checking and setting of Vernier calipers, vernier height gauge &vernier bevel protractor. Filing flat, square, steps and contour surfaces to an accuracy of 0.4 mm	Linear measurements & its units Classification, construction, materials and functional detail of following basic measuring and marking tools : - • Steel Rule • Calipers(Inside & outside), • Divider, Trammel • Try Square • Marking Punch Measuring Instruments. Vernier calipers, vernier height gauge &vernier bevel protractor - principle, construction, calculation of least count and its use and care.
4.	Chipping practice on flat surface, slots & oil grooves, and chamfer at different angle on MS plate. Scraping practice on curved surfaces. Preparation of flat surfaces and scraping practice on flat surface taking impression on face high spots using prussian blue sharpening by diamond dresser & wheel and lapping stone.	Precision Measuring Instruments: Concept of precision & accuracy Micrometer (outside, inside and depth) – use & care, calculation of least count. **Limits, fits and tolerances:** Different system of limit and tolerances - Newall, BIS, British, DIN, ISO. Details of BIS system. Interchangeability and standardization. Use of templates, jigs and fixtures, gauges for manufacturing of interchangeable parts. **Scrapers**: Introduction, its types, material and use.
5.	Hand grinding of different types of tools, e.g. chisel, drill, etc. Reaming with hand reamers. Threading by hand using taps and dies. Cold riveting of two components with different types of rivets. Pipe cutting, pipe threading, pipe fitting etc.	Joining & Fastening **Devices** Permanent, semi-permanent & temporary fastening devices. Different types of fasteners and their functions like bolts, nuts, washers, rivets, studs,pins cotter, keys, machine screws, Philip screws etc. Rivets and riveting - types, sizes, riveting

	Punching of holes with hollow punches on leather gaskets and other packing materials.	tools, etc. Pipes and pipe fitting - tools, fixtures, threads etc. Screws and screwing - different type of threads function etc. Taper and tapering - devices with the use of tapers.
6.	**Skills involving in repairing on machine e1ements:** Removing of broken studs from machine parts. Removal and mounting of pulleys, gears in the shaft. Replacement of /repairing of bolts. Removal and mounting of antifriction bearings. Practice of scraping on machine slides, machine beds, plain bearings etc. Checking and repairing of broken and worn-out gears, shafts, pulleys, clutches, flanges, etc.	**Boiler Plant Operation** ght-up and shutdown procedure, boiler emergency and normal operations, boiler protections. **General Terms of Boilers** sation with Indian Boiler Act, Boiler Protects, Hydraulic test, different boiler losses.
7-8.	**Basic skills involved in breakdown maintenance, preventive maintenance and overhauling of machine :** Diagnosis of faults in machines. Breakdown maintenance of general machine tools (lathe, drilling machine, etc.) Practice in carrying out preventive maintenance work (the jobs involve inspection and lubrication of the machine as per instruc-tions). Painting and use of surface protective coatings under preventive maintenance programme.	**Steam Turbines** Fundamental principles of turbine-impu1se and reaction, condensing and non-condensing turbines, turbine compounding. Nomenclature and parts of a turbine, simples features & construction and functions of nozzles, blades, rotors, discs, cylinders, Steam Chest, diaphragm, gland, couplings, bearings, thrust block, thrust balancing. Concept of turbine critical speed. **Turbine Plant Auxi1iaries** Condenser, its classification, function and its construction. Circulating water pumps, Condensate & feed water system extraction pumps, drain cooler, feed heaters, steam traps de-aerator. Air evacuation system, turbine gland sealing system, Air compressors – it

		working, types and Air drivers. **Gas Turbine Power Plant** Introduction, advantages and limitations of gas turbine power plant, cycles for gas turbine - open & close cycle gas turbine power plants. Methods used for improving of gas turbine power plant, fuel system of gas turbine plant, combustion chamber, essential auxiliaries of gas turbine power plant, governing system of gas turbine plant, starting and stopping procedures.
9-10.	Identify various pressure, temperature, flows, current and voltage measuring instruments and its use. Filling log sheets & record keeping. Identify and use of various types of valves like gate valve, globe valve, flap valve, butter fly valve, needle valve, disk valve, hydraulic valves, pneumatic valves, motor operated valves, non return valves, cocks etc. Identify and understanding operation of different types of pumps like centrifugal pumps - single stage & multistage, gear pumps, screw pumps, reciprocating pumps, etc. Priming the pumps, starting, stopping isolating them for maintenance etc.	**Diesel Engine Power Plant** of diesel engine, advantages and disadvantages of diesel engine power plant, essential components of diesel engine power plant. Air intake system, fuel supply system, Cooling system, Exhaust system, lubricating system, starting and stopping operation, governing system. **Nuclear Power PI ant: Fundamentals, basic elements of power plant, reactors.** **Hyde1 Power Plant** rbine working principles, basic elements of hydro power plant, classification, its auxiliaries, speed controls of water turbines, operation of hydro power station.
11.	Identification of various types of centrifugal pumps, their parts. Overhauling of pump. Priming of pump, Fitting gland packing. Starting and stopping of pumps. Trouble shooting in pump operation. Preventive and schedule maintenance of pumps.	Centrifugal Pump, Fan, Blower and Compressor: - Function of pump. Types and working principle of centrifugal pump. Constructional detail of pump Starting and stopping Pump performance and characteristics. Capitation & aeration. Preventive & schedule maintenance of pumps. Gland packing changing procedure. Concept of Mechanical seal Trouble shooting in pump. Air compressors - cooling system, inter & after coolers, storage devices, Air dryers, compressor on load - off load regulation

		etc.
12.	Identification of various types of fans, Blowers, their parts. Dismantling, cleaning and assembly of parts. Identification of various types of compressors, their parts. Starting and stopping of compressors Cleaning and changing of filters Preventive & schedule maintenance of Blower & Compressor	Fan & Blowers: Types and working principle Constructional detail of Fans & Blowers. Starting and stopping of Fans and Blowers Different parts of Fans & Blowers Concept of surge. Preventive & scheduled maintenance. Compressors: Compression theory, Types of compressors Constructional detail of compressors, working mechanism Different parts and their function. Loading unloading system Concept of air dryer. Preventive & schedule maintenance.
13.	**Revision &Internal Assessment**	

B. Block –II
Basic Training

Week No.	Professional Skills	Professional Knowledge
1-2.	**General Maintenance:** 1. Standard pipe thread, join pipes and make pipe assemb1y. 2. Scrap angular matching and sliding surfaces& originate flat surface without master. 3. Assemble components accurately using dowel pins and screw. 4. Lap and finish flat surfaces. 5. Make oil grooves on bearing with chisel. 6. Erect and align machines. 7. Assemble parts by riveting, screwing, pinning, so as to make complete unit according to drawing. 8. Dismantle or remove worn out broken or defective parts using hand tools and replace them by repaired or new one test completed article to ensure correct performance. 9. Fit parts together in set order using nuts, bolts, screws and pins etc. with necessary wrenches, spanners and other special tools. 10. Mounting and dismounting of pulleys and gears on shaft. 11. Mechanical handling of machines for transportation purpose involving the use of screw jacks, pulley blocks, cranes, hoists &slings, roller, bars and wire ropes etc. 12. Alignment of brackets and shafts. 13. Remove and fit antifriction bearings. 14. Maintenance of pneumatic tools & hydraulic driven machines. 15. Recondition thread by tap. 16. Use of precision measuring instruments.	Repair of machines including preventive maintenance: Importance of maintenance work, Different types of maintenance. Methods of maintenance and overhauling of machines and tools. Basic concepts on preventive maintenance.

	17. Reaming holes for proper assembly.	
3-4	**Basic skills involved in breakdown maintenance, preventive maintenance and overhauling of machine:** 1. Diagnosis of faults in machines. 2. Breakdown maintenance of general machine tools (lathe, drilling machine, etc.) 3. Practice in carrying out preventive maintenance work (the jobs involve inspection and lubrication of the machine as per instructions). Painting and use of surface protective coatings under preventive maintenance programme. 4. Overhauling of Bench Drilling Machine, Pedestal Grinding Machine, coolant pump, and machine accessories e.g. chucks vice, steadies, tai1 stock, etc.	**Power Transmission and Driver :** 1. Common methods of power transmission and drives. 2. Belts and belting - types, sizes and use of belts, fasteners, belt speeds, parallel and crossed belt drives. 3. Types and uses of keys and keyways - 4. Tooth gears and gearing - types and uses of gears, conversion of rotary motion into reciprocating motion, pinning and racks, etc. 5. Chain and sprockets - types and uses, solid, flexible, friction, universal etc. 6. Coupling and sprockets - types and uses, solid, flexible, friction, universal etc. 7. Mechanical, hydraulic and pneumatic drives - basic principles and uses. 8. Prime movers, line shafts and drive system, individual drive system, reciprocating drive, reverse drive, eccentric drive, crank drive, cam drive, rotary to linear drive and vice versa. 9. Systems of speed, variation using stepped pulleys, gear box, disc-contact, etc.
5.	Making of different types of keys, keyways on pulleys, gears, etc. by hand. Practice on exercise involving making of simple machine parts which have certain functional relationship to other parts. Make oil grooves on bearing with chisel. Erect and align machines.	Friction and Lubrication: Friction - its effect, methods of reducing friction, use of bearings. Coolants - different types and uses, cooling system. Lubrication and Lubricants - methods of lubrication, need and use, qualities of good lubricants, viscosity, techniques of selection, type of lubrication oil and greases - their rating, commercial names and uses.
6.	**Hydraulic &pneumatic** circuit reading practice & constructing hydraulic circuits for single & double acting cylinders, meter in, meter out circuit, pressure control circuits &regenerating circuit.	Basic principle of Hydraulic& pneumatic system. Advantages & limitation. Constructional & functional details of Hydraulic & pneumatic cylinder, motor, control valves and FRL unit.

7.	Dismantle or remove worn out broken or defective parts using hand tools and replace them by repaired or new one. Test completed article to ensure correct performance. Fit parts together in set order using nuts, bolts, screws and pins etc. with necessary wrenches, spanners and other special tools. Mounting and dismounting of pulleys and gears on shaft.	**Bearings:** Different types, their application and dimensional relationship with shafts, methods of clamping and fitting lubrication of bearings, methods of mounting and dismounting, care maintenance, inspection of bearings. **Machine foundations and alignment :** Methods employed for installation and erection of machines. Location and excavation of foundations. Types of foundation. Method of installation of medium duty machines. Machine alignment procedures, precautions to betaken for aligning leveling machines different types of alignment and testing for correct functioning of machine parts. Machine commissioning.
8.	Mechanical handling of machines for transportation purpose involving the use of screw jacks, pulley blocks, cranes, hoists slings, roller, bars and wire ropes etc.	**Mechanical handling of machines/equipment:** Different types of appliances and tackle for shifting, loading and un-loading of machines and equipments. Screw jacks - their use and working principles. Chain pulley blocks - their use and working principles. Crane and hoists for lifting purp oses - working principles and main constructional features. Working principles and use ofother tackle like crabs and winches, slings, rollers and bars, levers, lashings and packings. Mechanical advantages and velocity. Use of inclined planes. Special precautions in the handling of heavy equipments, removal and replacement of heavy parts.
9-10.	Alignment of brackets and shafts. Remove and fit antifriction bearings. Maintenance of pneumatic tools & hydraulic	**Coal Pulverisers** Types of pulverisers, -working principles.

	driven machines.	Importance of fineness of pulverised fuel and methods of controlling it, Coal feeders emergency operation during fire. **Ash Handling System** Handling bottom ash and fly ash in boilers. Description and use of cyclone type of mechanical dust collectors, Principle and function of electrostatic precipitator. **Water Treatment Plant** Impurities in water and their harmful effects. Priming, foaming, scale formation and corrosion, softening and de-mineraling plant, boiler internal chemical treatment of feed water. Familiarisation with TDS & PH value of water & their effects.
11-12.	Detect faults and undertake repair of the machine. Inspect, align and test machine for accurate functioning. Assemble and dismantle machines and their parts and adjust them as per requirement.	Boiler Maintenance: Maintenance of air-preheaters, Air-preheaters maintenance, Seal setting of air-preheaters, Inspection of Tabular air-heater, S C A P H cleaning, Knowledge of International Boiler Regulation. Pu1verisers and Feeders Maintenance. Fans Maintenance: Fan lubrication system, Ash & Dust Collect ion System Maintenance: Maintenance of dust collection ash handling system, Ash disposal line maintenance. Air Compressors Maintenance: Trouble shooting, Pump Maintenance: Steam Turbine Generator Overhauling: Maintenance of Heat Exchangers Ejector maintenance. Cooling Tower Maintenance: Components, Specific problems, Major maintenance / modifications, I D fan gear box overhauling. Types of faults, Types of joints, gland packing & gaskets.
13.	**Revision & Internal Assessment**	

7.1.3 EMPLOYABILITY SKILLS

GENERAL INFORMATION

1)	**Name of the subject**	**:**	**EMPLOYABILITY SKILLS**
2)	**Applicability**	**:**	ATS- Mandatory for fresher only
3)	**Hours of Instruction**	**:**	**110 Hrs. (55 hrs. in each block)**
4)	**Examination**	**:**	The examination will be held at the end of two years Training by NCVT.
5)	**Instructor Qualification**	**:**	

i) MBA/BBA with two years experience or graduate in sociology/social welfare/Economics with two years experience and trained in Employability skill from DGET Institute.

And

Must have studied in English/Communication Skill and Basic Computer at 12th /diploma level

OR

ii) Existing Social Study Instructor duly trained in Employability Skill from DGET Institute.

7.1.3.1 SYLLABUS OF EMPLOYABILITY SKILLS

A. Block – I
Basic Training

Topic No.	Topic	Duration (in hours)
	English Literacy	**15**
1	**Pronunciation :** Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)	
2	**Functional Grammar** Transformation of sentences, Voice change, Change of tense, Spellings.	
3	**Reading** Reading and understanding simple sentences about self, work and environment	
4	**Writing** Construction of simple sentences Writing simple English	
5	**Speaking / Spoken English** Speaking with preparation on self, on family, on friends/ classmates, on know, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Cardinal (fundamental) numbers ordinal numbers. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.	
	I.T. Literacy	**15**
1	**Basics of Computer** Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.	
2	**Computer Operating System** Basics of Operating System, WINDOWS, The user interface of Windows OS, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc, Use of Common applications.	
3	**Word processing and Worksheet** Basic operating of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & creation of Tables. Printing document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets	
4.	**Computer Networking and INTERNET** Basic of computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks), Meaning of World Wide Web (WWW), Web Browser, Web Site, Web page and Search Engines. Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites and its implication. Information Security and antivirus tools, Do's and Don'ts in	

	Information Security, Awareness of IT - ACT, types of cyber crimes.	
	Communication Skill	**25**
1	**Introduction to Communication Skills** Communication and its importance Principles of Effective communication Types of communication - verbal, non verbal, written, email, talking on phone. Non verbal communication -characteristics, components-Para-language Body - language Barriers to communication and dealing with barriers. Handling nervousness/ discomfort. Case study/Exercise	
2	**Listening Skills** Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening. Triple- A Listening - Attitude, Attention & Adjustment. Active Listening Skills.	
3	**Motivational Training** Characteristics Essential to Achieving Success The Power of Positive Attitude Self awareness Importance of Commitment Ethics and Values Ways to Motivate Oneself Personal Goal setting and Employability Planning. Case study/Exercise	
4	**Facing Interviews** Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview	
5	**Behavioral Skills** **Organizational Behavior** Problem Solving Confidence Building Attitude Decision making Case study/Exercise	

B. Block– II
Basic Training

Topic No.	Topic	Duration (in hours)
	Entrepreneurship skill	**15**
1	**Concept of Entrepreneurship** **Entrepreneurship**- Entrepreneurship - Enterprises:-Conceptual issue Entrepreneurship vs. Management, Entrepreneurial motivation. Performance & Record, Role & Function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, The process of setting up a business.	
2	**Project Preparation & Marketing analysis** Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of Product Life Cycle (PLC), Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.	
3	**Institutions Support** Preparation of Project. Role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme.	
4	**Investment Procurement** Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.	
	Productivity	**10**
1	**Productivity** Definition, Necessity, Meaning of GDP.	
2	**Affecting Factors** Skills, Working Aids, Automation, Environment, Motivation How improves or slows down.	
3	**Comparison with developed countries** Comparative productivity in developed countries (viz. Germany, Japan and Australia) in selected industries e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages.	
4	**Personal Finance Management** Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.	
	Occupational Safety, Health & Environment Education	**15**
1	**Safety & Health** Introduction to Occupational Safety and Health importance of safety and health at workplace.	

2	**Occupational Hazards** Basic Hazards, Chemical Hazards, Vibro-acoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.	
3	**Accident & safety** Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.	
4	**First Aid** Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person	
5	**Basic Provisions** Idea of basic provision of safety, health, welfare under legislation of India.	
6	**Ecosystem** Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.	
7	**Pollution** Pollution and pollutants including liquid, gaseous, solid and hazardous waste.	
8	**Energy Conservation** Conservation of Energy, re-use and recycle.	
9	**Global warming** Global warming, climate change and Ozone layer depletion.	
10	**Ground Water** Hydrological cycle, ground and surface water, Conservation and Harvesting of water	
11	**Environment** Right attitude towards environment, Maintenance of in -house environment	
	Labour Welfare Legislation	**5**
1	**Welfare Acts** Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.	
	Quality Tools	**10**
1	**Quality Consciousness :** Meaning of quality, Quality Characteristic	
2	**Quality Circles :** Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to starting Quality Circles, Steps for continuation Quality Circles.	
3	**Quality Management System :** Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.	
4	**House Keeping :** Purpose of Housekeeping, Practice of good Housekeeping.	
5	**Quality Tools** Basic quality tools with a few examples	

7.2 PRACTICAL TRAINING (ON-JOB TRAINING)
(BLOCK – I & II)
DURATION: 18 MONTHS (9 months in each block)

GENERAL INFORMATION

1) **Name of the Trade** : **OPERATOR CUM MECHANIC POWER -PLANT**

2) **Batch size** : a) Apprentice selection as per Apprenticeship guidelines.
b) Maximum 20 candidates in a group.

3) **Examination** : i) The internal assessment will be held on completion of each block
ii) NCVT exam will be conducted at the end of 2nd year.

4) **Instructor Qualification** :

i) Degree/Diploma in **Mechanical** Engg. from recognized university/Board With one/two year post qualification experience in the relevant field.

OR

ii) NTC/NAC in the trade of **Operator cum Mechanic Power -Plant** with three year post qualification experience in the relevant field.

Preference will be given to a candidate with Craft Instructor Certificate (CIC)

5) **Infrastructure for On-Job Training** : - As per Annexure – II

7.2.1 BROAD SKILL COMPONENT TO BE COVERED DURING ON-JOB TRAINING

A. BLOCK – I

1. Safety and best practices/Basic Industrial Culture (5S, KAIZEN, etc.)
2. Prepare different types of documentation as per industrial need by different methods of recording information.
3. Use of safety devices, familiarize with different fire extinguishers & first aid equipments. Reading various pressure, temperature, flows, current and voltage measuring instruments. Filling log sheets & record keeping.
4. Use of various types of valves, Operation of different types of priming the pumps, starting, stopping isolating them for maintenance etc.
5. Different operations of Water treatment plant, Coal handling plant, Fuel oil handling plant.
6. Air compressors - cooling system, inter & after coolers, storage devices, Air dryers, compressor on load - off load regulation etc.
7. **Boiler Operations their sub systems,** Periodical inspection & cleaning of boiler, preparation of boiler for inspection wet preservation , dry preservation of boiler during shutdown, scale, corrosion & slag control, boiler safety precautions
8. **Turbine Operations and** Turbine emergency operations - turbine tripping, tripping of various auxiliaries like oil pumps, extraction pumps, booster pumps, Feed heaters level high, loss of lubrication, loss of vacuum, bearing temperature high, loss of gland sealing, fire in turbine oil, exhaust hood temperature high, high axial shift, eccentricity high, differential expansion high, failure of journal / thrust bearings, turbine vibration high, condenser tube leakage, water induction in turbine, Generator hydrogen purity / pressure reduced, bearing cooling water lost etc.
9. **Other Power Plant Operations like:** Diesel engine power plant, Starting and stopping operations, emergency operations. Gas turbine Power plant starting operations, emergency operations an stopping. Nuclear power plant starting and stopping operations, emergency operations. Hydel power plant starting and stopping operations, Emergency operations, Wind turbine power generation.
10. **General Maintenance:** Standard pipe thread, join pipes and make asemb1y. Scrap angular matching and sliding surfaces & originate flat surface without master. Assemble components accurately using dowel pins and screw. Lap and finish flat surfaces. Make oil grooves on bearing with chisel. Erect and align machines. Assemble parts by riveting, screwing, pinning, so as to make complete unit according to drawing.
11. Dismantle or remove worn out broken or defective parts using hand tools and replace them by repaired or new one test completed article to ensure correct performance. Fit parts together in set order using nuts, bolts, screws and pins etc. with necessary wrenches, spanners and other special tools. Mounting and dismounting of pulleys and gears on shaft. Recondition thread by tap.
12. Mechanical handling of machines for transportation purpose involving the use of screw jacks, pulley blocks, cranes, hoists slings, roller, bars and wire ropes etc. Alignment of brackets and shafts.
13. Maintenance of pneumatic tools & hydraulic driven machines.

B. BLOCK – II

1. **Boiler Maintenance:** Layout, Function and Specification of Equipments, Checklist preparation, Tools for maintaining boiler, Pressure parts failure, repair and testing, Different welding methods, Maintenance of air-preheaters, Air-preheaters maintenance, Seal setting of air-preheaters, Inspection of Tabular air-heater, S C A P H cleaning, Open inspection and hydraulic inspection of boiler, Thickness measurement of worn-out out tubes, Knowledge of International Boiler Regulation.
2. Pu1verisers and Feeders Maintenance. Dismantling & assembly procedures, Lubrication study, Alignment procedure and Procedure of roller setting.
3. **Fans Maintenance:** Fan lubrication system, Alignment of fans with prime mover, Dismantling & alignment procedure.
4. Ash & Dust Collect ion System Maintenance: Maintenance of dust collection **ash** handling system, Excessive sand particles isolation procedure, Wear and tear of various components, Ash disposal linemaintenance, Dismantling & assembling procedure.
5. Air Compressors Maintenance: Clearance setting of piston & cylinder, Trouble shooting, Dismantling & assembling procedure.
6. Pump Maintenance**:** Dismantling procedure, Use measurements of worn-out Assembly of pumps and Repair methods.
7. Steam Turbine **Generator** Overhauling: Preparing for Overhauling, Repairs of cylinders, Rotor inspection, bearing maintenance, Turbine assembly, Generator overhauling.
8. Maintenance of Heat Exchangers Condenser tubes cleaning by High Pressure Water Jetting, Acid cleaning of condenser tubes, Condenser hydraulic test, Condenser re-tubing, Feed heaters fault repairing, Heaters tube replacement, Ejector maintenance.
9. Cooling Tower Maintenance: Components, Specific problems, Major maintenance / modifications, I D fan gear box overhauling. Types of faults, Lapping procedures, Piping material, Pipe flanges & expansion devices, Types of joints, gland packing & gaskets. Perform dry and hydraulic test of valves.

8. ASSESSMENT STANDARD

8.1 Assessment Guideline:

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration to be given while assessing for team work, avoidance/reduction of scrape/wastage and disposal of scarp/wastage as per procedure, behavioral attitude and regularity in training.

The following marking pattern to be adopted while assessing:

a) Weightage in the range of 60-75% to be allotted during assessment under following performance level:

For this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.

In this work there is evidence of:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- many tolerances while undertaking different work are in line with those demanded by the component/job.
- a fairly good level of neatness and consistency in the finish
- occasional support in completing the project/job.

b) Weightage in the range of above75%- 90% to be allotted during assessment under following performance level:

For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.

In this work there is evidence of:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- the majority of tolerances while undertaking different work are in line with those demanded by the component/job.
- a good level of neatness and consistency in the finish
- little support in completing the project/job

c) Weightage in the range of above 90% to be allotted during assessment under following performance level:

For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.

In this work there is evidence of:

- high skill levels in the use of hand tools, machine tools and workshop equipment
- tolerances while undertaking different work being substantially in line with those demanded by the component/job.
- a high level of neatness and consistency in the finish.
- minimal or no support in completing the project

8.2 FINAL ASSESSMENT- ALL INDIA TRADE TEST

(SUMMATIVE ASSESSMENT FOR TWO YEARS TRADE)

SUBJECTS	Marks	Sessional Marks	Full Marks	Pass Marks	Duration of Exam.
Practical	300	100	400	240	**08 hrs.**
Trade Theory	100	20	120	48	3 hrs.
Workshop Cal. & Sc.	50	10	60	24	3 hrs.
Engineering Drawing	50	20	70	28	4 hrs.
Employability Skill	50		50	17	2 hrs.
Grand Total	**550**	**150**	**700**	**-**	

Note: - The candidate pass in each subject conducted under all India trade test.

9. FURTHER LEARNING PATHWAYS

- On successful completion of the course trainees can opt for Diploma course (Lateral entry). [Applicable for candidates only who undergone ATS after CTS]
- On successful completion of the course trainees can opt for CITS course.

Employment opportunities:

On successful completion of this course, the candidates may be gainfully employed in the following industries:

1. Power plant generation unit.
2. Ship building and repair
3. In public sector industries (Central and State) and private industries in India & abroad involved in power generation.

ANNEXURE – I

TOOLS & EQUIPMENT FOR BASIC TRAINING

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

TRADE: OPERATOR CUM MECHANIC POWER -PLANT

LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES

A : TRAINEES TOOL KIT:-

Sl. No.	Name of the items	Quantity (indicative)
1.	**Scale BB 20**	20 Nos.
2.	Inside Spring Caliper 150 mm.	20 Nos.
3.	Outside Spring Caliper 150 mm	20 Nos.
4.	Spring Divider 150 mm	20 Nos.
5.	Engineers Square 150 mm.	20 Nos.
6.	Hacksaw Frame AB 250,300.	20 Nos.
7.	Engineer Ball Pein Hammer 400 complete with handle.	20 Nos.
8.	Engineer Ball Pein Hammer 800 Complete with handle.	20 Nos.
9.	Flat Chisel 20x200 H	20 Nos.
10.	Cross cut Chisel 10x150	20 Nos.
11.	Half round Chisel 10x250	20 Nos.
12.	Diamond Point Chisel 9.5 mm.	20 Nos.
13.	Centre Punch 5	20 Nos.
14.	Prick Punch 150 mm.	20 Nos.
15.	Engineers File Flat Bastard 300mm	20 Nos.
16.	Engineers File Flat 2^{nd} cut250 with two sq. edges	20 Nos.
17.	Engineers File Flat Bastard 350mm	20 Nos.
18.	Engineers File Flat smooth 200 mm. two safe edges.	20 Nos.
19.	Flat/Round Nose Piier	20 Nos.
20.	Combination Plier	20 Nos.

21.	Engg. Half Round File 2nd cut 250 mm.	20 Nos.
22.	Engg. Three sq. File Smooth	20 Nos.
23.	Engg. Round File Smooth 200	20 Nos.
24.	Engg. Square File Smooth 200 mm.	20 Nos.
25.	Engg. Needle Set of 12	20 Nos.
26.	File Handle	20 Nos.
27.	Caliper Hermaphrodite 150	20 Nos.
28.	Scraper A 250 mm.	20 Nos.
29.	Scraper D 160	20 Nos.
30.	Scraper B 160	20 Nos.
31.	Spindle Blade Screw Driver	20 Nos.
32.	Keys Allen Hexagonal 2.5 to 12	20 Nos.
33.	Tap Wrench (adj.) and fixed	20 Nos.
34.	Die Ho 1der s	20 Nos.
35.	Card File	20 Nos.
36.	Scriber 300 mm.	20 Nos.

B : TOOLS INSTRUMENTS AND GENERAL SHOP OUTFITS

Sl. No.	Name of the items	Quantity (indicative)
1.	Master Bar 45 Degree scraping Bar 600 mm. width of bar 75 mm., thickness25 mm., all sider an accuracy of 0.02 mm seasoned	1 No.
2.	--Do-	1 No.
3.	Master F1 at-scraping test bar 600 mm, length *7 5x7 5* mm sq. in cross section all sizes scraped to an accuracy of 0.02 mm. per 300 mm. seasoned.	1 No.
4.	Hand tap M-6 to 12 each size set of 3 with tap wrench thread cutting die MM6 to HS.	1 each
5.	Spaner Socket set of 8 with Ratchet 8, 12,20	1 each
6.	Hexagonal Key 1.5 to 12.	1 Set
7.	Hammer Soft (faced 30 mm dia. Plastic tipped).	4 Nos.
8.	Pipe Wrench 450	2 Nos.
9.	Chain Pipe Wrench 650	1 No
10.	Flat Nose Plier AI 80	1 No.
11.	Spindle Blade Screw Driver 150 mm.	1 No.
12.	Scriber Block Universal 300 mm	4 Nos.
13.	Bench Vice 100	8 Nos.
14.	Bench Vice 150	8 Nos.
15.	Ring Spanner set of 6 S.A.E.	1 No.

16.	Double Ended Open Spanner 5.5 to 50 mm.	1 Set
17.	Double Ended Off-set Ring spanner 5.5 to 50	1 Set
18.	Gear Puller 150 mm.dia. capacity three leg type	1 No
19.	'C'Spanner CxlO	1 Set
20.	Scale BB 80	8 Nos.
21.	Scale BB 20	1 No
22.	Metric Steel Tape measure	1 No
23.	Thread Pitch Gauge 0-25,6-00,150-60 deg	1 No
24.	Thread Pitch Gauge metric screw threads	1 No
25.	2/3 Cells Torch	2 Nos.
26.	Grease Gum	1 No
27.	Level 1 P 300-0.05/metre	1 No
28.	Engineer Square 400 blade	1 Set.
29.	Feeler Gauge(0.03 to 1 mm).	1 No
30.	Magnetic Basic Off-on Type	1 No
31.	Detachable Spout Oil Can 250	1 No
32.	Single Ended Open Jaw adj. Wrench **A**-200	1 No
33.	Stationery Scissors Type-II 65	1 No
34.	Gasket Hollow Punches 5,6,8,10,12, 19,25 mm. dia.	1 Each
35.	Bar Type Torque Wrench	1 No
36.	Hand operated Socket Wrench	1 Set
37.	Taps & Dies Complete Set.	1 No
38.	Cam Lock Type Screw Driver	1 No
39.	Dial Indicator Type Torque	1 No
40.	Propane Torch	1 No
41.	Ring Spanner SE of 8-25 mm.	1 Set
42.	Box Spanner SE Hexagonal	1 Set
43.	Heavy Duty Screw Driver	1 No.
44.	Spindle Blade Screw Driver (Engg. 200 mm).	1 No.
45.	Hammer Soft	1 No.
46.	Pipe Cutter 19 mm dia. capacity	1 No.
47.	Flaring Tool	1 No.
48.	Tube Expander upto 62 mm.	1 Set
49.	Cranked Double ended Ring Spanner	1 No
50.	Box Spanner DE 8 to 20	1 Set
51.	Gear Box Unit (For Trg.)	1 No
52.	Bearing Housing Unit (for trg.)	1 No
53.	Shafting Unit with Pulleys as available (for trg.)	1 No
54.	Horizontal Centrifugal Pumps (Gear and Spindle)	1 No
55.	Air Compressor	1 Se t .
56.	Key Alien Hex	
57.	Circiip P1iers(inside and outside)	1 Set .
58.	Right angle drill attachment 6 mm. capacity.	1 No .
59.	SRDG Bal1 Bearing	1 No.
60.	DRDG Bal1 Bearing	1 No.
61.	Self aligning Bali Bearing	1 No.
62.	SRAC Bal1 Bearing	1 No.

63.	Ball Bearing Thrust Type	1 No.
64.	Needle Bearing	1 No.
65.	Single Row Cylindrical Roller Bearing	1 No.
66.	Tapered Roller Bearing	1 No.
67.	Barrel Type Bearing	1 No.
68.	Plain Bush Bearing	1 No.
69.	Thin Walled Bearing	1 No.
70.	Thrust Roller Bearing	1 No.
71.	Se1f-alignment Roller Ball Bearings	1 No.
72.	Telescopic Gauges	1 No.
73.	Arbour Press Bench Type	1 No.
74.	Lubricant Tro11ey-2409x 1 200x1200 mm (8 mm chamber).	1 No.
75.	Compressor Sprayer Machine	1 No.
76.	Tap Extractor	1 No.
77.	Gear Pump	1 No.
78.	Vane Pump (fixed and variable delivery).	1 Each
79.	Piston Pump (radial and axial)	1 Each
80.	Re 1i ef Valve	1 No.
81.	Sequence Valve	1 No.
82.	Un-loading Valve	1 No.
83.	Pressure Reducing Valve	1 No.
84.	Check Valve	1 No.
85.	Directional Control Valve(rotary spool and sliding spool)	1 Each
86.	Flow Control Valve	1 No.
87.	Pressure Gauge	1 No.
88.	Reservoir	1 No.
89.	Linear Actuator (differential and non-differential)	1 Each
90.	Hydromotor	1 No.
91.	Accumulator (spring and gas)	1 Each
92.	Pneumatic too1s(portable nut runner, pneumatic chise1,pneumatic ram etc.) for demonstration purpose.	1 Each
93.	Pneumatic Valves and Actuators	1 Each
94.	Hydraulic and Pneumatic Board with necessary aggreagates for different machine circuits.	1 Set
95.	Double Face Sledge Hammer 1600	1 No.
96.	Wooden Straight Edge 300,600,900,1200.	1No.
97.	Man-on-chise1	1Each
98.	Tasla	1 No.
99.	Pick Axes.	2 Nos.
100.	Bar Bending Tools and Cutting Tools	1 No.
101.	Spirit Leve1	1 No.
102.	Pocket Steel Tape 150 mm	1 No.
103.	Four Fold Foot Rule	1 No.
104.	Crow Bar	2 Nos.
105.	Plumb Bob	1 No
106.	Masons Tool for Plaster Work	1 No.
107.	Drill Chuck 13	1 No.

108.	Reduction Sleeve and Extension Sockets	1 Each
109.	Centre Drill A-4	1 Each
110.	Revolving Centres	1 No
111.	Knurling Too 1(straight, cross &diamond)	1 Set
112.	Lathe Carriers up to 75 mm	1 Set
113.	Centre Gauge	1 Set
114.	Oil Stone 10x100	1 No.
115.	Emmery Cloth No.00, 0, & 1.	1 Pkt
116.	Engg. File 50 length	1 No.
117.	H.S.S Tool Bits 8 & 10sq.x75	16 Nos.
118.	Boring Tool Holder 10 mm sq9 Bit Size x Length 200 mm.	2 Nos.
119.	Cylindrical Milling Cutter	1 No.
120.	Side and Face Milling Cutter 150x10x271	1 No.
121.	Side and Face Cutter 100x6x27	1 No.
122.	Equal Angle Milling Cutter 45~ox27 mm bore 60x27 mm bore	1 Each
123.	Single Angle Milling Cutter 45~ox27 mm bore(LH) and (RH)	1 Each
124.	Single Angle Milling Cutter 60~ox27 mm bore(LH) and (RH)	1 Each
125.	Slot Milling Cutter with Parallel Shank	1 No.
126.	Slot Milling Cutter with Parallel Shank 10x27 mm.	1 No.
127.	Slitting Saw 3 mm Thick x 2 7 mm.	1 No.
128.	Slitting Saw 4 mm Thick x 27 mm.	1 No.
129.	Key Way Milling Cutter	1 Set
130.	T - Slot Mi 11ing Cutter	1 Set
131.	Convex Milling Cutter	1 Set
132.	Concave Milling Cutter	1 Set
133.	Single Corner Rounding Milling Cutter	1 Set
134.	Milling Cutter No.8,9,10, 12 , 16,20, D.P.No. 1 to 8	1 Set
135.	Rotary Gear Cutters for Spur and Helical Gear .	1 Set
136.	Fly Cutter Holder	1 No.
137.	Hexagonal Bolt and Nut M 60 x 150	1 Set
138.	Plain Washers	1 Set
139.	Plain Clamps	1 Set
140.	Engineers Parallel	1 Set
141.	Spanner D.E.G.P	1 Set
142.	Hexagon Socket Screw Keys	1 Set
143.	Engineers File	1 No.
144.	Single Ended Open Jaw adjustable Wrench A150	1 No.
145.	Table Chuck 3 Jaw with tightening arrangement and graduated in degrees.	1 No.
146.	Machine Vice 200 mm Swivel Base	1 No.
147.	Machine Vice Swivel Base 160	1 No.
148.	Tool Holder L.H,R.H & Straight	1 No.
	PRECISION INSTRUMENT	
1.	Vernier height Gauge 500 mm.	1 No.
2.	Mechanical Bevel Protractor A 150	1 No.
3.	Vernier Caliper A 200	1 No.
4.	Vernier Caliper A 300	1 No.

5.	External Micrometer Gr.1	1 No.
6.	External Micrometer Gr.I I	1 No.
7.	External Micrometer Gr.I I I	1 No.
8.	External Micrometer Gr.IV .	1 No.
9.	External Micrometer Gr.V	1 No.
10.	Combination Set with 300 mm Scale,	1 No.
11.	Centre Head sq. head & Protractor head.	1 No.
12.	Telescopic Gauge 12 mm to 150 mm Set.	1 Set
13.	Vernier Depth Gauge 200 with fine adjustment.	1 No.
14.	Sine Bar 200 mm.	1 No.
15.	Sine gauge (in sets)	1 Set
16.	Engineers Square 450 B	1 No.
17.	V - Block, Grade A & B	1 Each.
18.	V - Block 50/5 -40 A	1 No
19.	Precision Angle Plate 250x150	1 No.
20.	Precision Angle Plate 19195x75	1 No.
21.	Micrometer Internal	1 No.
22.	Micrometer External	1 No.
23.	Vernier Gear Tooth Caliper	1 No.
24.	Bevel Gauge 200	1 No.
25.	Dial Gauge Type 1 Gr. A (complete with clamping devices and stand).	2 Nos.
26.	Feeler Gauge (0.03 to 1)	1 No.
27.	Radius Gauge	1 No.
28.	Radius Gauge	1 No.
29.	Thread Pitch Gauge 0.25 to 6.15 degree x60 degree	1 No.
30.	Thread Gauge 55 deg.x47 1/2 degree	1 No.
31.	Thread Gauge 60 degree	1 No.
32.	Plug Gauge Plain(designation of tape as per tab 1e 1)	1 No.
33.	Ring Gauge Morse Taper No.1,2,3,4.	1 Set.
34.	Ring Gauge 5 to 25 by 2.5 mm.	1 No.
35.	Wire Gauge	1 No.
36.	Bore Dial Gauge(01 mm dial)	1 No.
37.	Indicator with Magnetic Base	1 No.
38.	Dial Gauge Tupe1, Gr. A complete with clamping devices	1 No.
39.	Straight Edge 485mm to 1445mm	1 Set
40.	Hand Techometer for checking the R.P.M. 0-10,000	1 No.
41.	Mandrels	1 Set

C : GENERAL MACHINERY INSTALLATIONS:-

Sl. No.	Name & Description of Machines	Quantity (indicative)
1.	Centre Lathe with all accessories	1 No.

2.	Mi11ing Machine, Universal motorized No.1 with all access.	1 No.
3.	Pedestal Grinder	1 No.
4.	Drilling Machine Pillar Type Sensitive 0-20 mm Cap. with Swivel Table Motorized with chuck and key	1 No.
5.	Drilling Machine Bench Sensitive 0-12.5 Cap. motorized with Chuck and Key and other access.	1 No.
6.	Portable Hand Grinder 150 mm.dia. motorized	1 No.
7.	Flexible Hand Grinder 100 mm. dia. (lighter Type)	1 No.
8.	Portable Drilling Machine 6 mm. capacity	1 No.
	MACHINE FOR REPAIR AND RECONDITIONING	
1.	Old Lathe	2 Nos.
2.	Old Milling Machine	1 No.
3.	Old Grinding Machine	1 No.
4.	Old Shaper Machine	1 No.
5.	Old Press (power)	1 No.
	ARC WELDING	
1.	DC Welding Generator 150-300 amps. Complete to AC Induction with all accessories.	1 No.
2.	Arc Welding Transformer Single operator type 380, 440 Volts up to 350 amps maximum continuous low welding current	1No.
3.	Rectifier Type D.C. Arc Welder (Manual Metal Arc)300.400 amps.	1 No.
4.	Insulated cable 2 length with links fitted	1 Set
5.	Electrode Holder the preferred rated current should be 200,400 amps.	1Set
6.	Welding Helmet Screen	1 No.
7.	Welders Chipping Hammer	1 No.
8.	Chipping Screen	1 No.
9.	Brush, Welders 40 mm wide	1 No.
	HOISTING EQUIPMENT	
1.	Portable Jacks	1 No.
2.	Cargo Winches 3,5 & 8 Tonnes.	1 No.
3.	Wall Hosts	1 No.
4.	Travelling & Gantry cranes	1 No.
5.	Shear Legs (tripod)	1 No.
6.	Flat Pulley	1 No.
7.	Hand Operated Chain Pulley block.	1 No.
8.	Mobi1e Crane,	1 No.
9.	Conveyor	1 No.
10.	Elevators	1 No.
11.	Fibre Rope Sling	1 No.
12.	Stee1 Wire S1ing	1 No.
13.	Steel Chain Slings from 6.3.to 45 mm.	1 No.

14.	For fan, light catch	2 Nos.
15.	Ramps and its fittings	4 Nos.
16.	Crow Bar	4 Nos.
17.	Cut sizes of Timber	3 Sets
18.	Rollers (steel tubes) from 38 to6 3.5 mm dia.	10 nos.
19.	Block of Timber (various sizes)	10 Nos.
20.	Steel Skids or Wood Skids	1 Set
21.	Steel Wedges	1 Each
22.	Manilor Rope 12 **Ø** 20 **Ø** 30 **Ø**	1 Each
23.	Eye Bolt with Collars range M 10 to M 36	2 Nos.
24.	Channel	1 No.
25.	Rails	1 No.
26.	Ratchet chain Pulley	2 Nos.
27.	Shack 1e s	1 No.
	EQUIPMENT FOR ELECTRICAL MAINTENANCE.	
1.	Combination side cutting pliers with insulated.	1 No.
2.	Handle 180 mm.	1 No.
3.	Spindle blade screw driver 150 mm	1 No.
4.	Double bladed electrician knife	1 No.
5.	Engineer's cross pein hammer 200 gm. with handle.	1 No.
6.	Spindle blade screw driver(electricians) 100 mm.	1 No.
7.	Neon tester 500 V double prove type	1 No.
8.	Spindle blade screw driver engineer's 200	1 No.
9.	Scale AA 300	1 No.
10.	Diagonal Cutting nippers 125	1 No.
11.	Hand drilling machine 6 mm capacity	1 No.
12.	Engineer's square 150 B	1 No.
13.	Hammer plastic faced	1 No.
14.	Test lamp 200 V, 25 W.	1 No.
15.	Hacksaw frame AB 250-300	1 No.
16.	Tachometer	1 No.
17.	Flat file rough, 250 mm with two square edges.	1 No.
18.	Moving iron voltmeter portable type class 1.0, 0-500 V.	1 No.
19.	Moving Iron Ammeter portable type 1.0, 0-25 Amp.	1 No.
20.	Wattmeter Ironless electro dynamo meter type, portable class 1.0, 0-3000 W, voltage range:150 V,300 V, 600 V. Current range 2.5 A and 5 A	1 No.
21.	Wire stripping pliers 150 A	1 No.
22.	Insulation resistance tester500 V, 100 M-2	1 No.
23.	Reverse current cut out over lead relay) no voltage relay	1 Each
24.	Starters for 3phase 415 V, 50 Hz 3.7 to 7.5 KW,AC. Motor. (a)Auto-transformer type (f1oormounted, manually operated) (b)Star-de1ta type with O/L and N.V protection floor mounted and manually operated.	1 Each

25.	A.C Motor 3 phase, 50 HZ,415 V (Induction mo tor)	1 No.
	ERECTION TOOLS	
1.	Foundation Bo 11	8 Each
2.	Threaded fastner type-B	
3.	Threaded fastner type-C	1 No.
4.	Threaded fastner type-F	1 No.
5.	Plum bob	1 No.
6.	Square box wrenches	1 No.
7.	Square Tee wrenches	1 No.
8.	Pipe wrenches	1 No.
9.	Chain pipe wrenches	1 No.
10.	Single ended open jaw adjustable wrench A 150 Gr.I I.	1 No.
11.	Slide wrenches	1 No.
12.	Pulley and tackle	1 No.
13.	Crow bar	1 No.
14.	Straight edges 500 B	1 No.
15.	Engineers square 700 mm.	1 No.
16.	Excavation tools	1 No.
17.	Spirit 1 eve 1	1 No.
	FURNITURE'S	
1.	Metal lockers 8 lockers type with individual locks 1980x910x480mm.	2 Nos.
2.	Metal office chair with arm, cane sit and back.	1 No.
3.	Metal shelving cabinet with 4 adjustable shelves 180x60x40 cm.	6 Nos.
4.	Metal office table with 3 drawers.	3 Nos.
5.	Work bench	4 Nos.
6.	Metal shelving rack open type 1800x900x500 with adjustable shelves.	4 Nos.
7.	Desk	1 No.
8.	Stool	1 No.
9.	Black Board with easel	2 Nos.
10.	Portable fire extinguisher water type (constant)	2 Nos.
11.	Galvanised mild steel fire bucket 4 liters.	4 Nos.

Note: In case of basic training setup by the industry the tools, equipment and machinery available in the industry may also be used for imparting basic training.

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: OPERATOR CUM MECHANIC POWER – PLANT

LIST OF TOOLS& EQUIPMENTS FOR 20 APPRENTICES

1) **Space Norms** : 45 Sq. m.(For Engineering Drawing)

2) Infrastructure:

A : TRAINEES TOOL KIT:-

Sl. No.	Name of the items	Quantity (indicative)
1.	Draughtsman drawing instrument box	20 Nos.
2.	Set square celluloid 45^0 (250 X 1.5 mm)	20 Nos.
3.	Set square celluloid 30^0-60^0 (250 X 1.5 mm)	20 Nos.
4.	Mini drafter	20 Nos.
5.	Drawing board (700mm x500 mm) IS: 1444	20 Nos.

B : FURNITURE REQUIRED

Sl. No.	Name of the items	Quantity (indicative)
1	Drawing Board	20 Nos.
2	Models : Solid & cut section	as required
3	Drawing Table for trainees	as required
4	Stool for trainees	as required
5	Cupboard (big)	01
6	White Board (size: 8ft. x 4ft.)	01
7	Trainer's Table	01
8	Trainer's Chair	01

ANNEXURE – II

INFRASTRUCTURE FOR ON-JOB TRAINING

TRADE: OPERATOR CUM MECHANIC POWER -PLANT

For Batch of 20 APPRENTICES

Actual training will depend on the existing facilities available in the establishments. However, the industry should ensure that the broad skills defined against On-Job Training part (i.e. 9 months + 9 months) are imparted. In case of any short fall the concern industry may impart the training in cluster mode/ any other industry/ at ITI.

ANNEXURE-III

GUIDELINES FOR INSTRUCTORS AND PAPER SETTERS

1. Due care to be taken for proper & inclusive delivery among the batch. Some of the following some method of delivery may be adopted:

A) LECTURE
B) LESSON
C) DEMONSTRATION
D) PRACTICE
E) GROUP DISCUSSION
F) DISCUSSION WITH PEER GROUP
G) PROJECT WORK
H) INDUSTRIAL VISIT

2. Maximum utilization of latest form of training viz., audio visual aids, integration of IT, etc. may be adopted.

3. The total hours to be devoted against each topic may be decided with due diligence to safety & with prioritizing transfer of required skills.