CURRICULUM

FOR THE TRADE OF

STEAM TURBINE-CUM-AUXILIARY PLANT OPERATOR

UNDER

APPRENTICESHIP TRAINING SCHEME

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

CONTENTS

1. ACKNOWLEDGEMENT

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1. TATA Steel, Jamshedpur

Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

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

Sl. No.	Name & Designation Sh./Mr./Ms.	Organization	Expert Group Designation
1.	Anand Kumar Singh, Manager	SNTI, TATA Steel Ltd.	Expert
2.	N. Nath, ADT	CSTARI, 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 **Steam Turbine cum Auxiliary Plant Operator** trade)

1. It will enhance the ability to understand importance of housekeeping, disposal procedure of waste material, health and safety. Preventive measure for electrical accident and fire hazards and actions to be taken after such accidents.
2. It will enhance the ability to fit, repair/replace the machine elements used in the boiler plant.
3. It will help the trainees to understand overview, components and auxiliaries of various power plants.
4. It will enhance the ability to operate, fault diagnosis, carry out preventive/breakdown maintenance and test various parts of the power plant e.g. pumps, blowers, various valves, compressors, pneumatic tools and hydraulic driven machines etc.
5. It will enhance the ability to assemble/dissemble, erection and alignment of machines and accessories.
6. It will enhance the ability to handle machines for transportation purpose involving the use of screw jacks, pulley blocks, cranes, hoists & slings, roller, bars and wire ropes etc.
7. It will enhance the ability to use the precision measuring instruments and batteries. Maintenance of small AC/DC motors.

4. JOB ROLES: REFERENCE NCO

Brief description of Job roles:

Turbine Operator, Steam; Turbo generator Operator, Steam operates steam powered turbine which drives generators for producing electricity. Starts of turbine by opening valve for supply of steam into turbine to rotate turbine wheels; runs turbine at low speed for pre-determined length of time and notifies switch-board operator when ready to run turbine at full working speed; increases speed of turbine and ensures that automatic regulator maintains correct working speed; notifies switch-board operator that turbine can be synchronized with other power units in plant. Observes gauges and meters to ensure proper handling of load by turbine and its proper functioning; alters power output of turbine and makes other adjustments as necessary. Cuts out unit evaporator to conduct blow down of turbine for periodic overhauling. May keep records of instrument readings. May repair and overhaul equipment and other auxiliaries.

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: 8161.30**

5. GENERAL INFORMATION

1. **Name of the Trade** : **STEAM TURBINE CUM AUXILIARY PLANT OPERATOR**

2. **N.C.O. Code No.** : NCO-2004: 8161.30

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 10^{th} Class under 10+2 system of Education or its equivalent

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** : **STEAM TURBINE CUM AUXILIARY PLANT OPERATOR**
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 **Steam Turbine cum Auxiliary Plant Operator/MMTM** 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

7.1.1 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. Safety regarding working with different types of steam and its First-Aid.	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 e.g.; 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** Boiler light-up and shutdown procedure, boiler emergency and normal operations, boiler protections. **General Terms of Boilers** Familiarization with different types of boiler and its mounting and accessories. Familiarisation with Indian Boiler Act, Boiler Protects, Hydraulic test, different boiler losses.
7-8.	Diagnosis of faults in machines. Identify various types of boiler and its mounting and accessories by using charts, posters and models.	**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 .	**Diesel Engine Power Plant** rking 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** ter turbine 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.	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. Assemble parts by riveting, screwing, pinning, so as to make complete unit according to drawing. 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. 8. Fit parts together in set order using nuts, bolts, screws and pins etc. with necessary wrenches, spanners and other special tools. 9. Mechanical handling of machines for transportation purpose involving the use of screw jacks, pulley blocks, cranes, hoists &slings, roller, bars and wire ropes etc. 10. Alignment of brackets and shafts. 11. Remove and fit antifriction bearings. 12. Maintenance of pneumatic tools & hydraulic driven machines. 13. Recondition thread by tap. 14. Use of precision measuring instruments. 15. Reaming holes for proper assembly.	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.
3-4	**Basic skills involved in breakdown maintenance, preventive maintenance and overhauling of machine:**	**Power Transmission and Driver :** 1. Common methods of power transmission and drives.

	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.	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.	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.	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.

		Basic working principal of water flowmeter, steam flowmeter, CO_2, indicator and reactors, Electro static pacificator, smoke density meter, types of draughts.
8.	a) Use of basic hand tools for electrical work. b) Making of points in single and multi-strand cables and wires. c) Wiring and use of electrical accessories, such as switches, plugs, cut-outs, fuese, regulators, fluorescent lights, etc. indoor and outdoor wiring. d) Making simple electrical circuits on wooden boards.	**Basic Electricity: -** Fundamental of electricity Definition and properties of conductors, insulators and semi-conductors. Voltage grading of different types of Insulators, Temp. Familiarization with the units and its measuring instruments - Volts, Amp., Ohm's, watt., B.O.T., H.P. etc. Capacitor, resistance, reluctance, Colour code of resistance. Types of wires & cables standard wire gauge Specification of wires & Cables-insulation & voltage grades -Low , medium & high voltage Precautions in using various types of cables / Ferrules Ohm's Law, Flemings rules. Simple electrical circuits and problems (series and parallel)
9.	a) Use of primary and secondary batteries. b) Use of electrical measuring instruments. c) Verification of Ohm's Law. d) Dismantling, cleaning and assembling of A.C. and D.C. motors upto one H. P., detection of failures of these motors and remedy thereof.	Different types of Batteries. Types of Voltage (A.C. and D.C.) Principal of Motor and generator (A.C. and D.C.)
10.	Identification by Flow chart of a thermal power plant.	**Coal Pulverisers** Types of pulverisers, -working principles. 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, Inspect, align and test machine for accurate functioning.	Familiarization of air-preheaters, Seal setting of air-preheaters, Inspection of Tabular air-heater, S C A P H cleaning, Knowledge of International Boiler Regulation. Pu1verisers and Feeders, Fans: Fan lubrication system, Ash & Dust Collect ion System of dust collection ash handling system, Ash disposal line. Air Compressors: Trouble shooting, Pump Maintenance: Steam Turbine Generator Overhauling: Maintenance of Heat Exchangers Ejector maintenance. Cooling Tower: Components, Specific problems, Major 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** : **STEAM TURBINE CUM AUXILIARY PLANT OPERATOR**

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 Steam **Turbine cum Auxiliary Plant Operator** 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 (09 months)

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. Introduction to elementary knowledge of feed water system and boiler feed pump, draught system of boilers, fuel system, steam network and turbine and visit at site.
4. Study of different parts & fittings of a boiler such as steam and water drums, stoker gauge, water tubes and flow tubes, high and low water level alarm, gauge glasses, soot blowers, safety valves etc. Forced draught, induced draught, balanced draught and secondary draught fans, Air pre-heater, chimney, water walls, water wall tubes, boiler bank tubes, primary and secondary super heaters, Attemperator, down comer and riser tubes, de-aerator, LP and HP dosing pumps, DM water plant and water chemistry, coal mills and coal handling plats, cooling towers & economizer, boiler controls, etc.
5. Measurement of temperature, pressure, vacuum, draught, flow using appropriate instruments for different system.
6. Uses, methods of jointing, checking of joints for leakage and remedy thereof.
7. Study of different parts of turbine; study the features of construction of blades, nozzles, governor parts, condensers, ejectors, etc. Study of different types of pumps, compressors and their parts. Different types of valves.
8. Boiler & their Auxiliaries:

    i. Working and management of steam boilers; economizers and air heater.
    ii. Correct use of various types of cocks, mounting and fittings used in boilers.
    iii. Functions of feed pumps.
    iv. Operation of fans, blowers, feed pumps including starting and stopping.
    v. Operation of fuel preparation equipment, fuel feeding indicators and recorders orsat apparatus, smoke density drive and draft regulation of proper combustion.
    vi. Operation of ash discharge disposal system in boiler.
    vii. Water level control in boiler operation, blow-down of boiler.
    viii. Control of steam pressure and steam flow.
    ix. Operation of super heater and control of super heated steam temperature.
    x. Starting and commissioning of boilers, banking and shutting down.
    xi. Periodical cleaning and inspection of boilers.
    xii. Preparation of boiler for testing, inspection, hydraulic, and steam test.
    xiii. Draining of steam lines - the danger of water logging and precautions to be observed in starting of steam lines.
    xiv. Testing the correctness of water gauges - replacement of gauge glass.
    xv. Detection of false water level and knowledge of alarm device.
    xvi. Use of safety valve, easing operation, use of blow down cock or valve, and adjustment of high steams and low water safety alarm.
    xvii. Checking and renewal of gland packings and mechanical seals of pumps, valve chest and working knowledge of feed pumps and/or injectors.

xviii. Use of thermometers and pressure gauges, vacuum gauges steam and water flow meters, pyrometers, fuel meters, CO_2 indicators and recorders, orsat apparatus, smoke-density meter.
xix. Boiler safety precautions.

9. CONTROL ROOM & ELECTRICAL SYSTEMS:

i. Starting of power plant equipment, such as fans, pumps, compressors, etc. Control room operations, such as operation of switch gear, control of turbo alternator load, excitation etc.
ii. Building up of voltage and synchronizing, alternator with operation of field rheostat, voltage regulator, governor control, synchroscope etc.
iii. Alternator cooling system air cooling, hot air stator water cooling and cold air temperature, air cooler, hydrogen cooling system (if available) normal pressures and temperature control and changing of hydrogen cylinders, method of regenerating hydrogen drier (if available) , safety precautions, (if hydrogen cooling exists).
iv. Study of methods of boiler control and turbine control. Method of loading an alternator, meger power factor control of machines running in parallel.
v. Use of emergency lighting, fire protection, handling of power failure and breakdown.

10. PERFORMANCE IMPROVEMENT IN OPERATION

Losses in boiler and turbine, Insulation of boiler, turbine and pipelines, Insulation in penthouse of boiler.

11. RELIABILTY OF BOILER OPERATION

Creep in boiler tube materials, boiler tube failures, Safety valve floating of boiler, Know-how of Remaining Life Assessment of boiler.

B. BLOCK – II (09 months)

1. Turbine and Auxiliaries:

i. Explanation on Turbine & construction of different parts, back-pressure turbine. PRDS operation, Advantage of back pressure turbine over pressure reducing station for process steam.
ii. Study of steam cylinder, steam chest, diaphragms rotor blades, discs, glands, coupling, bearing etc.
iii. Method of gland sealing - steam seals, water seals, clearances, sealing pressure regulators and controls.
iv. Lubrication system - oil tank, oil strainers, centrifugal filters and oil coolers, cleaning of oil coolers and oil strainers, oil piping, method of jointing -oil pumps, jack-oil pump, gear pumps, reciprocating pumps and centrifugal pumps, main oil pumps and auxiliary oil pumps, methods of dismantling & assembling. Contamination control of lubricating oil.
v. Turbine bearings, bearing clearances and blue matching, monitoring of parameters of bearing.

2. Turbine auxiliaries such as condensers, ejectors, extraction pumps, C.W. pumps etc.
i. Condensers - water flow, steam flow, constant water level control starting a condensing plant or stopping it. Care and precautions to prevent loss of vacuum, causes of loss of vacuum, remedies, air leakages, condenser cleaning methods.

ii. Pumps - centrifugal and reciprocating, starting a centrifugal pump. Different methods of priming, putting the pumps on load, starting a reciprocating pump, care and maintenance of running pumps.
iii. Air ejectors - different types, steam, hydraulic, starting ejectors, sequence of operation, stopping it, starting an ejector in conjunction with a condensing plant,
iv. Function and use of evaporators, drain collers and feed heaters, putting them into operation and taking them out of operation, maintenance of proper feed water temperature.
v. Atmospheric relief valve and other safety devices.
vi. Compressors, operation, care and maintenance.
vii. Cooling water system.
viii. Reheat and regenerative system.

3. Study, operation and adjustment of turbine governor, different types, method of working of synchronizing governor, over speed governor, speed limit governor and emergency shut-off devices, Electro-hydraulic governer. The trainee must get a thorough practical idea of manual remote control of governors.

4. Turbine plant operation - starting an condensing plant, starting a steam turbine from cold condition, method of running up to speed necessity of slow and uniform heating, critical speed avoiding, vibration at critical speeds, care to be taken when removing and applying load on turbo-alternators, stopping a turbine, sequence of operations, stopping the condensing plant and other auxiliaries. Study of feed water and steam: cycle. Turning gear.

5. Turbine troubles and remedies - study of abnormalities during operation and remedial measures. Troubles, such as loss of vacuum, air leakage, low oil pressure, hot bearings, etc. vibration - their causes and remedies.

6. Instrumentation and control - necessity of different instruments for measuring and recording temperature, pressure, flow etc. Co-relation of different date as recorded by various instruments. Study of these in relation to load. Turbine supervisory instrumentation.

7. Importance of maintenance of daily log sheets and records, delay register, defect register.

8. Operation of steam pressure reducing station and H. P., L. P. by pass station.

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. Production & Manufacturing industries like steel plant.
2. Power plant industries or other related industries where steam based power generation are involved.

ANNEXURE – I

TOOLS & EQUIPMENT FOR BASIC TRAINING

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

TRADE: STEAM TURBINE CUM AUXILIARY PLANT OPERATOR

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: STEAM TURBINE CUM AUXILIARY PLANT OPERATOR

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: STEAM TURBINE CUM AUXILIARY PLANT OPERATOR

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.