CURRICULUM

FOR THE TRADE OF

MECHANIC (CENTRAL AIR CONDITIONING PLANT, INDUSTRIAL COOLING AND PACKAGE AIR CONDITIONING)

UNDER

APPRENTICESHIP TRAINING SCHEME

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

CONTENTS

1. ACKNOWLEDGEMENT

The DGT sincerely express appreciation for the contribution of the Industry, State Directorate, Trade Experts and all others who contributed in revising the curriculum. Special acknowledgement to the following industries/organizations who have contributed valuable inputs in revising the curricula through their expert members:

1. Godrej India Ltd., Mumbai

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

Co-ordinator for the course: Sh. NirmalyaNath., ADT

Sl. No.	Name & Designation Sh./Mr./Ms.	Organization	Expert Group Designation
1.	Unavane V. N.	ITI Anudh, Pune	Expert
2.	S.M. Sawant	ITI Kurla	Expert
3.	D.R. Markandy	BTRI Vile Parle	Expert
4.	D.N. Neogi	Century Rayon Shehad	Expert
5.	Raja Sen,	Century Rayon Shehad	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 **Mechanic (Central Air Conditioning Plant, Industrial Cooling and Package Air Conditioning)**trade]

1. Install and maintain diverse heating, ventilation and air conditioning (HVAC)systems
2. Lay out wires and pipes to complete HVAC systems
3. Perform general and preventative maintenance on HVAC systems
4. Ensure that all installations are done in accordance to the set standards
5. Make sure that any loose wires are connected and secured properly
6. Ensure calibration of thermostats and other controls
7. Perform checks on motors and belts and handle lubrication duties
8. Change filters and replace any parts as they wear out
9. Repair motors and service steam and hot water boilers
10. Ensure that chemical compositions in equipment are adequate at all times
11. Handle conduit running for HVAC equipment
12. Order any supplies or equipment needed for HVAC maintenance or installation as needed
13. Ensure availability of all items needed for an HVAC project
14. Respond to emergency situations in order to resolve issues on an immediate basis
15. Handle maintenance of tools and equipment
16. Replace faulty or expired parts in an HVAC system
17. Fabricate parts in case parts are not readily available
18. Determine need for upgrading HVAC systems and take measures to take necessary actions

4. JOB ROLES: REFERENCE NCO

Brief description of Job roles:

Air-Conditioning and Refrigeration Plant Attendant; Refrigeration System Operator operates air-conditioning or refrigeration system for preserving food, providing cooling or warming media for industrial processes,cooling or warming buildings, or for other purposes. Manipulates various switches, at central control board to start and stop electric motors, pumps, compressors, coolers and other related equipment of refrigeration and air-conditioning system; observes readings in various meters, gauges and instruments regarding temperature, pressure and voltage of system to ascertain working condition of plant; operates switches, thermostats, rheostats and other controls to maintaindesired level of temperature; cleans and resets generator brushes, replaces burned fuses and defective devices, thaws frozenvalves, cleans equipment and performs other tasks such as oiling, greasing, cleaning of air and water filters etc. to keep system in good running order. May keep records of temperatures produced. May assist Refrigeration Mechanic in dismantling equipment for repairs.

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:** 8169.30

5. GENERAL INFORMATION

1. **Name of the Trade** : **MECHANIC (CENTRAL AIR CONDITIONING PLANT, INDUSTRIAL COOLING AND PACKAGE AIR CONDITIONING)**

2. **N.C.O. Code No.** : **NCO-2004:**8169.30

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

4. **Duration of Basic Training**: -

a) Block –I : 3 months

b) Block – II : 3 months

Total duration of Basic Training: 6 months

5. **Duration of Practical Training (On -job Training): -**

a) Block–I: 9 months

b) Block–II : 9 months

Total duration of Practical Training: 18 months

6. **Entry Qualification** : Passed 10th Class examination under 10+2 system of Education or its equivalent

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

8. **Rebate for ITI passed trainees** : i) **One year** in the trade ofBBBT inRefrigeration and Air-Conditioning Sector under CoE&**Advance** module of CoEScheme in Central Air Conditioning Plant, Industrial Cooling & Package Air Conditioning.
ii) Mechanic (Refrigeration and Air-Conditioner)

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** :**MECHANIC (CENTRAL AIR CONDITIONING PLANT, INDUSTRIAL COOLING AND PACKAGE AIR CONDITIONING)**
2) **Hours of Instruction** : 1000 Hrs. (500 hrs. in each block)
3) **Batch size** : 20
4) **Power Norms** : 6.82 KW for Workshop
5) **Space Norms** : 80 Sq. m.
6) **Examination** : The internal assessment will beheld on completion of each Block.
7) **Instructor Qualification** :

i) Degree/Diploma in **Refrigeration/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 **MECHANIC (CENTRAL AIR CONDITIONING PLANT, INDUSTRIAL COOLING AND PACKAGE AIR CONDITIONING)**with three year post qualificationexperience 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 DETAILSYLLABUS 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.**			

7.1.2DETAIL 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.	**Basic Fitting :** Marking on flat surfaces as per given drawing by using different marking tools and medias, Punching & hacksawing, Filing surfaces flat & square. Checking for flatness, straightness &squareness. Filing & Fitting of male & female joints within accuracy of + 0.2mm. Using a sprit level and dial test indicator.Measurements by precision instruments. Drilling, reaming & tapping as per given drawings. External thread cutting on pipes.	Introduction to basic workshop tools & operations like measuring, marking, hacksawing & cutting. Tools used, their identification, use care & maintenance, measurements, marking medias. Introduction to files, their types and uses, care & maintenance, Bench & pipe vice, their uses. Sprit levels & their uses, straight and angular measurements, Bevel Protractors. Introduction to precision measuring & least count. Micrometers, Vernier& Height gauges, applications, care & maintenance. Dial gauge vernier& indicator. Drilling, tapping &reaming , types of drills & reamers, different drilling operations, dies & die stocks. Drilling machines, their types & uses, holding devices & fixtures.Types of fasteners, threads. Adhesives & their applications.
3.	**Sheet Metal Work :** Practice in cutting sheet metal to different shapes using various types of snips. Folding/Bending sheet metal to 90^0 using wooden mallet. Practice on hard soldering method (Lead & Tin). Making holes on sheet metal by punching & riveting. Straight & oblique cutting, preparing A.C. ducts & components as per given drawings. Riveting practice, practice on removing dents on spherical & hemi spherical articles.	Introduction to sheet metal work & its applications, materials used for sheet metal work. Hand tools, measuring tools & gauges used in sheet metal work.Different sheet metal operations, theirnecessity & applications. Sheet metal joining processes, soldering brazing& welding. Sheet metal machinery, shears, forming & folding machines, bending & shearing machines seaming & nibbling machines. Development of surfaces for simple objects like boxes, cylinders, cones, prism & pyramids. Developing & forming A.C. ducts & components.
4.	**Basic Welding :** Setting beading practices, striking & maintaining an arc. Setting up an oxy-acetylene flame. Laying short , straight line & weaved beads on M.S. plates, Fillet welds in open corner, Tee & Lap Joint, fusion runs with & without filler rods. Preparing different joints with gas welding. Soldering & brazing on sheet metal asper braze welding practice.	Metal joining processes. Introduction to gas & arc welding. Different hand tools used in welding. Welding accessories like regulators, nozzles cylinders etc. Welding machines & welding transformers , Oxy-Acetylene gas welding plant. Welding processes & positions, welded joints, welding symbols, weld depositions, filler rods & electrodes, their types & selection, care & maintenance. Fluxes, types & application. Distortion in

	Brazing of different size of copper, steel, aluminum pipes with different brazing material.Use of sliver brazing by oxy-Ace process.	welding, welding defects, their causes & remedial measures. Soldering & brazing, Different types of solder, composition and use of flux- their effect on metal, method of soldering and brazing, Braze welding procedure. Brazing fluxes - their properties, types, constituents of fluxes.
5.	**Basic Electricity:** Use of hand tools. Joining practice with single and multi-stand conductors. Joining practice of bare conductors, cable joints. Use of Aluminum flux and Alca 'P' solder. Demonstration and practice of crimping of various wires, Electrical symbols. Use of Multimeters and measurement of current, voltage, resistance in DC/AC circuits. Series circuits - Parallel circuits. Demonstration & Practice on connecting & replacement of common electrical accessories in circuits - Use of tong tester and megger.	Electricity, Safety - in electrical shops& installations. General care & maintenance of common electrical hand tools. Wires & cables -conductors, Insulators & semiconductors, their shapes, sizes with respect to low, medium & high voltage. Crimping equipment -Single &Multistranded conductors joining and soldering. Resistance, Voltage, Current, open circuit and short circuits-Ohm's law - Voltage drop in series & parallel circuits, Electrical measuring Instruments viz., Multimeters, Testers. Common electrical accessories used in Industries, Bus-bars, Relays, Contactors, Circuit Breakers, etc.. Fuses and their ratings, materials used. Earthing& its importance. Preventive maintenance, routine & periodical tests
6.	Simple wiring practice with distribution boards, Junction Boxes, Main Switches two way and intermediate Switches. Identification of different parts of DC generators- testing and measuring the field and Armature resistances. Identification of different parts of AC Motors - Testing and measurement on Induction motors - and generators. Identification and testing of transformers. Grouping & testing of cells for a specified voltage & current - Preparation of battery charging.	Induction principles - Electro-magnetism-Faraday's Laws. Single phase & Poly phase system 3 phase star-delta connections, Impedance &power factor -Principles & Applications of DC Motors , Series, Shunt & compound motor - AC Motors. Transformers their types and applications. Rechargeable batteries - Care & maintenance of cells. AC Motor starting with DOL Starter and Star - Delta Starter. Panel boards & their designing.
7.	Identification and testing of different types of electronic components, symbols. Testing of capacitors, Identification and Testing of assorted diodes, PNP/NPN Transistors - Uni - junction Transistor, Field effect, Transistor & Silicon Controlled Rectifier ICs etc. Soldering & de-soldering practice - Demonstration on Rectifiers - Identification of	Fundamentals of electron theory - passive components semiconductor devices - Symbols -specifications - Diodes, Transistors, Uni-junction Transistor, Field effect Transistor Silicon Controlled Rectifier & ICs. Half wave, full wave & Bridge rectifier with filters, DC Power supply. Rectification and Rectifiers, zener diode as

	ICs Full wave & bridge rectifier circuits, voltage regulators, construction of low voltage power supply, construction of transistor, amplifier circuits. Multivibrator circuits, CR circuits for wave shaping, wiring of SCR, UJT for motor control.	voltage regulator, Transistor parameters-CB,CC,CE configuration, amplification, photo diodes, transistors, multivibrations CR & LR circuits, SCRs,UJTs &ICs.
8.	Testing solid state thermostats, PTCR, remote controls. Operating & testing contactors, relay, pressure controls, timer, solenoid, heater, pressure controls, Identification of keys & display of microprocessor trainer kit.	Thermistor, RTDs, Electronic thermostat, principle of remote control & controllers. Use & specifications of contactors, starter & crankcase heater etc., Introduction to Microprocessors.
9.	Introduction to operations on copper tubing like bending, flaring, swedging, pinching etc. & tools used. Study & sketch refrigerator parts, storing arrangement, Fitting refrigerator doors & hinges, Tube brazing. Safety in handling tools & equipment.	History of refrigeration, its principle & need. Introduction to refrigeration equipment, constructional details of a refrigerator. Heat and temperature. Types of heat and its measurement. Thermometers & thermometric conversions. Atmosphere, air & its constituents. Properties of gases & gas laws. Measurement of pressure. Pressure gauges. Humidity, relative humidity & due point temperature.
10.	Refrigerator cleaning, inspection, testing of components in refrigeration system. Tracing the electrical components and testing relay, OLP, Thermostat, light assembly, door switch etc. To remove &refix refrigerator doors. To cut & fix door gaskets. Refrigerator installation, care & maintenance.	Functions of refrigeration system components i.e condensers, evaporators and capillary tube. Compressor, its types & working principle. Reciprocating compressors. Comparative study of sealed & open type compressors, Internal construction of a sealed compressor, its part & their functions. Introduction to soldering & brazing, their applications. Brazing Vs welding. Advantages & disadvantages. Brazing Processes. Defects & remedial measures.
11.	Dismantling & assembly of a sealed compressor & value plates, lapping of valve plates & reeds Oil charging of a compressor Recovering CFC / HCFC / HFC by using recovery machines	Compressor lubrication method. Lubricants & their properties. Comparative study of compressors and other component used for R.12, R.134 a & HCs. Refrigerants & their properties Comparative study of refrigerants Ozone depletion & its causes, need for elimination of refrigerant emission through recovery recycling, phasing out of CFCs.

12.	Repairing rewiring & servicing of a refrigerator. Leak testing in the system Evacuation & gas charging of a refrigerator. Trouble shooting of electrical & mechanical faults	Methods of leak testing & instruments used. Electronic leak detectors, their types & uses. Defect diagnosis with the help of problem trees
13.	**Revision &Internal Assessment**	

B. Block –II
Basic Training

Week No.	Professional Skills	Professional Knowledge
1.	Tripping the components of frost Free Refrigerator, tracing elctrical circuits & defrost, Inspection & testing. Retrofitting of CFC filled refrigerator with Non CFC refrigerant i.e.134a & HC 600. Use of sealed components.	Study of Frost Free Refrigerators, Refrigeration system of Frost Free Refrigerators, components & their functions, electrical components, wiring, automatic defrost & air duct system. Comparative study of refrigerators available in the market. Scope and methodology of retrofitting CFC appliances with HFC & HCS refrigerants, study of refrigerator components using HC refrigerants. Comparative study of performance of refrigerators using different refrigerants.
2.	Dismantling & Assembly of an Air conditioner, study of different components, their functions & specifications. Calculating Relative Humidity by using slingpsychometric.	Introduction to Air conditioning , its past, present & future. Air conditioning Fundamentals. Constructional details and functioning of room air conditioner. Air circulation system. Psychometric & psychometric charts, construction & use of sling psychrometer.
3.	Study & testing of thermostatic relay, capacitors, OLP, blower motor. Inspecting & testing condenser & evaporator coil. Checking of electrical wiring by CSR method. PSC circuits in RoomA.C.	Study of mechanical & electrical components of Window A. C. & Split A.C., Role of each part. Split A.C., its constructional details, comparison with window air conditioner advantages & Disadvantages. Air cooled condensers : Constructional details & selection.
4.	Dry Servicing & brought down servicing of Air conditioners. Brazing & water immersion testing of evaporator & condenser coils. Evacuating & gas charging of an Air conditioner. Performance Testing for Air Velocity, grill & condenser temperature & smooth running of fan motor.	Air cleaning :Filters, their types and specifications. Air flow measurements Use of velocity meters. Performance Testing criterion. Principles of pipe sizing & study of services valves for charging at site. Principle of working of infra red remote control, study of electronic circuits.
5.	Testing all weather air conditioners. Trouble shooting electrical & mechanical faults.	Fault diagnosis in window & split A.C. units with the help of problem trees.
6.	Water cooler construction (Instantaneous and storage) refrigeration circuit, electrical circuit, working and control, soldering of copper tubes with stainless steel, Trouble shooting of commonly faced problem like condenser Fan	a) Water storage, distribution and drainage b) Refrigeration system using R-22 and components in lieu of R-12, Retrofitting with HFC-134a & HCs c) Electrical and control system

	Failure, corrosion etc.	d) Insulation and Energy conservation
7.	Checking- and servicing visi cooler, deep freezer, Preventive maintenance and Trouble Shooting. Retrofitting with Hydrocarbons and HFC 134a.	Chest type bottle coolers, Deep Freezers and visi coolers Description, Construction and function substituting R-12 with R-134a or Hydrocarbon (Montreal protocol) Low temperature thermostat, different type of deep freezer construction.
8.	Ice Candy Plant, refrigeration circuit, electrical circuit, working and control. Cold storage Plant, types of condenser cooling coil used, expansion devices, refrigerant used and electrical circuit study. Drawing out layout of a typical chilling plant.	Ice Candy Plant, Refrigerant used, Brine agitator, Expansion Device; used, Electrical Motor Controls etc. Cold storage plant construction, refrigeration system with condenser & coil type used, RCD device used, super heat concept, electrical devices used. Chilling plants constructional details, System of refrigeration.
9.	Dismantling a pump unit from foundation. Checking the parts, servicing re-installing & testing the unit for performance & power consumption. Identifying parts of pumps & valves & note their functions. Preparing a problem tree for fault diagnosis.	Pumps, types & applications. Centrifugal pumps, their constructional details & applications. Working of a centrifugal pump. Calculations of heads, frictional losses, selection of pump. Valve, their types & applications. Sluice valve, butterfly valve, non return valves, constructional details & principle of working. Fault diagnosis.
10.	Sketching & dimensioning the parts of a typical package unit and study its constructional & operational details. Operating a package unit for its working and performance. Study the installation details & duct system of a package unit. Rewire a package unit. Mechanical, electrical & operational fault finding.	Package Air conditioners, their need, types & applications Ductable& non ductable units. Constructional details of a package unit. Electrical wiring & refrigerant system controls & electrical controls. Installation & operational details. Fault diagnosis with help of a problem tree. Comparative study of package units available in the market.

11.	Installation, servicing & re-installing a car A.C. unit. To test, service & adjust different controls and switches.To check & test the total system for performance. Study of typical central A.C. system using vapour absorption system.	Automobile air conditioning, need & applications. Difference between a room A.C. and automobile A.C. Study the details of a typical automotive air conditioning system parts and their functions. Installation & operation of a Car A.C. Trouble shooting with the help of a problem tree. Vapour Absorption Refrigeration system. Typical refrigeration cycle. Amonia& Lithium Bromide absorption system. Advantages & disadvantages of vapour absorption refrigeration system. Air Refrigeration, steam jet refrigeration & non- conventional refrigeration.
12.	Studying and drawing the layout & piping arrangement of the given Central A.C. Plant. Studying & drawing the chilling water & condensatewater circuits. Studying different controls. Maintenance of pumps, compressors & controls. Studying & drawing the panel board connections &wiring. Testing, pumping down & re-testing the plant. Evacuating & gas charging the system. Designing Central A.C. systems for different applications.	Introduction to Central A.C. plants, selection & applications. Direct & Indirect cooling, Air & water as media for cooling. Central A.C. Plant system components, Compressor, condenser & chiller. Fan coiled units & Air handling units. Cooling Towers, their types, constructional details & operation. Cooling Tower installation &maintenance, make up water arrangements. Types of compressors used, loading and unloading arrangements. Ducting & its installation. Different switches & controls. Trouble shooting. Heat load calculations for different site conditions & applications.
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** :**MECHANIC (CENTRAL AIR CONDITIONING PLANT, INDUSTRIAL COOLING AND PACKAGE AIR CONDITIONING)**

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 **Refrigeration/ 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 **MECHANIC (CENTRAL AIR CONDITIONING PLANT, INDUSTRIAL COOLING AND PACKAGE AIR CONDITIONING)**with three year post qualificationexperience 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. Use of dry & wet bulb thermometer, sling psychrometer, using psychrometric chart to plot processes. Rough checking of the performance of A.C. equipment
2. Use of Anemometers of measuring Air-flow
   Use of inclined tube manometer for measuring
   Air pressure, pivot tube for air-flow measurement.
3. Servicing & trouble shooting of package A.C.
4. Operation of package A.C. check for system leaks and leak repairs
5. Electrical wiring of the compressor and check in the wiring system of package A.C.
   Checking & testing of H.P/L.O/O.P/cut out, solenoid valve, thermostat etc.
6. Duct material and standard, reading and understanding duct layout drawings sheet metal duct work. Longitudinal and transverse joints
7. Service & maintenance of various types of Air filters. Noise control and isolation of piping, ducting, AHU Room and apply of acoustic material
8. Chilled water pining and insulation, servicing of focus and water control valves, mixing dampers face and by pass dampers.
9. Installing compressor and other system component, verifying airflow and distribution. Operation of electrical and mechanic components
10. Pull and verify deep vacuum. Perform leak checks and make repairs. Check system operation whilst following all safety procedures.
11. Operation of A.C. plant, check for system leaks and check and clean heat exchanger. Check out sample for acidity, check superheat.
12. Dismantling of commercial type reciprocating compressor
13. Checking and servicing valve plat and piston assembly tapping
14. Checking lubricating system, servicing of oil pump
15. Checking & Servicing capacity control of compressor fitting and testing
16. Checking servicing bearing, shaft seal cutting gasket and assemble of compressor testing efficiency
17. Servicing of water cooler condenser and receiver checking leakage
18. Servicing of evaporative condenser checking and repairing and testing
19. Servicing of cooling tower –its care and maintenance installation

20. Servicing of water softening and removing paint its care and maintenance
21. Servicing of water circulating pumps dismantling and reassembly
    Testing and adjusting of expansion devices
22. Servicing of water/brine chillers
    Servicing of suction-liquid heat exchangers
23. Routine maintenance, overhauling preventive maintenance of large AC plants, Maintenance, log book and record keeping

B. BLOCK – II (09 months)

1. Operating Principles of Screw, Rotary and Scroll compressors.
2. Types of condensers, cooling towers, AHUs, chillers (D-X, / flooded)
3. Introduction to environment friendly refrigerants viz. R134a, R407c, R410, R290, R32, their merits / demerits, system pressures and procedures for vacuuming, handling, operation and maintenance.
4. Basic fundamentals of Variable Frequency Drives (VFD)
5. Principles and Operation of Variable Refrigerant Volume (VRV) systems
6. Operation and maintenance of modulating devices for chilled water AC systems and Variable Air Volume (VAV) units used in air distribution systems.
7. Basic operation of screw and scroll chillers
8. Basic operation of Programmable Logic Controllers (PLC) / Plant Manager / Building Management Systems (BMS)
9. Various types of RTD (Resistance Temp Detectors) and electronic sensors
10. Methods to measure system performance parameters, calculate the energy efficiency and ascertain the performance of Air Conditioning Systems.

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 FOR APPRENTICE

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. Industry involving installation and maintenance of Central Air Conditioning.
2. Industries/ Plants/ Establishment where Central Air Conditioning system installed.

ANNEXURE – I

TOOLS & EQUIPMENT FOR BASIC TRAINING

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

TRADE: MECHANIC (CENTRAL AIR CONDITIONING PLANT, INDUSTRIAL COOLING AND PACKAGE AIR CONDITIONING)

LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES

A. Trainees Toolkit

Sr. No.	Names of the tools &Equipments	Quantity
1.	Steel rule 300 mm	20 Nos.
2.	Outside spring caliper 150 mm	20 Nos.
3.	Inside spring caliper 150 mm	20 Nos.
4.	Hermaphrodite caliper 150 mm	20 Nos.
5.	Divider spring 150 mm	20 Nos.
6.	Hammer B.P. 0.5 kg.	20 Nos.
7.	Combination plier 150 mm	20 Nos.
8.	File flat bastard 300mm	20 Nos.
9.	File flat 2nd cut 250 mm	20 Nos.
10.	Engineers screw driver	20 Nos.
11.	File flat smooth 200 mm	20 Nos.
12.	Cold chisel flat 25 x 200 mm	20 Nos.
13.	Combination Pliers 200mm insulated	20 Nos.
14.	Screw Driver 100mm 200mm	20 Nos.
15.	Neon Tester 500V pencil bit type	20 Nos.
16.	Electrician Knife	20 Nos.
17.	Hammer ball peen 0.25kg	20 Nos.
18.	File round 150mm	20 Nos.
19.	Tweezers	20 Nos.

B. General Shop outfit:

Sr. No.	Names of the tools &Equipments	Quantity
1.	Granite Surface plate 1000mm x 630mm grade 1	4 Nos.
2.	Metal stand table for surface plate 900 x 900 x 1200mm	4 Nos.
3.	Screw Driver Set (multiheads)	1set
4.	Scribing block universal 300mm	2 Nos.

5.	"V" Block universal 300 mm	2 Nos.
6.	Try square 150mm	2 Nos.
7.	Outside spring caliper 200 mm	2 Nos.
8.	Divider spring 200 mm	2 Nos.
9.	Inside spring caliper 200 mm	2 Nos.
10.	Straight edge steel 1 meter	1No.
11.	Spirit level 2V 250, 05 meter	1No.
12.	Screwdriver, heavy duty 300mm with handle	4 Nos.
13.	Hammer lead 1 kg.	2 Nos.
14.	Combination set 300mm	2 Nos.
15.	Spindle blade screw driver 100mm	2 Nos.
16.	Allen hexagonal keys 2.5 to 12	2 Sets
17.	Spanner D.E.C.P. series 2(7 pcs. each)	6 sets
18.	Adjustable spanner 12 Nos	3 Nos.
19.	Reduction sleeve MT as required	1set
20.	Angle palate size 200 x 100 x 200mm	2 Nos.
21.	Angle plate adjustable 250 x 150 x 175	2 Nos.
22.	Solid parallels in pairs (Different sizes) in metric	12 pairs
23.	Oil can pressure feed 500mg	6 Nos.
24.	Oil stone 150 x 50 x 25mm	2 Nos.
25.	Twist drills 3mm to 13mm (Parallel Shank)	1set
26.	Drill chuck 0-20 with taper shank	1No.
27.	Centre drill A1 to 5	2 sets
28.	Grinding wheel dresser (star type)	1No.
29.	Clamps C 100mm	2 Nos.
30.	Clamps C 200mm	2 Nos.
31.	Tap and die set in box metric pitch	1set
32.	Drill HSS taper shank	1set
33.	File H/R 2nd cut 250mm	4 Nos.
34.	File triangular smooth 200mm	4 Nos.
35.	Needle file set	1No.
36.	File square 2nd cut 250 mm	4 Nos.
37.	Reamer 6mm to 13mm by 1 mm	1set
38.	Hacksaw adjustable 250-300 mm with blades	8 Nos.
39.	Magnifying glass 75mm	2 Nos.
40.	Micrometer outside 0-25mm	4 Nos.
41.	Micrometer outside 25-70 mm	4 Nos.
42.	Micrometer outside 50-75mm	2 Nos.
43.	Micrometer depth gauge 0-150mm	8 Nos.
44.	Direct reading Vernier caliper 0 to 300	4 Nos.
45.	Vernier height gauge 250mm	1No.
46.	Vernier bevel protractor with least count of 5 minutes	1No.
47.	Dial Gauge	4 Nos.
48.	Lever Type dial gauge	4 Nos.

49.	Dial gauge stand	4 Nos.
50.	Screw pitch gauge for metric pitches (0.5 to 7mm)	2 sets
51.	Radius gauge metric set (1-6mm)	1set
52.	Feeler gauge	1No.
53.	Sensitive Drilling machine pillar 12mm capacity with accessories	2 Nos.
54.	Drilling machine pillar 20mm capacity with accessories	1No.
55.	Planner 18" wooden	2 Nos.
56.	Handsaw 24"	6 Nos.
57.	Pedestal grinder	1No.
58.	Hand Drilling Machine Power (10mm)	1Nos.
59.	Planner Wooden 9"	4 Nos.
60.	Steel Jack planner 9"	1No.
61.	Centre punch 100 mm	17 Nos.
62.	Ordinary Wooden Mallet 50mm	17 Nos.
63.	Cross Peen Hammer 0.25 kg with handle	17 Nos.
64.	Protractor with blade 150mm	17 Nos.
65.	Steel tape 2 meters	17 Nos.
66.	Hammer peaning with handle	4 Nos.
67.	Hammer creasing with handle	4 Nos.
68.	Hammer Planishing with handle	4 Nos.
69.	Hammer Block with handle	2 Nos.
70.	D.E.Spanner G.P. (6mm to 32 mm) (set of 12 spanner)	2 Set
71.	Handvice 50mm	16 Nos.
72.	Steel wire Brush 50mm x 150mm	16 Nos.
73.	Gloves for welding (Leather and Asbestos)	16 Nos.
74.	Leather Apron	16 Nos.
75.	Tongs, Close mouth and pick up (1 each)	4pairs
76.	Portable Electric drill (single phase)	2 Nos.
77.	Round File 2nd cut 250mm	4 Nos.
78.	Triangular file smooth 250mm	4 Nos.
79.	Punch Round 3mm, 4mm & 6mm Dia	4 Nos.
80.	Punch Round 4mm Dia	4 Nos.
81.	File Flat 250mm smooth	2 Nos.
82.	File half round 300mm smooth	2 Nos.
83.	Hand Groover 3mm, 4mm, 5mm	4 Nos.
84.	Grip Wrench 200mm	2 Nos.
85.	Ladle 150mm Dia	2 Nos.
86.	Hand Drill 0 to 6mm, 8mm, 10mm, & 12mm	2 Nos.each
87.	Liquefied Petroleum Gas (LPG) Cylinder, Regulator and Torch with Burner	2 Nos.
88.	D.E.Grinder Pedestal motorized 200 mm	1 No.
89.	LPG 2.5 kg Cylinder for swirl jet torch	4 Nos.
90.	Welding Transformer (200 to 400 amps)	2 Nos.

91.	Slip roll former 1.6mm x 1000mm	1 No.
92.	Anvil 50kgs with stand	1 No.
93.	Swirl Jet Torch	4 Nos.
94.	Snip (Straight) 300mm	8 Nos.
95.	Snip (Straight) 150 mm	8 Nos.
96.	Shear (Straight) 450 mm	4 Nos.
97.	Shear (Straight) 600 mm	4 Nos.
98.	Stakes Half moon	2 Nos.
99.	Stake Hatchet	2 Nos.
100.	Stake funnel	2 Nos.
101.	Stake Anvil	2 Nos.
102.	Nylon Hammer (40mm Dia) with Handle	8 Nos.
103.	Snip(Bend) 300mm	4 Nos.
104.	Snip (Straight) 300mm	8 Nos.
105.	Snip (Straight) 150 mm	8 Nos.
106.	Shear (Straight) 450 mm	4 Nos.
107.	Shear (Straight) 600 mm	4 Nos.
108.	Stakes Half moon	2 Nos.
109.	Stake Hatchet	2 Nos.
110.	Stake funnel	2 Nos.
111.	Stake Anvil	2 Nos.
112.	Nylon Hammer (40mm Dia) with Handle	8 Nos.
113.	Snip(Bend) 300mm	4 Nos.
114.	Pliers side cutting 200mm	4 Nos.
115.	Pliers round nose 200mm	4 Nos.
116.	Pliers fat nose 150mm	4 Nos.
117.	Pliers long nose 200mm	4 Nos.
118.	Firmer chisel 25mm	4 Nos.
119.	Hammer ball pein 1.0kg	1 No.
120.	Wall jumper octagonal 37mm x 450mm	1 No.
121.	Center punch 100mm	1No.
122.	Steel measuring tape 20mts	1No.
123.	Allen keys	1Set
124.	Spanner double ended set of 6	2 sets
125.	Electric soldering iron 35W	4 Nos.
126.	Electric soldering iron 125W	2 Nos.
127.	Rubber gloves 5000V	2Pairs
128.	Multimeter 0-5, 100, 200, 500 mill amperes 0-100-1000, 10000 ohms 0150, 300, 600V AC/DC	2 Nos.
129.	Bar magnet	1No.
130.	Horse shoe magnet	1No.
131.	Electric Drill Machine 6mm capacity universal type 250V	1No.
132.	D.C.Shunt motor 1 H.P. 250V (Laboratory type)	2 Nos.
133.	Universal motor 750W AC/DC 250V	2 Nos.

134.	Squirrel cage induction motor 1 H.P., 230V with DOL starter	1Nos.
135.	Transformer single phase 500 ma./250/12V	4 Nos.
136.	L.F.oscilloscope with Attenuation probes	1No.
137.	Star Delta starter (contact type 8 points)	1No.
138.	Tong Tester	1No.
139.	Megger	1No.
140.	DC Power Supply 0V-110V/5A	1No.
141.	Auto – transformer – varies 230v	1No.
142.	Crimping tools	1Set

C. General Shop Outfit, Machinery and Installation

Sr. No.	Names of the tools &Equipments	Quantity
1.	Flaring tool set, single type for tube 4.7mm to 16mm O.D.	4 sets
2.	Electrical drill portable drill with chuck & key, capacity 6.4mm.	2 Nos.
3.	Swaging tool, punch type, set of size for tube 4.7mm to 16mm O.D.	4 sets
4.	Swaging tool, screw type, with adaptor set of size for tube 4.7mm to 16mm O.D.	1 set
5.	Gas cylinder truck two wheel type.	1 No.
6.	Bending spring external type, for copper tube 3mm to 16mm DIA.	4 sets
7.	Line tester 500 v. heavy duty.	4 Nos.
8.	Pipe cutter miniature for copper tube 3mm to 16mm DIA.	4 Nos.
9.	Tong tester 0-10-30 amps. 0 - 500 v.(clamp on multimeter.	4 Nos.
10.	Pipe cutter with built in reamer & space cutter, for copper tube 3mm to 32mm .	1 No.
11.	Knife folded stainless steel - 150mm.	4 Nos.
12.	pinch of tool, for copper tube, 6mm to 18mm DIA.	4 Nos.
13.	Voltmeter, AC/DC portable precision gread teak wood case leather belt 0 to 5 amp.	2 each
14.	Ratchet spanner of 6.4sq.mm reversible	4 Nos.
15.	Ammeter, AC/DC portable, precision gread teak wood case leather belt 0 to 5 amp.	2 Nos.
16.	Capillary plague gauge.	2 Nos.
17.	Megger - 1000 v.	1 No.
18.	Pinch of plier / crimping plier tool 6mm -18mm. DIA.	2 Nos.
19.	Wattmeter multirangeupto 1 kw.	1 No.
20.	Piercing plier 6-18mm & reversing valve with access fitting.	2 Nos. Each
21.	Multimeter analog type .	1 Nos.
22.	Spanner double ended 4.7mm to 16mm.	5 sets
23.	Multimeter digital type .	1 No.
24.	Spanner double ended 19mm to 31.8mm.	1 set
25.	Stop watch.	1 No.
26.	Ring spanner off set 4.7mm to 16mm.	5 sets
27.	Filler gauge 0.05mm - 1mm.	1 Set
28.	Ring spanner off set 19mm to 31.8mm.	1 set
29.	Wire gauge metric &whitworth.	1 Set
30.	Box spanner size 6.4mm to 10mm.	2 sets
31.	Refrigerant cylinder 2.5 kg.	2 Nos.

32.	Wrench adjustable length 150mm.	1 No.
33.	I) Evacuating & refrigerant charging station, compression. a) Rotary two stage vacuum pump & motor (with gas ballast & anti suck back) manifold with gauges & valves & capable of pulling vacuum upto 50 microns of Hg & with provision of connecting to a microns level vacuum gauge. b) Graduated charging cylinder with provision for temperature correction & all necessary isolating valves. II) Evacuating & charging station as above but fitted with weighing scale (upto 2 kg. In licu of (b) above & with accuracy of +/-1g for charging hydrocarbons.	1 No.
34.	Wrench adjustable length 200mm.	2 Nos.
35.	Two stage rotary vacuum pump capacity approx. 60 - 100 rpm, capable of evacuating to 50 microns of Hg & fitted with gas ballast, anti suck back valve & single phase motor.	1 No.
36.	Wrench adjustable length 250mm.	2 Nos.
37.	Scraper triangular blade removable 60mm.	2 Nos.
38.	Pipe wrench size 50 & 150 mm.	01 No. each
39.	Pressure testing tank with lighting arrangement, pressure gauge (0 to 35kg/sq.cm.) double stage.	1 No.
40.	Torque wrench 300mm, 12.7mm square drive right & left hand.	1 set
41.	Heating kit with infra red bulb. (200 watt capacity.)	1 No.
42.	Valve key -t handle - 4.7mm & 6.4mm.sq.	4 sets
43.	Refrigerator, compression type 165 litres	1 No.
44.	Socket set, reversible ratchet, 12.7mm square drive with extension4.7mm to 31.2mm.	2 sets
45.	Refrigerator, compression type 300 litres double door, double compressor system.	1 No.
46.	Socket set, reversible ratchet, 1/2" square drive with extension3/16" to 1/4" BSW & SR.	1 set
47.	Work bench 1000mm x 600mm x 800mm. High.	2 Nos.
48.	Pressure gauge diameter 63mm with recalibration set	4 Nos.
49.	Portable air- LPG brazing kit with 2 kg. LPG cylinder, torches, houses, stand make. A) with straight flame. B) witheyelone/ swirl jet flame.	1 No.
50.	Compound gauge, diameter 63mm. with recalibration set screw, scale vacuum 76mm. Pressure 15 kg/sq.cm.	4 Nos.

51.	Pliers flat nose 150mm.	1 No.
52.	Service man thermometer in metal case - 30^0 C to $+30^0$ C	4 Nos.
53.	Tap set with matching drills 3mm to 16mm.	1 Set
54.	Gas leak detector for halogen gas.	2 Nos.
55.	Micron vacuum gauge capable of reading upto 20 microns.	1 No.
56.	L-Allen key set size 1.5mm to 6.4mm.	4 Sets
57.	Sensor thermometer (digital).	2 Nos.
58.	T-Allen key set size 5/32" to 1/8".	4 Sets
59.	Fin straightener/fin comb.	4 Nos.
60.	Screw driver, plastic handle, 6mm TIP length 100mm to 150mm.	4 each
61.	HC refrigerant in cylinders / disposable containers.	2 Nos.
62.	Screw driver, plastic handle, 10mm TIP length 200mm to 250mm.	4 each
63.	134 A refrigerant in cylinders.	2 Nos.
64.	Philips screw driver - complete set in leather case.	2 sets
65.	Recovery unit one each for cfc &134A refrigerants with recovering cylinders	1 Nos.
66.	Screw driver, plastic handle, 3mm TIP length 100mm to 150mm. Insulated.	1 set
67.	Refrigerator170 lit. using 134a refrigerant	1 No.
68.	Pliers combination insulated length 200mm.	2 Nos.
69.	Pliers long nose 200mm.	2 Nos.
70.	Fire extinguisher power type.	2 Nos.
71.	Hammer ball peen 220 gms.	4 Nos.
72.	Dry N2 in cylinder with 2 stage regulator or commercial N_2 in cylinder with drier unit and 2 stage regulator.	1 No.
73.	Hammer nylon 300 gms.	4 Nos.
74.	Trichloroethylene bottle.	1 No.
75.	Engineers rule 300mm long.	1 No
76.	Two way manifold with gauges.	1 No.
77.	Tape measuring 2m graduation in mm.	1 No.
78.	Four way manifold with gauges.	1 No.
79.	Chisel flat length 150mm.	4 Nos.
80.	Filter driers for cfc - 12 &hfc - 134A for repairs - retrofits.	8 Nos.
81.	Hack saw tubular metal frame adjustable.	4 Nos.
82.	Sealed ex - proof components for use in hsappliances : thermostat, sealed olp's. solid state PTC's, door switches, lamp holders	4 Nos. each
83.	Centre punch length 100mm.	4 Nos.
84.	Safety gloves, eye protection glasses.	4 Nos.
85.	Oil can pressure type - 1 litre.	2 Nos.
86.	Schrader valve core removal tool.	1 No.

87.	File, flat medium, double cut, length 200mm.	4 Nos.
88.	Acid test kit.	1 No.
89.	File round , fine double cut, length 150mm.	4 Nos.
90.	Pop rivet gun.	1 No.
91.	File flat , fine double cut, length 150mm.	4 Nos.
92.	Brazing alloy rods for 1/4"to7/8" tubes-Cu tocu, cu to steel, cu to brass & appropriate fluxes	1Set
93.	File square , fine double cut, length 150mm.	4 Nos.
94.	I) Hermetic compressors 1/8hp to 1/2hp) for use in repair work of appliances for CFCs&HFCs 1) Hermetic compressor for 134a	2/3 No. 1/2 No.
95.	Engineers square 200mm long.	2 Nos.
96.	Ball valves service valves, hand shut of valves of 1/4"to 7/8"	2 Nos. Each
97.	Soldering iron exchangeable copper tip 65 watts.	5 Nos.
98.	Quick couplers , process tube adaptors for 1/4",3/8"	2 pairs each
99.	Pipe bending tool, lever type with degree indicator, for tube O.D. 6.4mm to 16mm.	2 Sets
100.	Compressors testers for small hermetic compressors	1 No.
101.	Hand blower portable complete 1/10 HP.	1 No.
102.	Evaporator of direct cooled refrigerator with capillary heat exchanger	1 No.
103.	Tap & die set 3mm to 16mm size	1 Set
104.	Evaporator of frost free refrigerator	1 No.
105.	Tap set with matching drills 1/4" to 5/8".	1 Set
106.	Bellow type thermostats, H.P.stat, L.P.stat, humid stat, solenoid valves	1 No. each
107.	Tape & die set 1/4" to 5/8" SAE size	1 Set
108.	Electrical accessories: current & potential relays, start & run capacitors, PTCs, overload protectors, relays, contactors	1 No. each
109.	Digital type clampmeter	1 No.
110.	Puller 3 legged, with flexible arm 300mm.	1 No.
111.	Bench vice 75mm jaw.	2 Nos.
112.	Electrical drill portable drill with chuck & key, capacity 6.4mm.	2 Nos.
113.	Pedestal grinder, double ended wheel dia 200mm. 3000rpm.	1 No.
114.	Oxy-Acetylene welding set complete with cylinders regulators welding torches with difference nozzles	1 No.
115.	Capillary plague gauge.	2 Nos.
116.	Voltmeter, AC/DC portable precision gread teak wood case leather belt 0 to 500 V.	2 Nos.
117.	Ammeter, AC/DC portable, precision gread teak wood case	2 Nos.

	leather belt 0 to 30 V	
118.	Technometer digital, multirange 0 rpm to 3000 rpm. Portable small size in leather case.	1 No.
119.	Refrigerant cylinder 2.5 kg.	2 Nos.
120.	Dial thermometer remote control, armoured capillary dial 75mm. -50^{0}C to +50^{0}C.	2 Nos.
121.	Anemometer (Vane type)	1 No.
122.	Sling psycrometer mounted on aluminium back, scale - 50 C to +50 C.	2 Nos.
123.	Pilot tube & inclined tube manometer	1 No.
124.	Hermetic compressors 1.5 (AC)	1 No.
125.	Sensor thermometer (digital).	2 Nos.
126.	Hammer ball peen 450 gms.	4 Nos.
127.	Scriber 150mm length	4 Nos.
128.	Puller 3 legged, with flexible arm 120mm.	1 No.
129.	frost free Refrigerator 260 liters use in H.C. Refrigerant	2 Nos.
130.	Cut section of semi-harmatic screw compressor	1 No.
131.	Ammeter, AC/DC portable, precision gread teak wood case leather belt 0 to 30 V	2 Nos.
132.	Variance input 230 v. output 400 v. Amp. Portable complete with metet& controls.	1 No.
133.	R.L.C. bridge.	1 No.
134.	Wrench adjustable length 200mm.	2 Nos.
135.	Air compressor, two stage for oil - less dry air, with rush proof tank assembly, heater & controls max. pr. 10kg/sq.cm. Capacity 45 litre, motor 1 hp.	1 No.
136.	Scraper triangular blade removable 60mm.	2 Nos.
137.	Lapping plate 250mm x 200mm.	2 Nos.
138.	Spray outfit, 'V' twin motor 1/2 hp. Delivery upto 120 litre free air pressure upto 3kg/sq.cm. With spray gun & fitting.	1 No.
139.	Punch hole for cutting gasket, 4.7mm to 16mmDIA.	4 Nos.
140.	Deep frizer 165 litres - 18^{0}C.,1/4 hp.	1 No.
141.	Scissor, gasket cutting stainless steel, length 25mm.	4 Nos.
142.	Bottle cooler 110 litres 1/6 hp.	1 No.
143.	Water cooler instantaneous type .	1 No.
144.	Water cooler storage type .	1 No.
145.	Ice candy unit complete with stainless steel tank, mould box, thermocol insulated sunmica body, agitator, compressor, motor ele. Temparature, pressure, refrigerant control gauges, motor, pipe fitting ele 3000kcal/hr. working trainer model/ simulator.	1 No.
146.	Cold storage plan complete with all controls & accessories including cooling tower &water treatment plant capacity 15000 kcal/hr. or working trainer model/ simulator.	1 No.
147.	Welding table 900mm x 900mm x 700mm high.	1 No.

148.	Micrometer outside measurement 0 to 25mm.	2 Nos.
149.	Tape measuring 10m graduation in mm.	1 No.
150.	Vernier height gauge 250mm.	1 No.
151.	Vernier Caliper gauge 250mm.	1 No.
152.	Sensor thermometer (digital).	2 Nos.
153.	Divider spring joint length 150mm.	4 Nos.
154.	Caliper spring joint out side length 150mm.	4 Nos.
155.	Caliper spring joint in side length 150mm.	4 Nos.
156.	Caliper, odd leg, spring joint length 150mm.	4 Nos.
157.	Filter driers for cfc - 12 & HFC - 134A for repairs - retrofits.	8 Nos.
158.	Small capacity shell & tube condenser.	1 No.
159.	Fan coil unit with water valves (2 & 3way).	1 No.
160.	Marking block, universed spindle 200mm.	2 Nos.
161.	Shell & tube, DX chillers (small).	1 No.
162.	V - block with clamp 75mm.	2 Nos.
163.	Circulating water pump (small).	1 No.
164.	Surface plate with stand 600mm x 450mm.	1 Set
165.	Angle plate, 120^0 C 100mm 90^0 C.	1 No.
166.	Safety shoes (optional).	NIL
167.	Pipe threading dies protection glasses.	1 No.
168.	Refractometer(optional).	1 No.
169.	Hand formers & 20 g capacity lock former.	1 No.
170.	Plumb weight 200g.	1 No.
171.	Snipper sheet metal straight nose 200mm.	1 No.
172.	Visi cooler	1 No.
173.	Desktop Personnel Computers Intel Pentium-IV-CPU, 17" Monitor, Key Board, FDD, HD 80 GB, Window XP Professional Operating System	8 Nos.
174.	UPS 600 VA	8 Nos.
175.	Suitable Computer Tables	As per required
176.	Shoe Rack	As per required
177.	Computer Chairs	17 Nos.
178.	Vacuum cleaner	1 No.
179.	Spanner double ended 4.7mm to 16mm.	5 sets
180.	Descaling pumpset with stainless steel impeller & housing complete with motor 1 hp& accessories.	1 No.
181.	Micron vacuum gauge capable of reading upto 20 microns.	2 Nos.
182.	Components for car AC systems.	1 each
	A) Wobble plate compressor with mounting	
	B) Serpentine evaporator.	
	C) Parallel flow condenser.	
	D) Hoses, tubes, receiver, expansion valve.	
	E) electrical components & wiring harness.	

183.	Air compressor, two stage for oil - less dry air, with rush proof tank assembly, heater & controls max. pr. 10kg/sq.cm. Capacity 45 ltr, motor 1 hp.	1 No.
184.	Air conditioning, direct & indirect water chiller. Complete with all controls including humidity control ele capacity 15000kcal/hr. or working trainer model/ simulator. Alternatively, a packaged air -conditioner of similar capacity.	1 No.
185.	Reciprocating compressor with provision of capacity control etc. for demonstration. Capacity 9000kcal/hr. semi hermetic open type.	1 No.
186.	Recovery unit one each for cfc &134A refrigerants with recovering cylinders	1 No.
187.	Condensing unit with open type compressor air-cooled condenser, controls cap.3000 k.cal/ hr.	1 No.
188.	Condensing unit with open type compressor, evaporative condenser, with electric control cap.3000 k.cal/hr.	1 No.
189.	Working model of absorption system of Refrigeration cap. 3000 k.cal/hr.	1 No.
190.	Air-velocity meter (Digital type)	1 No.
191.	Testing machine for calibration & testing fo electrical starter, relay, contractor, solenoid valve. LP, HP, Oil pressure cut out.	1 No.
192.	Package A/C 7.5 ton cap. Water cool type	1 No.
193.	Package A/C 3 ton Air cooled type	1 No.
194.	Small capacity shell & Tube type condenser	1 No.
195.	Fan coil unit with water valve (2 & 3 way)	1 No.
196.	Shell & tube type Dx chiller (Small)	1 No.
197.	Thermostatic Exp. Valve	1 No.
198.	Solenoid valve	1 No.
199.	HP, LP, Oil pressure cut out switch	1 each
200.	Cut section of Dxchiiler	1 No.
201.	Cut section of Shell & tube type condenser	1 No.
202.	Cut section of Hermatic Scroll comp	1 No.
203.	Cut section of Hermatic Reciprocating compressor	1 No.
204.	Table model of vapur absorption system	1 No.
205.	Screw compressor (open type)	1 No.

NOTE: - In case of any tools and equipments repeated in the above tool list only one (1) item to be considered for procurement.

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: MECHANIC (CENTRAL AIR CONDITIONING PLANT, INDUSTRIAL COOLING AND PACKAGE AIR CONDITIONING)

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: MECHANIC (CENTRAL AIR CONDITIONING PLANT, INDUSTRIAL COOLING AND PACKAGE AIR CONDITIONING)

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.