**CURRICULUM**

**FOR THE TRADE OF**

# MECHANIC REFRIGERATION AND 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 is expended by DGT to the following expert members who had contributed immensely in this curriculum.

**Co-ordinator for the course:** Shri G. Venkatesh, ADT, ATI, Vidyanagar, Hyderabad

| Sl. No. | Name & Designation Sh./Mr./Ms. | Organization | Expert Group Designation |
|---|---|---|---|
| **1.** | T Veeradharanath | Mega Services , Hyderabad | Managing Director |
| **2.** | G Balaji | Voltas Ltd., Hyderabad | Manager |
| **3.** | JaikeshwaeGour | M/s Sri Srinivasa Dairy Products Pvt. Ltd., Hyderabad | Asst. Executive |
| **4.** | Md. Roshan | Setwin, Govt. of Telangana | Retd. MRAC (i/c) |
| **5.** | TK Bhattacharaya | ATI, Hyderabad | Trg. Officer |
| **6.** | B AppaRao | ATI, Hyderabad | Trg. Officer |

# 2. BACKGROUND

## 1.1 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.

## 1.2 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.

## 1.3 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 Refrigeration and Air conditioning trade)

The revised Apprenticeship Training Scheme (ATS) shall make the students more adapt to industry requirement through latest theoretical & practical inputs as:

1. It offers a good synergy between BT (Theoretical Inputs) & PT (On The Job training) unlike earlier scheme where students need to complete two year's classroom training before undergoing PT (On The Job training).
2. It will enhance knowledge about scientific principles, familiarization with industrial culture, and basics of RAC and its need.
3. It will enhance the ability to work with help of hand tools, power tools and machines. At the same time it creates the base for achieving hard skills.
4. It will enhance knowledge about different types of service techniques being used in RAC at industries.
5. It will enhance knowledge about industrial terminology, industrial practices and revitalize previous learning.
6. It will enhance the ability of problem solving related to Refrigeration and Air conditioning services.

# 4. JOB ROLES: REFERENCE NCO

**Brief description of Job roles:**

To repair and service in

Refrigerator,

Water cooler,

Bottle cooler,

Deep freezer,

Visi Cooler,

Walk in Cooler,

Ice candy plant,

Cold storage,

Ice plant,

Split Air Conditioner, Package Air Conditioner, Central Air Conditioner,

Auto mobile Air Conditioner, Transport refrigeration, Air craft Air conditioning,

Railway Air conditioning, Ship Refrigeration and Air conditioning.

Reference NCO: 845.706

# 5. GENERAL INFORMATION

1. **Name of the Trade** **: MECHANIC REFRIGERATION AND AIR CONDITIONING**

2. **N.C.O. Code No.**: 845.706

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

3.1 **For Fresher :-**

**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**

6. **Entry Qualification** : 10th Passed

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

**8. Rebate to ITI Passed out Trainees :one year** for the trade of **MECHANIC REFRIGERATION AND AIR CONDITIONING**

*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 |

**Duration of Training in Months**

| 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

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

### GENERAL INFORMATION

1) **Name of the Trade** : MECHANIC REFRIGERATION AND AIR CONDITIONING.
2) **Hours of Instruction** : 1000 Hrs. (500 hrs. in each block)
3) **Batch size** : 16 Nos.
4) **Power Norms** : 6.00 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 Mechanical Engg. from recognized university/Board with one/two year post qualification experience respectivelyin the relevant field.

**OR**

**ii)** NTC/NAC in the trade of Mechanical with three year post qualification experience in the relevant field.

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

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

## 6.1.1 DETAIL SYLLABUS OF CORE SKILL

### A. Block– I
### Basic Training

| Topic No. | a) Engineering Drawing | Duration (in hours) | b) Workshop Science & Calculation | Duration (in hours) |
|---|---|---|---|---|
| 1 | **Engineering Drawing: Introduction and its importance**<br>- Viewing of engineering drawing sheets.<br>- Method of Folding of printed Drawing Sheet as per BIS SP:46-2003 | **30** | **Unit**: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units | **20** |
| 2 | **Drawing Instruments : their uses**<br>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. | | **Fractions**: Fractions, Decimal fraction, Addition, Subtraction, Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems using Calculator. | |
| 3 | **Lines :**<br>- Definition, types and applications in Drawing as per BIS SP:46-2003<br>- Classification of lines (Hidden, centre, construction, Extension, Dimension, Section)<br>- Drawing lines of given length (Straight, curved)<br>- Drawing of parallel lines, perpendicular line.<br>- Methods of Division of line segment | | **Properties of Material** : properties -Physical & Mechanical, Types –Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous Alloys. | |
| 4 | **Drawing of Geometrical Figures:** Drawing practice on:<br>- Angle: Measurement and its types, method of bisecting.<br>- Triangle -different types<br>- Rectangle, Square, Rhombus, Parallelogram.<br>- Circle and its elements. | | **Average :** Problems of Average.<br>**Ratio & Proportion** : Simple calculation on related problems.<br>**Mass, Weight and Density**:<br>Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density. | |
| 5 | **Dimensioning:**<br>- Definition, types and methods of dimensioning (functional, non-functional and auxiliary)<br>- Types of arrowhead<br>- Leader Line with text | | | |
| 6 | **Free hand drawing of**<br>- Lines, polygons, ellipse, etc.<br>- geometrical figures and blocks with dimension | | | |

| | | | | |
|---|---|---|---|---|
| | - Transferring measurement from the given object to the free hand sketches. | | | |
| 7 | **Method of presentation of Engineering Drawing**<br>- Pictorial View<br>- Orthogonal View<br>- Isometric view | | **Percentage**: Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa. | |
| 8 | **Symbolic Representation (as per BIS SP:46-2003) of :**<br>- Fastener (Rivets, Bolts and Nuts)<br>- Bars and profile sections<br>- Weld, brazed and soldered joints.<br>- Electrical and electronics element<br>- Piping joints and fittings | | - Forces definition.<br>- Definition and example of compressive, tensile, shear forces, axial and tangential forces.<br>Stress, strain, ultimate strength, factor of safety for MS.<br>**Speed and Velocity**: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation. | |
| 9 | **Dimensioning practice:**<br>- Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003)<br>- Symbols preceding the value of dimension and dimensional tolerance. | | **Mensuration:** Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle.<br>Volume of solids – cube, cuboids, cylinder and Sphere.<br>Surface area of solids – cube, cuboids, cylinder and Sphere.<br>- Area of cut-out regular surfaces: circle and segment and sector of circle.<br>- Volume of cut-out solids: hollow cylinders, frustum of cone, block section.<br>- Volume of simple solid blocks. | |
| 10 | **Construction of Geometrical Drawing Figures:**<br>- Polygons and their values of included angles.<br>Conic Sections (Ellipse) | | **Algebra** : Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).<br>- Circular Motion: Relation between circular motion and Linear motion, Centrifugal force, Centripetal force. | |
| 11 | **Projections:**<br>- Concept of axes plane and quadrant.<br>- Orthographic projections<br>- Method of first angle and third angle projections (definition and difference)<br>- Symbol of 1st angle and 3rd angle projection as per IS specification.<br><br>Drawing of Orthographic projection from isometric/3D view of blocks | | **Work, Power and Energy**: work, unit of work, power, unit of power, Horse power, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy. | |

## B. Block- II
## Basic Training

| Topic No. | a) Engineering Drawing | Duration (in hours) | b) Workshop Science & Calculation | Duration (in hours) |
|---|---|---|---|---|
| 1 | - Machined components; concept of fillet & chamfer; surface finish symbols. | 30 | **Trigonometry:** Trigonometric ratios, Trigonometric tables.<br>- Finding the value of unknown sides and angles of a triangle by Trigonometrical method.<br>- Finding height and distance by trigonometry. | 20 |
| | | | **Friction** and its application in Workshop practice. | |
| 2 | - Screw thread, their standard forms as per BIS, external and internal thread, conventions on the features for drawing as per BIS. | | **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 | - Reading & interpretation of assembly drawing and detailing. | | **Basic Electricity**: Introduction, use of electricity, 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 earthing. | |
| | | | **Heat treatment** – Necessity, different common types of Heat treatment. | |
| | | | **Graph:**<br>- Read images, graphs, diagrams – bar chart, pie chart.<br>- Graphs: abscissa and ordinates, graphs of straight line, related to two sets of varying quantities. | |
| 4 | - Reading of drawing. Simple exercises related to missing lines, dimensions and views.<br>How to make queries. | | **Transmission of power:** By belt, pulleys & gear drive. | |
| 5 | - Simple exercises related to trade related symbols.<br>- Solution of NCVT test papers. | | **Concept of pressure** – units of pressure, atmospheric pressure, gauge pressure – gauges used for measuring pressure.<br>**Introduction to pneumatics & hydraulics systems.**<br>Solution of NCVT test papers | |

## 6.1.2DETAIL SYLLABUS OF PROFESSIONAL SKILLS & PROFESSIONAL KNOWLEDGE

### A. Block –I

### Basic Training

| Week No | PROFESSIONAL SKILL (275 Hours) | PROFESSIONAL KNOWLEDGE (120 Hour) |
|---|---|---|
| 1 | Familiarization of refrigeration tools, instruments, equipment. Care and maintenance of tool, instruments and equipment. | Introduction to basic refrigeration, job opportunities, Safety precautions and first aids, Applications and History of Refrigeration and Air conditioning. |
| 2 | **FITTING**<br><br>Use of hand tools, instruments, Bench vices and simple marking and measuring tools. Marking/Layout practice as per drawing. Sawing to a line. Chipping with flat chisel and hammer. Filing flat, square & curved surfaces. Slots, grooves angular profile, Drilling clear and blind hole, Tapping, Counter sinking, counter boring, drill bit grinding and reaming. Use of Hand and Power drills. | **FITTING**<br><br>Study the different types of Fitting hand tools, power tools, precision measuring instruments & their use. Equipments used in fittings like drilling machines, grinding machines, types, specifications and care and maintenance. Vernier caliper and micrometer. |
| 3 | **SHEET METAL**<br><br>Use of sheet metal tools and equipment, care and safety. Sheet metal working basics comprising shearing / cutting, bending at the edges to form flanges and hemmed locks, Embossing, forming. Use of sheet metal screws for joining, using rivets for joining. Rectangular duct fabrication. | **SHEET METAL**<br><br>Sheet metal tools and equipment type specification, care and safety. Types of sheet metal joints and their use. Rivet & riveting- their types and use. Calculation of Blank sizes from component drawing. |
| 4 | **ELECTRICAL**<br><br>Use of electrical hand tools Instruments. Joints on single and stranded conductors and soldering. | **ELECTRICAL**<br><br>Electrical hand tools & measuring instruments, types, specifications, use, care and safety. Common terms used in the trade. Conductors and insulators. Selected letters symbols and sign as per I. S. I. Rules for medium voltage. |
| 5 | Measurement of current, voltage, power and energy by voltmeter, Ammeter, wattmeter & energy meter. Measurement of resistance with Ohm meters Formation of simple electrical circuit, series circuit and parallel circuit, measuring insulation resistance & earth resistance. Uses of D.C Circuit, Fixing and connecting electrical | Introduction to Electricity,<br><br>Safety precaution and first aid. Electric current, voltage, Resistance and their units. Simple electrical circuit, essential requirement of electrical circuit, series and parallel circuit. Different types of resistances. Earthing and fuses. Types, |

| | | |
|---|---|---|
| | switches, holders fuses, plug sockets on T. W. Board and testing. Care & maintenance and running of A. C. Single and poly phase motor, starters and transformer. Single phase motor starting methods circuit like RSIR, PSC, CSIR & CSCR and the use of Current and Potential relays. | grades and sizes of insulated wire and cables – their selection and use. List of material for wiring. Switches, A.C. Motor, starters and transformer. Their working principles, specification & use. Care & safety. Run/start capacitors and PTCs. Motor Protection devices. Temperature rise of windings |
| 8 | **ELECTRONICS**<br><br>Identification of Electronic components and tools & instruments, colour coding of resistors, verification of ohms law, use of voltmeter, ammeter, multi meter, Practice of soldering & de soldering. Identification of transistors, resistors, capacitors, diodes, S.C.R, U.J.T, I.Cs. used in refrigeration & AC, Full wave and bridge rectifier circuit, voltage regulators. Construction of low voltage Power Supply. Construction of transistor amplifier circuit. Multi-vibrator circuits and RC wave shaping circuits. Wiring of SCR, UJT for power control circuits, applications of OP –AMP, soldering, de-soldering practice | **ELECTRONICS**<br><br>Introduction to Electronics. Basic Principles of semiconductors, Principles and application of Diodes Rectification, Zener diode as voltage regulator – transistors parameters- CB, CE, CC, configuration, amplification.<br><br>SCR Photo diodes, photo transistors, multi – vibrator, CR & LR circuit. SCRs, UJTs, ICs. |
| 7 | **WELDING**<br><br>Identification of gas welding, equipments& accessories, setting up Safety in handling of Oxy Acetylene Cylinders, Regulators etc., Setting oxy-acetylene plant, lighting and adjustment of flame-simple joint on M.S. Preparing of using a) AIR-LPG, b) $O_2$-LPG c) Oxy Acetylene plant with safety. c) $O_2$-$C_2H_2$. Familiarization with the practice of Gas brazing using close fitting lap joints for both soldering/ brazing cu to cu, cu to MS. Importance of wetting and capillary action. Use of appropriate torches, Nozzles, adjusting required flames and using proper fluxes, Practice on Oxy Acetylene. | **WELDING**<br><br>Introduction to basic principles of commonly used Welding processes, Arc welding, oxy fuel gas welding, brazing.<br><br>Welding tools and equipment type specification and use. Safety method in welding. Method of gas welding, gas used and flames adjustment. Difference between soldering and Brazing in terms of temperatures, filler materials, joint strengths and applications. Use of Oxy Acetylene, Oxy LPG and Air LPG for brazing/soldering |
| 8 | **BASIC REFRIGERATION.**<br><br>Familiarization & use of general and special tools used in refrigeration work practice. Identification of various Refrigeration equipments& components of vapour compression system like , compressor, condenser, expansion valve | **BASIC REFRIGERATION**<br><br>Fundamentals of Refrigeration, units and measurements, Pressure & its Measurements. Heat and Temperature, Different temperature scales, Ton of Refrigeration working of vapour compression cycle, low side & high side components of vapour compression system |

| | | |
|---|---|---|
| | and evaporator etc<br><br>Working on soft copper tubing like, cutting, bending, flaring, swaging, brazing cu to cu and cu to steel, pinching & preparing flare joints.<br><br>**REFRIGERANT**<br><br>Identification of refrigerant cylinders, Identification of unknown refrigerants, Recovery & Transfer of refrigerant, safe handling Cylinders and Valves, Leak testing, Evacuation, Charging refrigerants in Refrigerator. | and functions and applications of components.<br><br>**REFRIGERANT**<br><br>Classification of refrigerants, Properties, Chemical name and formulas, HFC, CFC. Ozone rule, substitute of CFC, Montreal protocol & India's CFC/HCFC phase out schedules. Ozone rules 2000. Substitute refrigerants in lieu of CFC'S their properties & comparison with CFCs, HFCs and HCs. |
| 9 | **REFRIGERATOR (SINGLE DOOR)**<br><br>Direct cooled Domestic Refrigerator stripping accessories & cleaning, Checking Door alignment & replacing of gaskets. Tracing the electrical and mechanical components of sealed refrigerator. Testing Thermostats & semi-automatic defrost system, Testing of compressor, Identification of CSR Terminals, Starting of compressor without relay, & starting with Relay, testing OLP, and Electric safety devices. Reassembly the components & Test performance. Cleaning, Flushing, replacing capillary and drier, evacuation, leak testing, gas charging in Refrigerator. | **REFRIGERATOR (SINGLE DOOR)**<br><br>Study the types of Refrigerator, construction & working of compressor, Condenser, Capillaries & evaporators, suction Heat exchanger, door, gaskets, Heat Insulation materials, Electrical components. Importance of flushing in evaporator and condenser, necessity of replacing capillary and drier. Evacuation, leak testing, gas charging method in refrigerator, Refrigerants used in Refrigerators and its properties. |
| 10 | **FROST FREE REFRIGERATOR:**<br><br>Tracing Electrical circuit, checking and testing of electrical accessories like, thermostat, Timer, Defrost Heaters, Bi-metal etc., checking air distribution system, servicing of refrigerator, testing of components. | **FROST FREE REFRIGERATOR**<br><br>Study the construction of Frost Free (2 or 3 door) Refrigerator parts particularly, the forced draft cooling, Air Duct circuit, temperature control in Freezer & cabinet of Refrigerator, the automatic defrost system. Study of Electrical accessories & their functions (Timer, Heater, Bi-Metal, Relay, OLP, T/S etc,.) Refrigerator cabinet volume calculation. Study the faults, Causes and their remedies of Refrigerator. |
| 11 | **WINDOW AIR CONDITIONER**<br><br>Identify the electrical and mechanical components, servicing and maintenance, tracing wiring circuit, evacuation, leak testing, gas charging. | **WINDOW AIR CONDITIONER**<br><br>Study the construction and working of window A.C, Care and Routine maintenance, installation procedure. Study the faults, Causes and their remedies of |

| | | |
|---|---|---|
| | | Window AC. |
| 12 | **SPLIT A.C ( Duct** )& **MULTI SPLIT A.C**<br><br>Identifying various components, electrical circuits, testing components, evacuation, gas charging, Installation, | **SPLIT A.C (Duct**) & **MULTI SPLIT A.C**<br><br>Study the construction and working, various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting. VRV &VRF system. |
| 13 | **ASSESMENT /Exam-03 days** | |

## B. Block –II
## Basic Training

| Week No. | PROFESSIONAL SKILL (275 Hours) | PROFESSIONAL KNOWLEDGE (120 Hour) |
|---|---|---|
| 1. | **COMPRESSOR**<br><br>Dismantling of Hermetic compressors, Identification of components, cutting gaskets, lapping and assembling, Add oil , check efficiency (pumping) compressors used in refrigerators, window & split A.C. types like, reciprocating, rotary ,wobble, swash plate, scroll type compressors. | **COMPRESSOR**<br><br>Types & working principle of compressor like, Reciprocating, rotary , scroll, wobble, swash plate, lubrication method, Compressor efficiency factors, wet compression, oil, properties, lubrication methods. |
| 2. | **CONDENSER**<br><br>Familiarization with condensers used in Refrigerators, Bottle coolers, visible coolers, Deep freezer, window and<br><br>Split A.C, Cleaning, Flushing and servicing of air cooled condenser, leak testing of condenser. | **CONDENSER**<br><br>Function of condenser, types, Construction of air cooled condenser, calculating Capacity of air cooled Condenser. Effect of chocked condenser. Advantages, decaling air cooled condenser |
| 3 | **EVAPORATOR**<br><br>Identification of evaporators in refrigerators, bottle cooler, water coolers, window and split A.C, Installation, Leak test, remove oil from evaporator, Flushing, Defrosting. | **EVAPORATOR**<br><br>Working principle, Function, types of evaporators used in refrigerator, water coolers, bottle coolers, window and split A.C, Super heating in evaporators, Function of accumulator and types. Methods of defrosting, heat exchanger. |
| 4 | **EXPANSION VALVE AND DRIER**<br><br>Replacing drier, capillary tube, in refrigerator and window AC. | **EXPANSION VALVE AND DRIER**<br><br>Function of drier & Expansion valve used in domestic refrigeration and air conditioning systems. Capillaries, Automatic and Thermostatic Ex. Valves. |
| 5 | **THERMAL INSULATION**<br><br>Filling insulation materials in refrigeration systems | **THERMAL INSULATION**<br><br>Function, types, thermodynamic properties of heat insulation materials used in refrigeration and Air Conditioning systems. |
| 6 | **WALK IN COOLER & REACH IN** | **WALK IN COOLER & REACH IN** |

| | | |
|---|---|---|
| | **CABINET**<br><br>Identify parts, Controls & accessories Specification of Walk in cooler & Reach in cabinet preventive maintenance of attach components, wiring circuit. Cleaning, leak testing, Evacuation, charging. | **CABINET**<br><br>Details about components, their functioning, working principle, Circuit diagram, capacity & types. Care and maintenance. |
| 7 | **COLD STORAGE**<br><br>Identify parts, Controls & accessories of Cold storage and Specification understanding.<br><br>Add oil, add refrigerant, test leak, evacuation, gas charging, plant operation | . **COLD STORAGE**<br><br>Study of cold storage plant, parts, Construction, applications, controls & electrical diagram used in cold storage plant. Food preservation spoiling agents- controlling of spoiling agents, preservation by refrigeration system, maintaining temperature in different places. Types of cold storage and its details. |
| 8 | **CAR AIR CONDITIONING**<br><br>Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, testing magnetic clutch, regular maintenance, condenser de scaling, add refrigerant. | **CAR AIR CONDITIONING**<br><br>Study various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting, Magnetic clutch operation, free wheeling |
| 9. | **COMMERCIAL COMPRESSOR**<br><br>Dismantling of Commercial type reciprocating compressor, centrifugal compressor, checking of components & accessories. Checking valve plate and piston assembly, lapping valve plate etc. Preparing gasket, check belt tension and replacing. Checking lubricating system, servicing oil pump, Checking of capacity control of the compressor Checking of bearing, shaft seal etc. Fitting and testing , cutting gasket, assembling of compressor. | **COMMERCIAL COMPRESSOR**<br><br>Types, Construction & applications of Open type compressor and working,<br><br>Performance of reciprocating compressor volumetric efficiency, Capacity control, factor influencing volumetric efficiency.<br><br>Selection of lubricant, Function and characteristic of lubricant, types of lubrication methods such as splash, forced feed. Construction and working principle of Centrifugal and Screw compressor. |
| 10 | **WATER COOLED CONDENSER & Evaporator**<br><br>Checking leakage, De Scaling of condenser. checking, repairing and testing, Pump down of gas. | **WATER COOLED CONDENSER& Evaporator**<br><br>Condenser its type and capacity, water cooled condenser, construction and working, de scaling, application. Evaporative condenser- |

| | | |
|---|---|---|
| | | their function, construction and application. |
| 11 | **COOLING TOWER & water treatment**<br><br>Cooling tower care & maintenance Dismantling and assembling water circulating pumps.Water softening and Ion removing plant- its care and maintenance. Water piping. | **COOLING TOWER & water treatment**<br><br>Cooling tower, types, Construction, capacity, advantage & disadvantages of different types of cooling tower. Efficiency, approach and Cooling tower range.Water treatment necessary, Causes of water contamination control of scale deposit, corrosion, Slime and algae, Water softening and De-scaling method, pump and fan used, |
| 12 | **ICE PLANT/ CANDY**<br><br>Identify parts, Controls & accessories Specification, Checking ice candy plant temperature maintaining. Preparing Brine solution, Checking wiring circuit, test components, replacing components, evacuation, gas charging, Installation, testing performance. | **ICE PLANT/ CANDY**<br><br>Function, construction, working principle, Circuit diagram, capacity & types of compressor used. Brine composition to maintain required temperature. Operation, maintenance. |
| 13 | **Assessment (Exam)-03 days** | |

# 6.1.3 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.**

## 6.1.3.1 SYLLABUS OF EMPLOYABILITY SKILLS

### A. Block – I
### Basic Training

| Topic No. | Topic | Duration (in hours) |
|---|---|---|
| | **English Literacy** | **15** |
| **1** | **Pronunciation :**<br>Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech) | |
| **2** | **Functional Grammar**<br>Transformation of sentences, Voice change, Change of tense, Spellings. | |
| **3** | **Reading**<br>Reading and understanding simple sentences about self, work and environment | |
| **4** | **Writing**<br>Construction of simple sentences Writing simple English | |
| **5** | **Speaking / Spoken English**<br>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**<br>Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer. | |
| **2** | **Computer Operating System**<br>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**<br>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.<br>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**<br>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),<br>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<br>Information Security, Awareness of IT - ACT, types of cyber crimes. | |
| | **Communication Skill** | **25** |
| **1** | **Introduction to Communication Skills**<br>Communication and its importance<br>Principles of Effective communication<br>Types of communication - verbal, non verbal, written, email, talking on phone.<br>Non verbal communication -characteristics, components-Para-language<br>Body - language<br>Barriers to communication and dealing with barriers.<br>Handling nervousness/ discomfort.<br>Case study/Exercise | |
| **2** | **Listening Skills**<br>Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening.<br>Triple- A Listening - Attitude, Attention & Adjustment.<br>Active Listening Skills. | |
| **3** | **Motivational Training**<br>Characteristics Essential to Achieving Success<br>The Power of Positive Attitude<br>Self awareness<br>Importance of Commitment<br>Ethics and Values<br>Ways to Motivate Oneself<br>Personal Goal setting and Employability Planning.<br>Case study/Exercise | |
| **4** | **Facing Interviews**<br>Manners, Etiquettes, Dress code for an interview<br>Do's & Don'ts for an interview | |
| **5** | **Behavioral Skills**<br>Organizational Behavior<br>Problem Solving<br>Confidence Building<br>Attitude<br>Decision making<br>Case study/Exercise | |

## B. Block–II
## Basic Training

| Topic No. | Topic | Duration (in hours) |
|---|---|---|
| | **Entrepreneurship skill** | **10** |
| 1 | **Concept of Entrepreneurship**<br>**Entrepreneurship**- Entrepreneurship - Enterprises:-Conceptual issue Entrepreneurship vs. Management, Entrepreneurial motivation. Performance & Record, Role & Function ofentrepreneurs 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**<br>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**<br>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**<br>Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes. | |
| | **Productivity** | **10** |
| 1 | **Productivity**<br>Definition, Necessity, Meaning of GDP. | |
| 2 | **Affecting Factors**<br>Skills, Working Aids, Automation, Environment, Motivation<br>How improves or slows down. | |
| 3 | **Comparison with developed countries**<br>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**<br>Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance. | |
| | **Occupational Safety, Health & Environment Education** | **10** |
| 1 | **Safety & Health**<br>Introduction to Occupational Safety and Health importance of safety and health at workplace. | |
| 2 | **Occupational Hazards**<br>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**<br>Basic principles for protective equipment.<br>Accident Prevention techniques - control of accidents andsafety measures. | |

| | | |
|---|---|---|
| 4 | **First Aid**<br>Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person | |
| 5 | **Basic Provisions**<br>Idea of basic provision legislation of India.<br>of safety, health, welfare under legislation of India. | |
| 6 | **Ecosystem**<br>Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance. | |
| 7 | **Pollution**<br>Pollution and pollutants including liquid, gaseous, solid and hazardous waste. | |
| 8 | **Energy Conservation**<br>Conservation of Energy, re-use and recycle. | |
| 9 | **Global warming**<br>Global warming, climate change and Ozone layer depletion. | |
| 10 | **Ground Water**<br>Hydrological cycle, ground and surface water, Conservation and Harvesting of water | |
| 11 | **Environment**<br>Right attitude towards environment, Maintenance of in -house environment | |
| | **Labour Welfare Legislation** | **5** |
| 1 | **Welfare Acts**<br>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** | **5** |
| 1 | **Quality Consciousness :**<br>Meaning of quality, Quality Characteristic | |
| 2 | **Quality Circles :**<br>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 :**<br>Idea of ISO 9000 and BIS systems and its importance in maintaining qualities. | |
| 4 | **House Keeping :**<br>Purpose of Housekeeping, Practice of good Housekeeping. | |
| 5 | **Quality Tools**<br>Basic quality tools with a few examples | |
| | **Leadership and Team Building skills.** | **5** |
| | Leadership<br>Discipline and Morale<br>Team Work<br>Case Study/ Exercise | |
| | **Meet the Mentor**<br>**Role - play as a Supervisor** | **5** |
| | **Organizing and Planning.** | **5** |
| | Time Management<br>Group Dynamics<br>Case Study/ Exercise | |

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

## GENERAL INFORMATION

1) **Name of the Trade** :**MECHANIC REFRIGERATION AND AIR**
   i. **CONDITIONING**
2) **Duration of On-Job Training** : As per Apprentices Act amended time to time.
3) **Batch size** : 16 Nos.
4) **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.
5) **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 MechanicalEngg. with three year post qualification experience in the relevant field.

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

6) **Tools, Equipments& Machinery required** : - As per Annexure – II

## 6.2.1 BROAD SKILL COMPONENT TO BE COVERED DURING ON-JOB TRAINING

## A. BLOCK – I

| |
|---|
| 1. Identification of Refrigeration system & components for different appliances in refrigeration fields/systems. |
| 2. Trace out electrical wiring , disconnect & rewiring of single door refrigerator |
| 3. Servicing of single door refrigerator |
| 4. Recovery of refrigerant, cleaning, flushing, evacuation & charging of single door refrigerator. |
| 5. Fault finding & performance testing of single door refrigerator. |
| 6. Identification of Frost free refrigerator component. |
| 7. Trace out electrical wiring , disconnect & rewiring of Frost free refrigerator |
| 8. Servicing of Frost free refrigerator |
| 9. Recovery of refrigerant, cleaning, flushing, evacuation & charging of Frost free refrigerator |
| 10. Fault finding & performance testing of Frost free refrigerator. |
| 11. Retro fitting of Frost free refrigerator HFC to HC. |
| 12. Servicing of water cooler, storage type & instantaneous type. |
| 13. Servicing of bottle cooler and visi-cooler, preventive maintenance, trouble shooting and remedial measures. |
| 14. Retrofitting of CFC filled visi-cooler with HC & HFC gas. |
| 15. Servicing of deep freezer. Faults diagnosis and remedial measures. |
| 16. Servicing of water cooler, storage type & instantaneous type. |
| 17. Servicing of bottle cooler and visi-cooler, preventive maintenance, and trouble shooting and remedial measures. |
| 18. Trace out electrical wiring , disconnect & rewiring of Window air-conditioner |
| 19. Water and air Servicing of Window air-conditioner outer |
| 20. Recovery of refrigerant, cleaning, flushing, evacuation & charging of Window air-conditioner |
| 21. Fault finding & performance testing of Window air-conditioner |
| 22. Installation of Window air-conditioner following norms |
| 23. Trace out electrical wiring , disconnect & rewiring of split air-conditioner |
| 24. Water and air Servicing of split air-conditioner [outer ] |
| 25. Recovery of refrigerant, cleaning, flushing, evacuation & charging of split air-conditioner. |
| 26. Fault finding & performance testing of split air-conditioner. |
| 27. Installation of split air-conditioner following norms [extra charging procedure] |
| 28. Trace out electrical wiring , disconnect & rewiring of multi duct type split air-conditioner VRV &VRF system |
| 29. Water and air servicing of multi duct type Split air conditioner VRV &VRF system |
| 30. Pump down refrigerant, cleaning, flushing, evacuation & charging of multi duct type split air-conditioner VRV &VRF system |
| 31. Fault finding & performance testing of multi duct type split air-conditioner VRV &VRF system |
| 32. Installation of multi duct type split air-conditioner following norms VRV &VRF system |
| PRACTICAL TEST |

## B. BLOCK – II

| | |
|---|---|
| 1. | Checking and fitting- shaft seal, bearingof commercial compressor |
| 2. | Servicing large air cooled commercially used condenser. |
| 3. | Servicing large water cooled commercially used condenser. |
| 4. | Servicing large Evaporative commercially used condenser. |
| 5. | Servicing Cooling tower- Care and maintenance. |
| 6. | Installation of different types of Cooling tower. |
| 7. | Servicing of Water softening plant- Care and Routine maintenance, back wash, checking of water hardness, pH value. |
| 8. | Servicing large air fins cooled commercially used Dx Evaporator. |
| 9. | Central air-conditioning system Installation of complete plant, erection & pipe lay out etc. Electrical wiring with electrical accessories. safety cutouts, control panel board microprocessor, transducer, thermistor etc. |
| 10. | Package air-conditioning system servicing (water cooled condenser |
| 11. | Servicing, overhauling,log book maintenance of central air condition plant. |
| 12. | Cold storage plant(Ammonia system)Servicing, overhauling,log book maintenance. |
| 13. | Package airconditioning system Installation of complete plant, erection & pipe lay out etc. Electrical wiring with electrical accessories. Safety cutouts , control panel board microprocessor,transducer, thermistor etc. |
| 14. | Walk in cooler Installation erection & pipe lay out etc. Electrical wiring with electrical accessories. Safety cutouts , control panel board microprocessor, transducer, thermistor etc. |

# 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

## 8.2FINAL ASSESSMENT- ALL INDIA TRADE TEST (SUMMATIVE ASSESSMENT FOR TWO YEARS TRADE)

| SUBJECTS | Marks | Internal assessment based on competency | Full Marks | Pass Marks | Duration of Exam. |
|---|---|---|---|---|---|
| Basic Training(Block-I) | | **250** | **250** | **150** | |
| Professional Skill | 250 | | 250 | 150 | **08 hrs.** |
| Professional Knowledge | 100 | | 100 | 40 | 3 hrs. |
| Workshop Cal. & Sc. | 50 | | 50 | 20 | 3 hrs. |
| Engineering Drawing | 50 | | 50 | 20 | 4 hrs. |
| Employability Skill | 50 | | 50 | 20 | 3 hrs. |
| Basic Training (Block-II) | | **250** | **250** | **150** | |
| **Grand Total** | **500** | **500** | **1000** | **550** | |

**Marks Distribution** TOTAL: 1000 marks for I & II Blocks Pass marks: 550

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).
- On successful completion of the course trainees can opt for CITS course.

**Employment opportunities:**

On successful completion of this course, the candidates shall be gainfully employed in the following places :-

1. Production & Manufacturing industries having cooling plant
2. Refrigerator Service centres viz. Goderaj, Samsung etc.
3. A/C Service Centres Viz. Voltas, Blue star etc.
4. Service industries like Road Transportation, Railways and Hospitals
5. Ship building and repair
6. Ice Candy plant
7. Self employment.

**ANNEXURE – I**

## TOOLS & EQUIPMENT FOR BASIC TRAINING

## INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

## TRADE:MECHANIC REFRIGERATION AND AIR -CONDTIONING

## LIST OF TOOLS & EQUIPMENTS FOR 16APPRENTICES

### A : TRAINEES TOOL KIT:-

| SL.NO | Name of tools | Broad specifications | Quantity |
|---|---|---|---|
| 1. | File flat rough double cut | 200mm | 17 nos. |
| 2. | File, half round, fine double cut, | length 150mm | 17 nos. |
| 3. | File, round, fine double cut | length 150mm | 17 nos. |
| 4. | File flat, fine double cut, | length 150mm | 17 nos. |
| 5. | File square, fine double cut, | length 150mm | 17 nos. |
| 6. | File triangular fine double cut | length 150mm | 17 nos. |
| 7. | Scriber | 150mm length | 17 nos. |
| 8. | Centre punch | length 100mm | 17 nos. |
| 9. | Try square | 150 mm | 17 nos. |
| 10. | Divider spring joint | length 150mm | 17 nos. |
| 11. | Caliper spring joint in side | length 150mm | 17 nos. |
| 12. | Caliper, odd leg, spring joint | length 150mm | 17 nos. |
| 13. | Hammer ball pain | 220 gms | 17 nos. |
| 14. | Cold Chisel flat and cross cut | length 150mm | 17 nos. |
| 15. | Engineers rule | 300mm long | 17 nos. |
| 16. | Tape measuring | 10m graduation in mm | 17 nos. |
| 17. | Pliers combination insulated | length 200mm | 17 nos. |
| 18. | Pliers long nose | 200 mm | 17 nos. |
| 19. | Pliers flat nose | 150mm | 17 nos. |
| 20. | Line tester | 500 v heavy duty | 17 nos. |
| 21. | End cutting nipper | 15cm | 17 nos. |
| 22. | Tweezers | 10 cm | 17 nos. |
| 23. | Gloves for welding[Treated as consumable] | | 16+1 nos. |
| 24. | Leather Apron [Treated as consumable] | | 16+1 nos. |

## B :TOOLS INSTRUMENTS AND GENERAL SHOP OUTFITS:-

| SL. No. | Name of tools | Broad specifications | Quantity |
|---|---|---|---|
| 1. | Surface plate | 45 x45 cms | 1no. |
| 2. | Oil can | 500 ml | 5 nos. |
| 3. | Surface Gauge universal | 150 mm | 5 nos. |
| 4. | Bench vice | 300mm jaw | 10 nos. |
| 5. | Hack saw tubular metal frame adjustable | 300mm | 10 nos. |
| 6. | Snip sheet metal straight nose | 200 mm | 10 nos. |
| 7. | Snip sheet metal curved nose | 200 mm | 10 nos. |
| 8. | Anvil | 100X200mm | 1no. |
| 9. | Stakes [ different Types] | 100mm | 1 no each |
| 10. | Tin smith | 400mm | 1 No. |
| 11. | Wooden mallet /Nylon mallet | 500 gm good finish | 5 Nos. |
| 12. | Round Punch | 3mm,4mm,6mm | 5 Nos. each |
| 13. | Grover set | 4mm forming | 1 set |
| 14. | Electrical drill portable drill with chuck and key, | capacity 6.4mm | 5 nos. |
| 15. | Tape measuring graduation in mm | 2 m | 5nos. |
| 16. | Screw driver, plastic handle, | 6mm TIP length 100mm to 150mm | 6nos. |
| 17. | Screw driver, plastic handle, Flat tip | 10mm TIP length 200mm & 250mm | 6 nos. each |
| 18. | Philips screw driver – | complete set in leather case | 5 nos. |
| 19. | Screw driver, plastic handle, Flat tip | handle 3mm TIP length 100mm to 150mm insulated | 5 nos. |
| 20. | Soldering iron exchangeable copper tip | 65 watts | 10 nos. |
| 21. | Knife folded stainless steel – | 150mm | 10 nos. |
| 22. | Tong tester (clamp on multi meter) | 0-10-30 amps 0-500 v | 5 nos. |
| 23. | Voltmeter, AC/DC portable precision grade Digital Panel board type | 0 to 500 volt | 5nos. |
| 24. | Ammeter, AC/DC portable precision grade Digital Panel board type | belt 0 to 5 amp | 5nos. |
| 25. | Ammeter, AC/DC portable precision grade Digital Panel board type | 0 to 30 amp | 5nos. |
| 26. | Megger | 1000v | 5nos. |
| 27. | Wattmeter multi-range up to | 1 KW | 1no. |
| 28. | Multi meter digital type | | 5nos. |
| 29. | Tenon saw | 250 mm | 5nos. |
| 30. | Firmer chisel | 6,12,25mm | 2 nos. |
| 31. | Rawal plug tool | 6 mm | 2 nos. |

| | | | |
|---|---|---|---|
| 32. | K.W. meter | 0 -1 K w | 4 no. |
| 33. | Fire extinguisher | ABC dry powder type2 kg capacity | 1 no. |
| 34. | Fire buckets | 10 Litre | 1 no. |
| 35. | D.E spanner | 6-32 mm | 5 set |
| 36. | Ring spanner | 6 -32 mm | 5 set |
| 37. | Diagonal cutter | 15 cm | 5 nos. |
| 38. | Service Oscillator | | 1 no. |
| 39. | C.R.O Single beam | 5 MHZ | 2 nos. |
| 40. | C.R.O Dual trace/ Double beam | 60 MHZ | 2 nos. |
| 41. | A.F.O Oscillators | | 2 nos. |
| 42. | Tong, Close mouth and pick up | | 1 no. |
| 43. | Welding table for gas/Arc | 1200x760 | 1each |
| 44. | Flaring tool set, single type for tube. | 4.7mm to 16mm O.D | 5 nos. |
| 45. | Swaging tool, punch type, set of size for tube. | 4.7mm to 16mm O.D | 5sets |
| 46. | Swaging tool, screw type with adaptor set of size for tube | 4.7mm to 16mm O.D. | 5sets |
| 47. | Bending spring external type, for copper tube | 3mm to 16mm DIA | 5sets |
| 48. | Pipe cutter miniature for copper tube | 3mm to 16mm DIA | 5sets |
| 49. | Pinch of tool, for copper tube, | 6mm to 18mm DIA | 5sets |
| 50. | Ratchet spanner of | 6.4 sq.mm reversible | 5sets |
| 51. | Capillary plug gauge | | 5sets |
| 52. | Pinch of pliers/crimping pliers tool | 6mm – 18mm DIA | 5sets |
| 53. | Piercing pliers & reversing valve with access fitting | 6-18mm | 5sets |
| 54. | Spanner double ended | 4.7mm to 16mm | 5sets |
| 55. | Ring spanner off set | 4.7mm to 16mm | 5sets |
| 56. | Wrench adjustable | length 150mm | 5sets |
| 57. | Wrench adjustable | length 200mm | 5sets |
| 58. | Wrench adjustable | length 250mm | 5sets |
| 59. | Valve key handle[Treated as consumable] | – 4.7mm & 6.4mm sq. | 5sets |
| 60. | Pressure gauge Digital type | diameter 63mm with recalibration set | 5sets |
| 61. | Compound gauge, Digital type | diameter 63mm, with recalibration set screw, scale vacuum 76mm. Pressure 15 Kg/sq.cm | 5sets |
| 62. | Service man thermometer in metal case | – 30 C to +30 C | 5sets |
| 63. | Scissor, gasket cutting stainless steel | length 25mm | 5sets |
| 64. | L-Allen key | set size 1.5mm to 6.4mm | 5 sets |
| 65. | T-Allen key set | size 5/32" to 1/8" | 5sets |
| 66. | Pipe cutter with built in reamer | 3mm to 32mm | 5nos. |

| | | | |
|---|---|---|---|
| | and space cutter, for copper tube | | |
| 67. | Pipe /Tube bender lever type | 3-16 mm | 1 no each |
| 68. | Spanner double ended | 19mm to 31.8 mm | 5nos. |
| 69. | Pipe wrench | size 50mm to 150mm | 5nos. |
| 70. | Gas leak detector for halogen gas | | 5nos. |
| 71. | Sling psychro meter mounted on aluminum back, | scale 50 C to +50 C | 5nos. |
| 72. | Lapping plate | 250mm x 200mm | 2nos. |
| 73. | Hammer ball peen | 450 gms | 5nos. |
| 74. | Puller 3 legged with flexible arm | 300mm | 5nos. |
| 75. | Hand blower portable complete | 1/10 HP | 2nos. |
| 76. | Spirit level precision metallic | 200mm | 2nos. |
| 77. | Stop watch | | 2nos. |
| 78. | Tap set with matching drills | 3 mm to 16mm | 3nos. |
| 79. | Tap set with matching drills | ¼'' to 5/8'' | 3nos. |
| 80. | Refrigerant cylinder | 2.5 Kg | 3nos. |
| 81. | Vernier caliper | length 250mm | 2nos. |
| 82. | Micrometer outside measurement | 0 to 25mm | 2nos. |
| 83. | Heating kit with infrared bulb | (200 w capacity) | 2nos. |
| 84. | Plumbing hammer weight | 200 gm | 2nos. |
| 85. | Multi meter analogue type | | 5nos. |
| 86. | Tachometer digital, multi range | 0 r m p to 3000 r m p. Portable small size in leather case | 2nos. |
| 87. | Micron vacuum gauge | capable of reading up to 20 microns | 2nos. |
| 88. | Sensor thermometer (digital) | -50 degree Celsius to150 degree 35Celsius | 2nos. |
| 89. | Fin straightened/fin comb. | With strong steel wire based combing on wood | 3nos. |
| 90. | Filler gauge | 0.05 mm – 1 mm | 3nos. |
| 91. | Wire gauge metric and with worth | Steel plate embossing converse of British & Metric | 2nos. |
| 92. | Dial thermometer remote control, armored capillary dial | 75mm – 50C to +50 C | 3nos. |
| 93. | Anemometer Digital type | | 1no. |
| 94. | Compressors testers for small hermetic compressors | Fixed with electrical input/ output indicating facilities | 2nos. |
| 95. | Electrical accessories [Treated as consumable] | current and potential relays, start & run capacitors, PTCs overload protectors', relays contactors | As required |
| 96. | Engineers square | 150mm with 5' tolerance | 5nos. |
| 97. | Digital thermometer [Treated as consumable] | Graduated disc analogy type | 1no. |
| 98. | Temperature & Humidity recorder | Capacity to record 24 hrs record | 1no. |

| | | | |
|---|---|---|---|
| 99. | Electronic leak detector Digital type | Capable to detect of R134a,HC,R-22 | 2nos. |
| 100. | Instrumentation screw driver set | 100mm | 5nos. |
| 101. | Digital weighing machine | 100 kg | 1no. |
| 102. | Recycling unit | | 1 no. |
| 103. | Quick couplers/Self sealing coupler [Treated as consumable] | 1/4 - 3/8" | 2 pairs for each |
| 104. | Schrader valve [Treated as consumable] | | 1 each |
| 105. | Cylinder 134 a | 5 kg | 1 no. |

## C : GENERAL MACHINERY INSTALLATIONS:-

| SL. No. | Name of tools | Broad specifications | Quantity |
|---|---|---|---|
| 1. | Split phase induction motor | ¼ hp, 230 V | 1 no. |
| 2. | Capacitor start induction motor | ½ Hp, 230 V | 1 no. |
| 3. | AC 3 Phase motor, 400/50 Hz | 2 Hp | 1 no. |
| 4. | Star delta starter | 2 hp | 1 no. |
| 5. | Auto Transformer starter | 3 hp | 1 no. |
| 6. | D.O.L Starter | 2 hp | 1 no. |
| 7. | Portable air – LPC brazing kit | 2 kg. LPC cylinder, torches, houses, stand make | 1 no. |
| 8. | Oxy-acetylene welding set complete | cylinders, regulators welding torches with difference nozzles | 1 no. |
| 9. | Refrigerator | 165L carrying with HFC-134a, & HC | 2 Each |
| 10. | Frost free refrigerator | 200L carrying with HC blend | 2 nos. |
| 11. | Three/four door refrigerator | 300L carrying with HC R-600a | 2 nos. |
| 12. | Bench Drilling machine | 20 mm capacity,200-2500rpm | 1 no. |
| 13. | Grinding Machine | 200mm,3000rpm,Double ended1/2 hp | 1 no. |
| 14. | Evacuating and refrigerant charging station, consist of<br><br>a)Rotary two stage vacuum pump and motor (with gas ballast and anti such back)<br>b) manifold with gauges and valves and capable of pulling vacuum up to 50 microns of Hg and with | | 1 no. |

| | | | |
|---|---|---|---|
| | provision of connecting to a microns level vacuum gauge<br><br>b)Graduated charging cylinder with provision for temperature correction and all necessary isolating valves<br><br>II) Evacuating and charging station as above but fitted with weighing scale | (CAP. 2 kg. In lieu of (b) above and with accuracy of +/-1 g for charging hydrocarbons) | 1 no. |
| 15. | Two stage rotary vacuum pump | capacity approx. 60 – 10rmp capable of evacuating to 50 microns of Hg and fitted with gas ballast, anti such back valve and single phase motor | 1 no. |
| 16. | Air compressor, | two stage for oil – less dry air, with rush proof tank assembly, heater and controls max. pr. 10 kgs /sq.m Capacity 45 ltr. Motor 1 hp. | 1 no. |
| 17. | Reciprocating compressor | provision of capacity control etc. for demonstration. Capacity 9000Kcal/hr. semi hermetic open type. | 1 no. |
| 18. | Dry N2 in cylinder | 2 stage regular or commercial N 2 in cylinder with drier unit and 2 stage regular 7meter cube | 1 no. |
| 19. | Window A.C | 1 Ton with R-22 or HFC Blend reciprocating compressor | 2 nos. |
| 20. | Split A.C | 1.5 Ton with R134a or R-22 reciprocating compressor | 2 nos. |
| 21. | Duct able split A.C 1.5 ton | 1.5 Ton with R134a or R-22 reciprocating compressor | 1 no. |
| 22. | Recovery unit with cylinders | CFC & 134 a | 1 each |
| 23. | Heat pump | 3000 Kcal/hr | 1 no. |
| 24. | Cassette Air conditioner | 4500 kcal/hr with R-404 . | 1 no. |

| | | | |
|---|---|---|---|
| 25. | De scaling pump set | with stainless steel impeller and housing complete with motor 1/2 hp and accessories | 1 no. |
| 26. | Small capacity shell and tube condenser | 5 Ton with Cu tubing only | 1 no. |
| 27. | Fan coil unit | with water valves (2 & 3 way) | 1 no. |
| 28. | Shell and tube, DX chillers (small) | 5 Ton with Cu tubing only | 1 no. |
| 29. | Circulating water pump (small) | 0.5 H.P with stainless steel tank capacity 20 liters with in let/ outlet provision. | 1 no. |
| 30. | Shell and tube type condenser | 5 Ton | 1 no. |
| 31. | Rotary hermetic compressor | 2 Ton | 1 no. |
| 32. | Screw compressor | 5Ton | 1 no. |
| 33. | scroll compressor | 1Ton | 1 |
| 34. | Bottle cooler visible | 200 L carrying with HFC-134a& reciprocating compressor | 1 no. |
| 35. | Deep freezer | 200 L carrying with HFC-134a& reciprocating compressor | 1 no. |
| 36. | Water cooler storage type | 200 L carrying with HFC-134a& reciprocating compressor | 1 no. |
| 37. | Ice candy plant | 2 ton with capacity to make 32 ice candy at a time with Forma tray, stainless steel tank on trolley | 1 no. |
| 38. | Walk in cooler | 3 Ton cap. with open type compressor, water cooled condenser, providing with PUF insulated room sealed proof size 8X8X10Ft maintain 0 - 5 degree centigrade. | 1 no. |
| 39. | Air-conditioning, direct and indirect water chiller. | Complete with all controls including humidity control capacity 15000Kcal/hr | 1 no. |
| 40. | Package A/C | 7.5 ton capacity, Water | 1 no. |

| | | | |
|---|---|---|---|
| | | cooled type with open type compressor reciprocating type | |
| 41. | Car A.C components(full kit)<br>a) Wobble plate compressor with mounting brackets.<br>b) Serpentine Evaporator<br>c) Parallel Flow Condenser<br>d) Hoses, tubes, Receiver, Ex. valve.<br>e) Electrical components & wiring Harness | | 1 Set |
| 42. | CAR AC tutorial model | | 1 set |

**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: MECHANIC RERIGERATION AND AIR CONDITIONING

## LIST OF TOOLS& EQUIPMENTS FOR 16 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 | 17 |
| 2. | Set square celluloid $45^0$ (250 X 1.5 mm) | 17 |
| 3. | Set square celluloid $30^0$-$60^0$ (250 X 1.5 mm) | 17 |
| 4. | Mini drafter | 17 |
| 5. | Drawing board (700mm x500 mm) IS: 1444 | 17 |

**B : FURNITURE REQUIRED**

| Sl. No. | Name of the items | Quantity (indicative) |
|---|---|---|
| 1 | Drawing Board | ……. |
| 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**

# TOOLS & EQUIPMENT FOR ON-JOB TRAINING

## INFRASTRUCTURE FOR PROFESSIONAL SKILLS & PROFESSIONAL KNOWLEDGE

## TRADE: MECHANIC REFRIGERATION AND AIR CONDITIONING

## For Batch of 16 APPRENTICES

### General Machinery Installations –

| Sl. No. | Name & Description of Machines | Quantity |
|---|---|---|
| 1 | Water cooler storage type | 1 |
| 2 | Ice candy plant | 1 |
| 3 | Walk in cooler | 1 |
| 4 | Air-conditioning, direct and indirect water chiller. | 1 |
| 5 | Package A/C | 1 |
| 6 | Car A.C components(full kit)<br>f) Wobble plate compressor with mounting brackets.<br>g) Serpentine Evaporator<br>h) Parallel Flow Condenser<br>i) Hoses, tubes, Receiver, Ex. valve.<br>j) Electrical components & wiring Harness | 1 |

**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.