

CURRICULUM

FOR THE TRADE OF

**REFRIGERATION AND AIR
CONDITIONING**

UNDER

DUAL TRAINING SYSTEM

2017

BY



Government of India

GOVERNMENT OF INDIA

MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP

DIRECTORATE GENERAL OF TRAINING

**PROPOSED TIME DISTRIBUTION FOR REFRIGERATION AND AIR
CONDITIONING TRADE UNDER DUAL TRAINING SCHEME**

BLOCK WITH DURATION	THEORY	PRAC.	WSC/ CAL	ENGG. DRG.	EMP. SKILL	ECA, LIB. & OTHERS	REM.
BLOCK – I (12 months/52 Weeks duration) Institute level trg.	510 hrs.	830 hrs.	170 hrs.	250 hrs.	110 hrs.	50 hrs.	160 hrs. Revision & Test
BLOCK – II (09 months /39 weeks duration) Industry level trg.	---	1560 HRS.	---	---	---	---	---
BLOCK – III (3 months/ 13 Weeks duration) Institute level trg.	100 hrs.	210 hrs. (Practical practice and submission of report related to industry training)	50 hrs.	60 hrs.	---	20 hrs.	Last 2 weeks revision & exam.
GRAND TOTAL	610 HRS.	2600 HRS.	220 HRS.	310 HRS.	110 HRS.	70 HRS.	240 HRS.
Total duration of training inclusive of Industry & Institute is 2 years (4160 HRS.)							

GENERAL INFORMATION FOR INSTITUTE (ITI)

1. **Name of the Trade** : **REFRIGERATION AND AIR-CONDITIONING (Dual mode)**
2. **N.C.O. Code No.** : 3132.0900
3. **Duration of Craftsmen Training** : Two years (Three Blocks).
4. **Power norms** : 6.82 KW
5. **Space norms** : Workshop: 80 Sq. meters.
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6. **Entry Qualification** : Passed 10th Class with Science and Mathematics under 10+2 system of Education or its equivalent
7. **Trainees per unit** : 20 (Max. Supernumeraries: 5)
- 8a. **Qualification for Instructors** : Degree in Mechanical Engineering from recognized engg. college / university with one year experience in the relevant field
- OR
- Diploma in Mechanical Engineering from recognized board of technical education with two years experience in the relevant field
- OR
- NTC NTC/NAC in Mechanic Refrigeration & Air-conditioning trade with 3 years' post qualification experience
- 8b. **Desirable qualification** : Preference will be given to a candidate with CITS. (If not done CITS must be trained with in 2 yrs of joining)

Note:

- (i) Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications.
- (ii) Instructor qualification for WCS and E.D, as per the training manual.

Distribution of training on Hourly basis:

Total hours /week	Trade practical	Trade theory	Work shop Cal. & Sc.	Engg. Drawing	Employability skills	Extra curricular activity
40 Hours	25 Hours	6 Hours	2 Hours	3 Hours	2 Hours	2 Hours

SYLLABUS CONTENT WITH TIME STRUCTURE FOR REFRIGERATION AND AIR-CONDITIONING TRADE

Block – I

Duration- 12 Months (52 weeks)

Institute Level Training: -

Sl. No.	Practical (Duration: - 830 hrs.)	Theory (Duration: - 510 hrs.)
1.	<p>Importance of trade training, List of tools & Machinery used in the trade. Health & Safety: Introduction to safety equipments and their uses. Introduction of first aid, operation of Electrical mains.</p> <p>Occupational Safety & Health Importance of housekeeping & good shop floor practices. Health, Safety and Environment guidelines, legislations & regulations as applicable. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Basic safety introduction, Personal protective Equipment's(PPE):- 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. Use of Fire extinguishers.</p>	<p>Importance of safety and general precautions observed in the industry /shop floor. All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures.</p> <p>Soft Skills: its importance and Job area after completion of training. Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept & its application. Response to emergencies e.g.; power failure, fire, and system failure. Fire precautions-causes and types of fires, precautions against out break of fire. Fire Extinguishers-types and use.</p>
2.	<p>Familiarization with workshop & machineries. Safety precautions. Familiarization of refrigeration tools, instruments & equipments. Care and maintenance of tool, instruments and equipments.</p>	<p>Introduction to trade, general safety precautions and first aids, history of Refrigeration and Air conditioning. Function, working, use, specifications of refrigeration tools, instruments and equipment.</p>
3.	<p>ELECTRICAL: Familiarization of Electrical tools. Wire joint practice, Soldering and Brazing practice. Verification of Ohm's law. Identification of phase and neutral of AC supply. Construction of a load circuit with single phase AC and DC supply. Measurement of Voltage, Current, Resistance, power, Frequency and energy consumed in an electrical circuit. Measurement of earth resistance. Insulation and continuity test.</p>	<p>ELECTRICAL Electrical terms such as AC and DC supply, Voltage, Current, Resistance, Power, Energy, Frequency etc. Safety precautions to be observed while working on electricity. Conductors and Insulators, Materials used as conductors. Measuring Instruments such as voltmeter, ammeter, ohm meter, watt meter, energy meter and frequency meter. Earthing and its importance. Earth</p>

		resistance. Insulation and continuity test
4.	COMPRESSOR Dismantling of Hermetic compressors, Identification of components, Servicing, cutting gaskets, lapping and assembling of compressors used in refrigerators, window & split A.C, and assembling.	COMPRESSOR Function, construction, working, application of compressor like, Reciprocating, rotary, scroll type.
5.	Dismantling & assembling of Hermetic compressors like, reciprocating, rotary, wobble, swash plate & scroll type compressors. Identify the parts and rectify the defects	Study the construction & working of centrifugal compressor, wobble & swash plate compressor. Compressor efficiency factors, wet compression, oil, properties, lubrication methods.
6.	CONDENSER Familiarization with condensers used in Refrigerators, Bottle coolers, visible coolers, Deep freezer, window and Split A.C, Cleaning, Flushing and servicing of air cooled condenser, leak testing of condenser	CONDENSER Function of condenser, types, Construction of air cooled condenser. Effect of choked condenser. Advantages, de scaling of air cooled condenser.
7.	DRIER Replacing drier & capillary tube, in refrigerator and window AC.	DRIER Function of drier, types, application and its advantage.
8.	EXPANSION VALVE Install capillary tube, Test and adjust expansion valves.	EXPANSION VALVE Expansion valve used in domestic refrigeration and air conditioning systems. Capillaries, Automatic and Thermostatic Ex. Valves.
9.	EVAPORATOR Servicing of evaporators in refrigerators, bottle cooler, water coolers, window and split A.C, Installation, Leak test, remove oil from evaporator, Flushing, Defrosting.	EVAPORATOR 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.
10.	REFRIGERANT Identification of refrigerant cylinders, Identification of unknown refrigerants, Recovery & Transfer of refrigerant,	REFRIGERANT 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.
11.	RETROFITTING Retrofitting of a CFC filled Domestic Refrigerator with Hydrocarbons (HC) using sealed components.	RETROFITTING Changes of components & practices while retrofitting CFC appliances with HC refrigerants. Properties of HCs
12.	THERMAL INSULATION Filling insulation materials in refrigeration systems.	THERMAL INSULATION Function, types, thermodynamic properties of heat insulation materials used in refrigeration and Air Conditioning systems.
13.	WINDOW AIR CONDITIONER Identify the electrical and mechanical	WINDOW Air conditioner. Their types, applications. Construction

	components, servicing and maintenance, trouble shooting, installation, tracing wiring circuit, evacuation, leak testing, and gas charging in window Air conditioner.	and working, care and maintenance,
14.	SPLIT A.C Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting in split A.C.	SPLIT A.C Construction and working principle, types, trouble shooting & care and maintenance.
15.	SPLIT A.C (Wall Mounted) Identifying various components, electrical circuits, testing components, fault detection, install gauge manifold in the system, leak testing, evacuation, gas charging, Installation, trouble shooting.	SPLIT A.C (Wall mounted) Construction and working principle, types, trouble shooting. Description of electrical components used in split A.C. Study the wiring circuit .
16.	SPLIT A.C (Floor & Ceiling Mounted) Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting.	SPLIT A.C (floor & Ceiling mounted) Construction and working principle, types, trouble shooting. Description of electrical components used in split A.C. Study the wiring circuit.
17.	SPLIT A.C (Duct) Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting.	SPLIT A.C (Duct) Study of the Duct able split AC, its Construction and working principle, types, trouble shooting. Description of electrical components used in split A.C. Study the wiring circuit .
18.	MULTI SPLIT A.C Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting.	MULTI SPLIT A.C Study the construction and working, various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting.
19.	CAR AIR CONDITIONING Identifying various components, electrical circuits, testing components, fault detection, install gauge manifold in the system, leak testing, evacuation, gas charging, Installation, trouble shooting, testing magnetic clutch, regular maintenance, compressor overhauling, condenser de scaling, add refrigerant.	CAR AIR CONDITIONING Study various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting, Magnetic clutch operation, free wheeling , care and maintenance.
20.	COMMERCIAL COMPRESSOR Dismantling of Commercial type reciprocating compressor, centrifugal compressor, checking of components & accessories. Checking & servicing valve plate and piston assembly, lapping valve plate etc. Preparing gasket, check belt tension and replacing.	COMMERCIAL COMPRESSOR Function, types, Construction & working, applications of compressors used in commercial refrigeration. Volumetric efficiency, Capacity control, factor influencing volumetric efficiency.
21.	Checking lubricating system, servicing oil pump,	Compressor oil, types, properties, types

	Checking and servicing of capacity control of the compressor	of lubrication methods such as splash, forced feed.
22.	EXPANSION VALVE Testing & Installation of thermostatic Ex. Valve. Internal & external equalizer connection, super heat adjustment in TXV.	EXPANSION VALVE Expansion valve types and function, construction, working principle, & their advantage & disadvantages..TXV, AXV, Float valves, fixed and modulating orifice controls & electronic Ex. Valves.
23.	EVAPORATOR Servicing of extended surface forced air cooled evaporators. Servicing of Water/ brine chillers, check De- Frost system, Oil removing.	EVAPORATOR Function, types, Plate & Tube forced air DX evaporators. Types of Defrost system .Water/ Brine chillers. Types of brine used as secondary refrigerant. Accumulator, its function.
24.	DEEP FREEZER Deep freezer Checking & servicing , preventive maintenance & trouble shooting Checking wiring circuit, test components, replacing components, install gauge manifold in the system, evacuation, gas charging, Installation, testing performance.	DEEP FREEZER Deep freezer description, Construction, working, specifications, function, care and maintenance, faults and remedies.
25.	ICE PLANT Identify parts, Controls & Specification of Ice plant temperature maintaining,, trouble shooting, servicing, Checking wiring circuit, test components, replacing components, evacuation, gas charging, Installation, testing performance, plant operation.	ICE CREAM PLANT Details about components of Ice plant their functioning, working principle, Circuit diagram, capacity & types of compressor used, temperature maintaining.
26.	COLD STORAGE Identify parts, Controls & accessories Specification, Servicing of Cold storage plant. Operation of cold storage. Testing electrical controls, cooling system, mechanical components, add oil, add refrigerant, test leak, evacuation, gas charging, periodic maintenance.	COLD STORAGE 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.
27.	PSYCHROMETRY. Find DBT, WBT, RH & other properties by using psychometric chart. Use of psycho meter.	Fundamentals of Central Air Conditioning, requirements of comfort A.C, study of psychometric terms, DBT, WBT, RH, enthalpy, dew point, and specific humidity.
28.	Use of Anemometers for measuring Air flow, use	Types of Central air conditioning (Direct

	of monometers, measuring air flow, pivot tube for air flow measurement.	and indirect system) Construction, working, components, faults, care and maintenance,
29.	Servicing of Fans & blowers, motors, used in Air conditioning system.	Description of blowers& fans, function and types, static and velocity pressure measurements.
30.	DUCT Installation of ducts, construction of ducts, understanding Duct lay out drawings, selection of ducts, and insulation in ducts. Longitudinal and transverse joints.	DUCT Function, types, materials, duct designing, duct insulation, air distribution methods, air flow, AHU, fan, blower.
31.	AIR FILTERS Servicing and maintenance of different filters, Installation of filter	AIR FILTERS Function of air filters, types, construction, maintenance, effect of choked Air filter.
32.	SPLIT A.C (Duct) Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, Trouble shooting.	SPLIT A.C (Duct) Study the Duct able split AC, its Construction and working principle, types, trouble shooting.
33.	MULTI SPLIT A.C (Duct) Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, Trouble shooting.	MULTI SPLIT A.C (Duct) Study various mechanical and electrical components construction and working,, electrical circuits, testing components, fault detection, trouble shooting.
34.	PACKAGE A.C Identifying various components, electrical circuits, testing components, fault detection, install gauge manifold in the system, leak testing, evacuation, gas charging, Installation, Trouble shooting.	PACKAGE A.C Study Package AC, types, construction and working principle, trouble shooting, and various applications. Duct system, AHU.
35.	Identifying various components, electrical circuits, testing components, fault detection, install gauge manifold in the system, leak testing, evacuation, gas charging, Installation, Trouble shooting.	Care and maintenance, installation method, capacity calculation.
36.	SPLIT PACKAGE Identifying various components, electrical circuits, testing components fault detection, leak testing, evacuation, gas charging, Installation, Trouble shooting.	SPLIT PACKAGE Construction and working principle, types, Study various electrical and mechanical components, trouble shooting.
37.	CENTRALISED/INDUSTRIAL AIRCONDITIONING. Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Trouble shooting, Servicing AHU. Check air flow, Check temperature & pressure, operation of plant, Decaling condenser and cooling tower.	CENTRALISED/INDUSTRIAL AIRCONDITIONING. Construction and working principle, types, maintenance of Industrial Air-conditioning plant. Humidification and dehumidification methods. AHU.
38.	Pump down of gas, add oil to compressor, add gas in the system, trouble shoot and repair air	Temperature and pressure controls used in AC plant, its construction, working,

	conditioner. Check temperature and pressure controls.	safety devices, cooling towers, chilled piping lines,
39.	DIRECT EX.SYSTEM Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, Trouble shooting. Operation & Maintenance of Central AC plant.	DIRECT EX.SYSTEM Understanding Direct expansion system. Operation & Preventive Maintenance Schedule of central AC plant.
40.	Check and test VRF system.	Details of VRF system.
41.	INDIRECT/CHILLER SYSTEM Identifying various components, electrical circuits, testing components, fault detection, install gauge manifold in the system, leak testing, evacuation, gas charging, Installation, Trouble shooting..	INDIRECT/CHILLER SYSTEM Understanding central station AHU and FCU, Air washers used in chilled water system, understanding lay out, modulating valves for temperature control. Expansion tanks.
42.	Revision & Examination	

NOTE: - Maximum uses of video demonstration and other IT based teaching aids may be adopted to deliver the theoretical knowledge.

Syllabus for

EMPLOYABILITY SKILLS

GENERAL INFORMATION
(Employability Skill)

1. **Name of the subject** : **EMPLOYABILITY SKILLS**
2. **Hours of Instruction** : 110 Hrs.
3. **Examination** : The examination will be held at the end of the training.

4. **Instructor Qualification** :

MBA OR BBA with two years experience OR Graduate in Sociology/ Social Welfare/ Economics with Two years experience OR Graduate/ Diploma with Two years experience and trained in Employability Skills from DGET institutes

AND

Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above

OR

Existing Social Studies Instructors duly trained in Employability Skills from DGET institutes

5. **Instructor** :
- One full time regular instructor shall be engaged on every 240 numbers of trainees for teaching the subject "Employability Skills". One additional full time regular instructor would be required on increase in every 240 trainees. Wherever the trainees are less than 240 or part thereof, a part-time instructor may be engaged to teach the subject.

ALLOTMENT OF TIME AND MARKS AMONG THE TOPICS

Sl. No.	Topics	Allotted Hours	Marks Allotted	To be covered in
1.	English Literacy	20 hrs.	9	Block - I
2.	I.T. Literacy	20 hrs.	9	
3.	Communication Skills	15 hrs.	7	
	SUB TOTAL:	55	25	
4.	Entrepreneurship Skills	15 hrs.	6	
5.	Productivity	10 hrs.	5	
6.	Occupational safety , health and Environment Education	15 hrs.	6	
7.	Labour Welfare Legislation	05 hrs.	3	
8.	Quality Tools	10 hrs.	5	
	Sub Total:	55	25	
TOTAL		110 hrs.	50	

	and its implication. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.
3. Communication Skills Hour of Instruction: 15 Hrs.	
Marks Allotted: 07	
Topic	Contents
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.
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.
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.
Facing Interviews	Manners, Etiquettes, Dress code for an interview
	Do's & Don'ts for an interview
Behavioral Skills	Problem Solving
	Confidence Building

	Attitude
4. Entrepreneurship Skills Hour of Instruction: 15 Hrs.	
Marks Allotted: 06	
Concept of Entrepreneurship	Entrepreneur - 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.
Project Preparation & Marketing analysis	Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of PLC, Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.
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.
Investment Procurement	Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.
5. Productivity	
Hour of Instruction: 10 Hrs.	
Marks Allotted: 05	
Benefits	Personal / Workman - Incentive, Production linked Bonus, Improvement in living standard. Industry Nation.
Affecting Factors	Skills, Working Aids, Automation, Environment, Motivation How improves or slows down.
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.
Personal Finance Management	Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.
6. Occupational Safety, Health and Environment Education Hour of	
Instruction: 15 Hrs.	
Marks Allotted: 06	
Safety & Health	Introduction to Occupational Safety and Health importance of safety and health at workplace.

Occupational Hazards	Basic Hazards, Chemical Hazards, Vibroacoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.
Accident & safety	Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.
First Aid	Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person
Basic Provisions	Idea of basic provision of safety, health, welfare under legislative of India.

Ecosystem	Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.
Pollution	Pollution and pollutants including liquid, gaseous, solid and hazardous waste.
Energy Conservation	Conservation of Energy, re-use and recycle.
Global warming	Global warming, climate change and Ozone layer depletion.
Ground Water	Hydrological cycle, ground and surface water, Conservation and Harvesting of water
Environment	Right attitude towards environment, Maintenance of in-house environment
7. Labour Welfare Legislation Hour of Instruction: 05 Hrs.	
Marks Allotted: 03	
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.
Hour of Instruction: 10 Hrs.	
8. Quality Tools	
Marks Allotted: 05	
Quality Consciousness	Meaning of quality, Quality characteristic.
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.
Quality Management System	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.
House Keeping	Purpose of House keeping, Practice of good Housekeeping.
Quality Tools	Basic quality tools with a few examples

Tools & Equipments for Employability Skills:

Sl. No.	Name of the Equipment	Quantity
1	Computer (PC) with latest configurations and Internet connection with standard operating system and standard word processor and worksheet software	10 nos.
2	UPS - 500Va	10 nos.
3	Scanner cum Printer	1 no.
4	Computer Tables	10 nos.
5	Computer Chairs	20 nos.
6	LCD Projector	1 no.
7	White Board 1200mm x 900mm	1 no.

* Note: Above Tools & Equipments not required, if Computer LAB is available in the institute.

Syllabus for

ENGINEERING DRAWING

GENERAL INFORMATION
(Engineering Drawing)

1. **Name of the Subject** : ENGINEERING DRAWING
2. **Hours of Instruction** : 310 hrs.
3. **Instructor Qualification** : Degree in Engineering with one year experience
OR
Diploma in Engineering with two years experience
OR
NCVT / NAC in the Draughtsman (Mechanical / Civil) with three years experience.
4. **Desirable** : Craft Instructor Certificate in RoD & A course under NCVT.
5. **Instructor:**
 - One full time instructor is required for 144 Engineering seats sanctioned in the institute. Additional instructor will be required on increase in every 144 students.
 - For seats less than 144, the instructor may be out sourced/ hired on contract basis.

Details of syllabus

Sl. No.	Topics (Total duration - 310 hrs.)
1.	Engineering Drawing: Introduction and its importance <ul style="list-style-type: none"> - Relationship to other technical drawing types - Conventions - Viewing of engineering drawing sheets. - Method of Folding of printed Drawing Sheet as per BIS SP:46-2003
2.	Drawing Instruments : their Standard and uses <ul style="list-style-type: none"> - 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.
3.	Lines : <ul style="list-style-type: none"> - Definition, types and applications in Drawing as per BIS SP:46-2003 - Classification of lines (Hidden, centre, construction, Extension, Dimension, Section) - Drawing lines of given length (Straight, curved) - Drawing of parallel lines, perpendicular line - Methods of Division of line segment
4.	Drawing of Geometrical Figures: Definition, nomenclature and practice of - Angle: Measurement and its types, method of bisecting. <ul style="list-style-type: none"> - Triangle -different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.
5.	Lettering and Numbering as per BIS SP46-2003: - Single Stroke, Double Stroke, inclined, Upper case and Lower case.
6.	Dimensioning: <ul style="list-style-type: none"> - Definition, types and methods of dimensioning (functional, nonfunctional and auxiliary) - Types of arrowhead - Leader Line with text
7.	Free hand drawing of <ul style="list-style-type: none"> - Lines, polygons, ellipse, etc. - geometrical figures and blocks with dimension - Transferring measurement from the given object to the free hand sketches.
8.	Sizes and Layout of Drawing Sheets <ul style="list-style-type: none"> - Basic principle of Sheet Size - Designation of sizes - Selection of sizes - Title Block, its position and content - Borders and Frames (Orientation marks and graduations) - Grid Reference - Item Reference on Drawing Sheet (Item List)
9.	Method of presentation of Engineering Drawing <ul style="list-style-type: none"> - Pictorial View - Orthogonal View - Isometric view
10.	Symbolic Representation (as per BIS SP:46-2003) of : Fastener (Rivets, Bolts and Nuts) - Bars and profile sections

	<ul style="list-style-type: none"> - Weld, brazed and soldered joints. - Electrical and electronics element - Piping joints and fittings
11.	Construction of Scales and diagonal scale
12.	Practice of Lettering and Title Block
13.	<p>Dimensioning practice:</p> <ul style="list-style-type: none"> - Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003) - Symbols preceding the value of dimension and dimensional tolerance. - Text of dimension of repeated features, equidistance elements, circumferential objects.
14.	<p>Construction of Geometrical Drawing Figures:</p> <ul style="list-style-type: none"> - Different Polygons and their values of included angles. Inscribed and Circumscribed polygons. - Conic Sections (Ellipse & Parabola)
15.	Drawing of Solid figures (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions.
16.	Free Hand sketch of hand tools and measuring tools used in respective trades.
17.	<p>Projections:</p> <ul style="list-style-type: none"> - Concept of axes plane and quadrant. - Orthographic projections - Method of first angle and third angle projections (definition and difference) - Symbol of 1st angle and 3rd angle projection as per IS specification.
18.	Drawing of Orthographic projection from isometric/3D view of blocks
19.	Orthographic Drawing of simple fastener (Rivet, Bolts, Nuts & Screw)
20.	Drawing details of two simple mating blocks and assembled view.
21.	- Machined components; concept of fillet & chamfer; surface finish symbols.
22.	- Screw thread, their standard forms as per BIS, external and internal thread, conventions on the features for drawing as per BIS.
23.	- Free hand Sketches for bolts, nuts, screws and other screwed members.
24.	- Free hand Sketching of foundation bolts and types of washers.
25.	- Standard rivet forms as per BIS (Six types).
26.	- Riveted joints-Butt & Lap (Drawing one for each type).
27.	- Orthogonal views of keys of different types
28.	- Free hand Sketches for simple pipe, unions with simple pipe line drawings.
29.	- Concept of preparation of assembly drawing and detailing. Preparation of simple assemblies & their details of trade related tools/job/exercises with the dimensions from the given sample or models.
30.	-Free hand sketch of trade related components / parts (viz., single tool post for the lathe, etc.)
31.	- Study of assembled views of Vee-blocks with clamps.
32.	- Study of assembled views of shaft and pulley.
33.	- Study of assembled views of bush bearing.
34.	- Study of assembled views of a simple coupling.
35.	- Free hand Sketching of different gear wheels and nomenclature.
36.	- Free hand Details and assembly of simple bench vice.
37.	- Reading of drawing. Simple exercises related to missing lines, dimensions. How to make queries.

38.	- Simple exercises relating missing symbols. - Missing views
39.	- Simple exercises related to missing section.
40.	-Free hand sketching of different types of bearings and its conventional representation.
41.	- Free hand sketching of different gear wheels and nomenclature/ Simple duct (for RAC). Free hand sketch of Reciprocating compressor - open type (for RAC)
42.	- Solution of NCVT test. - Simple exercises related to trade related symbols. - Basic electrical and electronic symbols
43.	- Study of drawing & Estimation of materials.
44.	- Solution of NCVT test papers.
45.	Revision
46.	Examination

LIST OF TOOLS & EQUIPMENTS

Sl. No.	NAME OF TOOLS / EQUIPMENTS	QUANTITY
1.	Drawing Board	20 Nos
2.	Models : Solid & cut section	as required
3.	Table for trainees	20 Nos
4.	Stool for trainees	20 Nos
5.	Cupboard (big)	01 No
6.	White Board (size: 8ft. x 4ft.)	01 No
7.	Trainer's Table	01 No
8.	Trainer's Chair	01 No

Syllabus for

Workshop Calculation & Science

GENERAL INFORMATION
(Workshop Calculation & Science)

1. **Name of the subject** : WORKSHOP CALCULATION & SCIENCE
2. **Hours of Instruction** : 220 hrs.
3. **Examination** : The examination for the subject will be held at the end of training.
4. **Instructor Qualification** : Degree in Engineering with one year experience
OR
Diploma in Engineering with two years experience
5. **Desirable** : Craft Instructor Certificate in RoD & A course under NCVT.
6. **Instructor** : One full time instructor is required for 144 Engineering seats sanctioned in the institute. Additional instructor will be required on increase in every 144 students.

For seats less than 144, the instructor may be out sourced/ hired on contract basis.

SYLLABUS FOR WORKSHOP CALCULATION AND SCIENCE
(Total duration – 220 hrs.)

Topic No	Workshop Calculation	Workshop Science
1.	Unit: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units	Material Science : 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 metals, Non-Ferrous Alloys.
2.	Fractions: Fractions, Decimal fraction, L.C.M., H.C.F., Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems using Scientific Calculator.	Mass .Weight and Density : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals.
3.	Square Root: Square and Square Root, method of finding out square roots, Simple problem using calculator.	Speed and Velocity: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation, equations of motions, simple related problems.
4.	Ratio & Proportion : Simple calculation on related problems.	Work, Power and Energy: work, unit of work, power, unit of power, Horse power of engines,
5.	Percentage: Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	Mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.
6.	Algebra: Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	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.
7.	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.	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.
8.	Trigonometry: Trigonometrical ratios, measurement of angles. Trigonometric tables	Levers and Simple Machines: Levers and its types. Simple Machines, Effort and Load, Mechanical Advantage, Velocity Ratio, Efficiency of machine, Relationship between Efficiency, velocity ratio and Mechanical Advantage.
9.	- Geometrical construction & theorem: division of line segment, parallel lines, similar angles, perpendicular lines, isosceles triangle	- Forces definition. - Compressive, tensile, shear forces and simple problems.

	and right angled triangle.	-Stress, strain, ultimate strength, factor of safety. -Basic study of stress-strain curve for MS.
10.	- Area of cut-out regular surfaces: circle and segment and sector of circle.	- Temperature measuring instruments. Specific heats of solids & liquids.
11.	- Area of irregular surfaces. - Application related to shop problems.	- Thermal Conductivity, Heat loss and heat gain.
12.	- Volume of cut-out solids: hollow cylinders, frustum of cone, block section. - Volume of simple machine blocks.	- Average Velocity, Acceleration & Retardation. - Related problems.
13.	- Material weight and cost problems related to trade.	- Circular Motion: Relation between circular motion and Linear motion, Centrifugal force, Centripetal force
14.	- Finding the value of unknown sides and angles of a triangle by Trigonometrical method.	
15.	- Finding height and distance by trigonometry.	
16.	- Application of trigonometry in shop problems. (viz. taper angle calculation).	
17.	Graph: - Read images, graphs, diagrams - Bar chart, pie chart. - Graphs: abscissa and ordinates, graphs of straight line, related to two sets of varying quantities.	- Friction- co-efficient of friction, application and effects of friction in Workshop practice. Centre of gravity and its practical application.
18.	Simple problem on Statistics: - Frequency distribution table - Calculation of Mean value. - Examples on mass scale productions. - Cumulative frequency -Arithmetic mean	- Magnetic substances- natural and artificial magnets. - Method of magnetization. Use of magnets.
19.	Acceptance of lot by sampling method (within specified limit size) with simple examples (not more than 20 samples).	- Electrical insulating materials. - Basic concept of earthing.
20.		- Transmission of power by belt, pulleys & gear drive. - Calculation of Transmission of power by belt pulley and gear drive.
21.		- Heat treatment and advantages.
22.		Concept of pressure - units of pressure, atmospheric pressure, absolute pressure, gauge pressure -gauges used for measuring pressure
23.		Introduction to pneumatics & hydraulics systems.

BLOCK – II

DURATION: 09 MONTHS (39 weeks)

Industry level training

BROAD LEARNING TO BE COVERED IN INDUSTRY FOR REFRIGERATION AND AIR CONDITIONING TRADE:

- 1. Safety and best practices /Basic Industrial Culture (5S, KAIZEN, etc.)**
- 2. Record keeping and documentation**
- 3. Basic machining operations**
- 4. Preparing components**
- 5. Assembling**
- 6. Repair & Maintenance work**
- 7. Inspection & testing**

DETAILS OF PRACTICAL SKILLS TO BE COVERED DURING INDUSTRY TRAINING FOR REFRIGERATION AND AIR-CONDITIONING TRADE

Duration of training: - 09 Months

Actual training will depend on the existing facilities available in the establishments.

The candidate should be competent to execute following operation/ skills after completion of the industrial training: -

- 1. Safety** - a) personal safety b) Product appliance safety c)Customer's place safety
- 2. Behavioral training** - a) Atire & Uniform; Identity card; Safety shoes' gloves. b) appearance c) Soft skills ; communication; inter personal skill d) Preparation of report / Job card e) Communicated to customer what is done.
- 3. Identification & Use of Tools.**- a) Electrical tools.; millimeter; meager meter; clamp ; thermometer. Etc. b) Mechanical tools; Pressure gauge. Drill Machines; pipe benders vacuum pump; Flaring tools; swaging tools ;tube cutters.etc.
- 4. Introduction to Refrigerant** a) R290, R600a, R32, R410a R22, R134a etc. b) Safety while handling c) Operating pressures.
- 5. Installation of Air conditioners.** Location selection; Mounting of unit; Piping; brazing (if required); pipe joining ; wiring; drain piping. Insulation; mounting of bracket. Leak testing vacuuming; commissioning; checking; paramours; operating instructions. Explained to customer.
- 6. Installation of Refrigerator.** Selecting location; leveling; power point checking; air circulation ensuring; safety &usage explained.
- 7. Dry servicing of A.C.** Filter cleaning; blowing IDU & ODU. Cleaning fan & blower; Drain Clean; electrical checkpoint; Pressure testing; Performance checking; insulation checking.

8. **Wet servicing of AC.** Filter cleaning; jet pump cleaning of ODU condenser bower & fan motor; Drain cleaning; insulation; performance checking.
9. **Troubleshooting & Repair.** a) Interact with customer & get details of machine b) Try to find whether it's a mechanical or electrical problems. C) If it is electrical problem check supply & electrical components. d) If mechanical problem check compressor, gas leak or any other sealed system related problem.
10. **Wiring diagram reading** Understanding series & parallel connection; understanding electricity / current flow, schematics and symbol used in the diagram.
11. **Pipe joining and brazing** ...creating brazing joints. a) Copper to copper b) copper to aluminums c) copper to Mild steal.
12. Introduction to BLDC motor, inverter, VRF & their controls' (Black nut Lon works D3 net adapter). B IDC winding circuit and inverter logic,. Use & advantage & applications
13. Introduction to oil coolers for industrial use. Wiring and control of oil cooler, fault finding, rectification, testing and preventive maintenance.
14. Compressor testing Checking of primary & auxiliary winding; checking for ground with megger & insulation resistance. Checking pumping efficiencies of compressors. Understanding compressor related components like relay, OLP and capacitors
15. Introduction Dehumidifiers function of dehumidifier, wiring testing and trouble shoot / repair.
16. Introduction to repairing of car A. C. Identifying parts of AC in car, operation electrical & sealed system repair.
17. Plant visit – Chiller introduction. De scaling of condenser, microprocessor data. Reading and their uses.
18. Field experience as a service technician a) 2 demo visit calls') 6 device break down calls. C) 2 pm calls.
19. Introduction to deep freezer Identify scaled system related parts, wiring connection, electrical components, understanding application and temperatures, range of its working.
20. Introduction to thermocouple refrigeration system understanding peltier effect, wiring circuit functioning and applications.

NOTE: -

1. All the operations suggested in Block-II should be covered during Industrial Training.
2. In addition to above mentioned skills/ operations industry may impart training on any other skills/ operations related to trade

BLOCK – III

DURATION: 3 months (13 weeks)

Institute level training

For last three months candidates will be engaged in following works: -

1. Revision of theoretical components covered during Block – I.
2. Practical practice and report submission
3. Preparing candidate to face interview, preparation of bio-data, awareness about different jobs in the related field and grooming to be an entrepreneur.
4. Self study and final AITT examination

Note:-

1. The training may be conducted in Block mode i.e. few months in ITI & few in Industry.
2. The training may be conducted in flexible mode i.e. few days of a week in ITI & few days in Industry.
3. Nine months industrial training is mandatory.
4. Last three months of training in ITI is mandatory.
5. No admission of trainees without signing MOU with industry by the Institute (ITI).
6. At the time of signing MOU with ITI, Industry must ensure that training facility is available for operations covered under Block-II.
7. Minimum 75% of total skill set of Block- II must be covered in Industry who is signing MOU. However Industry must ensure 100% skill training in Block-II & necessary arrangement to be made to cover training on rest skill sets (beyond the percentage indicated in sl-6) in collaboration with any other related industries. (The same will be part of guidelines in MOU)

TRADE: REFRIGERATION AND AIR-CONDITIONING (Dual mode)

LIST OF TOOLS & EQUIPMENT FOR 20 TRAINEES

A. TRAINEES TOOL KIT FOR 20 TRAINEES +1 INSTRUCTOR

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

22.	Surface plate	45 x45 cms	1no.
23.	Oil can	500 ml	5 nos.
24.	Surface Gauge universal	150 mm	5 nos.
25.	Bench vice	300mm jaw	10 nos.
26.	Hack saw tubular metal frame adjustable	300mm	10 nos.
27.	Snip sheet metal straight nose	200 mm	10 nos.
28.	Snip sheet metal curved nose	200 mm	10 nos.
29.	Anvil	100X200mm	1no.
30.	Stakes [different Types]	100mm	1 no each
31.	Tin smith	400mm	1 No.
32.	Wooden mallet /Nylon mallet	500 gm good finish	5 Nos.
33.	Round Punch	3mm,4mm,6mm	5 Nos. each
34.	Grover set	4mm forming	1 set
35.	Electrical drill portable drill with chuck and key,	capacity 6.4mm	5 nos.
36.	Tape measuring graduation in mm	2 m	5nos.
37.	Screw driver, plastic handle,	6mm TIP length 100mm to 150mm	6nos.
38.	Screw driver, plastic handle, Flat tip	10mm TIP length 200mm & 250mm	6 nos. each
39.	Philips screw driver -	complete set in leather case	5 nos.
40.	Screw driver, plastic handle, Flat tip	handle 3mm TIP length 100mm to 150mm insulated	5 nos.
41.	Soldering iron exchangeable copper tip	65 watts	10 nos.
42.	Knife folded stainless steel -	150mm	10 nos.
43.	Tong tester (clamp on multi meter)	0-10-30 amps 0-500 v	5 nos.
44.	Voltmeter, AC/DC portable precision grade Digital Panel board type	0 to 500 volt	5nos.
45.	Ammeter, AC/DC portable precision grade Digital Panel board type	0 to 30 amp	5nos.
46.	Megger	1000v	5nos.
47.	Wattmeter multi-range upto	1 KW	1no.
48.	Multi meter digital type		5nos.
49.	Tenon saw	250 mm	5nos.
50.	Firmer chisel	6,12,25mm	2 nos.
51.	Rawal plug tool	6 mm	2 nos.
52.	K.W. meter	0 -1 K w	4 no.
53.	Fire extinguisher	ABC dry powder type2 kg capacity	1 no.
54.	Fire buckets	10 Litre	1 no.
55.	D.E spanner	6-32 mm	5 set
56.	Ring spanner	6 -32 mm	5 set
57.	Diagonal cutter	15 cm	5 nos.
58.	Service Oscillator		1 no.
59.	C.R.O Single beam	5 MHZ	2 nos.

60.	C.R.O Dual trace/ Double beam	60 MHZ	2 nos.
61.	A.F.O Oscillators		2 nos.
62.	Tong Close mouth and pick		1 no.
63.	Welding table for gas/Arc	1200x760	1each
64.	Flaring tool set, single type for tube.	4.7mm to 16mm O.D	5 nos.
65.	Swaging tool, punch type, set of size for tube.	4.7mm to 16mm O.D	5sets
66.	Swaging tool, screw type with adaptor set of size for tube	4.7mm to 16mm O.D.	5sets
67.	Bending spring external type, for copper tube	3mm to 16mm DIA	5sets
68.	Pipe cutter miniature for copper tube	3mm to 16mm DIA	5sets
69.	Pinch of tool, for copper tube,	6mm to 18mm DIA	5sets
70.	Ratchet spanner of	6.4 sq.mm reversible	5sets
71.	Capillary plug gauge		5sets
72.	Piercing pliers & reversing valve with access fitting	6-18mm	5sets
73.	Spanner double ended	4.7mm to 16mm	5sets
74.	Ring spanner off set	4.7mm to 16mm	5sets
75.	Wrench adjustable	length 150mm	5sets
76.	Wrench adjustable	length 200mm	5sets
77.	Wrench adjustable	length 250mm	5sets
78.	Valve key handle[Treated as consumable]	- 4.7mm & 6.4mm sq.	5sets
79.	Pressure gauge Digital type	diameter 63mm with recalibration set	5sets
80.	Compound gauge, Digital type	diameter 63mm, with recalibration set screw, scale vacuum 76mm. Pressure 15 Kg/sq.cm	5sets
81.	Service man thermometer in metal case	- 30 C to +30 C	5sets
82.	Scissor, gasket cutting stainless steel	length 25mm	5sets
83.	L-Allen key	set size 1.5mm to 6.4mm	5 sets
84.	T-Allen key set	size 5/32" to 1/8"	5sets
85.	Pipe cutter with built in reamer and space cutter, for copper tube	3mm to 32mm	5nos.
86.	Pipe /Tube bender lever type	3-16 mm	1 no each
87.	Spanner double ended	19mm to 31.8 mm	5nos.
88.	Pipe wrench	size 50mm to 150mm	5nos.
89.	Gas leak detector for halogen gas		5nos.
90.	Sling psychro meter mounted on aluminum back,	scale 50 C to +50 C	5nos.
91.	Lapping plate	250mm x 200mm	2nos.
92.	Hammer ball peen	450 gms	5nos.
93.	Puller 3 legged with flexible arm	300mm	5nos.
94.	Hand blower portable complete	1/10 HP	2nos.
95.	Spirit level precision metallic	200mm	2nos.

96.	Stop watch		2nos.
97.	Tap set with matching drills	3 mm to 16mm	3nos.
98.	Tap set with matching drills	V to 5/8"	3nos.
99.	Refrigerant cylinder	2.5 Kg	3nos.
100.	Vernier caliper	length 250mm	2nos.
101.	Micrometer outside measurement	0 to 25mm	2nos.
102.	Heating kit with infrared bulb	(200 w capacity)	2nos.
103.	Plumbing hammer weight	200 gm	2nos.
104.	Multi meter analogue type		5nos.
105.	Tachometer digital, multi range	0 r m p to 3000 r m p. Portable small size in leather case	2nos.
106.	Micron vacuum gauge	capable of reading up to 20 microns	2nos.
107.	Sensor thermometer	-50 degree Celsius	
	(digital)	to 150 degree Celsius	2nos.
108.	Fin straightener/fin comb.	With strong steel wire based combing on wood	3nos.
109.	Filler gauge	0.05 mm - 1 mm	3nos.
110.	Wire gauge metric and with worth	Steel plate embossing converse of British & Metric	2nos.
111.	Dial thermometer remote control, armored capillary dial	75mm - 50C to +50 C	3nos.
112.	Anemometer	Digital type	1no.
113.	Compressor testers for	Fixed with electrical	
114.	Small hermetic compressors	input/ output indicating facilities	2nos.
115.	Engineers square	150mm with 5' tolerance	5nos.
116.	Digital thermometer [Treated as consumable]	Graduated disc analogy type	1no.
117.	Temperature & Humidity recorder	Capacity to record 24 hrs record	1no.
118.	Instrumentation screw driver set	100mm	5nos.
119.	Digital weighing machine	100 kg	1no.
120.	Cylinder 134 a	5 kg	1 no.

B. General Machinery Shop Outfit:

Sl. No	Name of Equipment	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 a) Rotary two stage vacuum pump and motor (with gas ballast and anti such back) b) manifold with gauges and valves and capable of pulling vacuum up to 50 microns of Hg and with provision of connecting to a microns level vacuum gauge b)Graduated charging cylinder with provision for temperature correction and all necessary isolating valves II) Evacuating and charging station as above but fitted with weighing scale	(CAP. 2 kg. In lieu of (b) above and with accuracy of g for charging hydrocarbons)	1 no. 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 2 ton 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.	Cassette Air conditioner	4500 kcal/hr	1 no.
24.	De scaling pump set	with stainless steel impeller and housing complete with motor 1/2 hp and accessories	1 no.
25.	Fan coil unit	with water valves (2 & 3 way)	1 no.
26.	Shell and tube, DX chillers (small)	5 Ton with Cu tubing only	1 no.
27.	Circulating water pump (small)	0.5 H.P with stainless steel tank capacity 20 liters within let/ outlet provision.	1 no.
28.	Shell and tube type condenser	5 Ton	1 no.
29.	Rotary hermetic compressor	2 Ton	1 no.
30.	Screw compressor	5Ton	1 no.
31.	Bottle cooler visible	200 L carrying with HFC-134a& reciprocating compressor	1 no.
32.	Deep freezer	200 L carrying with HFC-134a& reciprocating compressor	1 no.
33.	Water cooler storage type	200 L carrying with HFC-134a& reciprocating compressor	1 no.
34.	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.
35.	Air-conditioning, direct and indirect system.	Complete with all controls including humidity control capacity 15000Kcal/hr	1 no.
36.	Package A/C	5 ton capacity, Air cooled type with open type compressor reciprocating type	1 no.
37.	Car A.C components(full)		1 Set
38.	CAR AC tutorial model		1 set

C. WORKSHOP FURNITURE

SL. No.	Name of Furniture	Broad specifications	Quantity
1.	Class room table	One table for each trainee size of 2.5 provisions with open rack. Frame square conduit of 1".top ½" sun mica ply board	10 nos.
2.	Work bench	2000 x1000 x 700 mm with 2" pipe frame. Top with teak slab and fixing with ¾" good quality rubber sheet.	6 nos.
3.	Almirah	195 x90 x 48 cm outer sheet 20 SWG inner partition with four selves of 22Swg	4 nos.
4.	Lockers	195 x 90 x 48 set six locker in one structure	2 nos.
5.	Glass board portable	2.5'X4' with stand	2 nos.
6.	Instructor table	4'X2'X2.5' with steel tubular frame & sun mica top	1 no.
7.	Instructor chair	Standard revolving with wheel	1 no.
8.	Computer table	Standard with drawers & self to accommodate UPS&CPU	1 no.
9.	Computer chair	Revolving type metal based & metal wheel standard one	1 no.
10.	White board	4'X3' ferrous base sheet to hold magnetic duster with white finish surface.	1 no.
11.	Chart stand	6'X3' providing with hanging clip top & bottom plate	1 no.
12.	Computer latest version with printer		1 no.
13.	LCD PROJECTOR / LED / LCD TV	40"	1 no.
14.	Laptop	Latest version	1 no.
15.	UPS	650 VA	1 no
16.	Stool	2' x 1.5'	10 nos
17.	Book Self with glass panel	6' x 3'	1 No.

18.	Storage rack	6' x 3'	2 nos
19.	Storage shelf	6' x 3'	2 nos

D. LIST OF CONSUMABLES.

SL. No.	Name of consumables (As required)	Broad specifications
1.	Copper tube	¼",5/16",3/8",7/16",1/2",5/8"
2.	Capillary tube	0.026 to 0.64"
3.	Flare nut	¼",5/16",3/8",7/16",1/2",5/8"
4.	Straight union	¼",5/16",3/8",7/16",1/2",5/8"
5.	Half union	¼",5/16",3/8",7/16",1/2",5/8"
6.	Elbow	¼",5/16",3/8",7/16",1/2",5/8"
7.	Tee	¼",5/16",3/8",7/16",1/2",5/8"
8.	Brazing rod	Cu to Cu
9.	Brazing flux	Borax
10.	Kerosene	
11.	Diesel	
12.	Cotton waste	
13.	Baniyan waste	
14.	Nitrogen	
15.	L p g brazing kit	
16.	Lapping paste	Hard and Soft
17.	Refrigeration oil	Capilla - D- Oil
18.	Charging line	500 psi
19.	Carbide	
20.	Door switch	5 amps
21.	Refrigerator Bulb	15 watts
22.	Box type relay	1/6, 1/8 Hp
23.	Open type relay	1/6, 1/8 Hp
24.	Thermal relay	1/6, 1/8 Hp
25.	O L P	1/6, 1/8 Hp
26.	Thermostat	-15degree Centigrade
27.	Door Gasket	15 mm
28.	Drier	D N 50, 150
29.	De frost heater	
30.	Defrost timer	4 -6 Hr
31.	Bimetal thermo	
32.	Wiring leg	5 mm
33.	Hand shut off valve	¼ "
34.	Solenoid valve	230 V, ¼ "
35.	L P Cut out	40 psi
36.	H P Cut out	240 psi
37.	Oil pressure cut out	40 psi
38.	Tread seal	10 mm
39.	Starting capacitor	60-80 Mfd
40.	Running capacitor	40 Mfd
41.	Fan Capacitor	4 mfd
42.	Flexible Wire	1.5 mm

43.	Freon gas	12
44.	Freon gas	22
45.	HFC	134 a
46.	Match box	
47.	Washing soap	
48.	Incandescent lamp	500 W
49.	Cell	12 V
50.	L.M.S relay	¼, 1/6, 1/8 HP
51.	Sand paper	
52.	Stove pin	
53.	Epoxy compound/ M seal	
54.	Gloves for welding[Treated as consumable]	
55.	Leather Apron [Treated as consumable]	

Note: -

- 1. Consumables may procure according to skills requirements.**
- 2. Specification may change depends upon availability of market.**
- 3. Quantity depends up on number of trainees**

Format for Internal Assessment

Name & Address of the Assessor :						Year of Enrollment :								
Name & Address of ITI (Govt./Pvt.) :						Date of Assessment :								
Name & Address of the Industry :						Assessment location: Industry / ITI								
Trade Name :			Block:			Duration of the Trade/course:								
Operation/Skill:														
Sl. No	Maximum Marks (Total 100 Marks)		15	5	10	5	10	10	5	10	15	15	Total internal assessment Marks	Result (Y/N)
	Candidate Name	Father's/ Mother's Name	Safety consciousness	Workplace hygiene	Attendance/ Punctuality	Ability to follow Manuals/ Written instructions	Application of Knowledge	Skills to handle tools & equipment	Economical use of materials	Speed in doing work	Quality in workmanship	VIVA		
1														
2														

LIST OF TRADE COMMITTEE MEMBERS

Sl. No.	Name & Designation	Organization	Remarks
1.	R. K. Pathak, Director (T)	DGT, MSDE, New Delhi	Chairman
2.	L. K. Mukherjee, DDT	CSTARI, Kolkata	Member
3.	R. N. Manna, Training Officer	CSTARI, Kolkata	Member
4.	Amar G. Prabhu, Principale	Don Bosco ITI, Kurla	Member
5.	Sarang Ghanwat, Asst. Manager	Godrej & Boyce, Mumbai	Member
6.	Narendra Nimbalkar, Retired	Godrej & Boyce, Mumbai	Member
7.	Donald Martis, Asst. Manager	Daikin, Mumbai	Member
8.	Nitin G. Patil, Proprietor	Chill-n-Cool, Mumbai	Member
9.	Ramesh N. Director (Customer Service)	ACME Ref. Mumbai	Member
10.	Sanjay M. Kudun, Customer Care	ACME Ref. Mumbai	Member
11.	Sanjay Vedah, Associate Chief Manager	Godrej & Boyce, Mumbai	Member