

REFRIGERATION AND AIR CONDITIONING MECHANIC

COMPETENCY BASED CURRICULUM

(Duration: 2 Yrs.)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL- 5



SECTOR – SERVICES INCLUDING REPAIR AND MAINTENANCE



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

REFRIGERATION AND AIR CONDITIONING MECHANIC

(Revised in 2018)

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NSQF LEVEL - 5

Skill India
कौशल भारत - कुशल भारत

Developed By

Ministry of Skill Development and Entrepreneurship
Directorate General of Training

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1. 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.



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2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under aegis of National Council of Vocational Training (NCVT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programmes of NCVT for propagating vocational training.

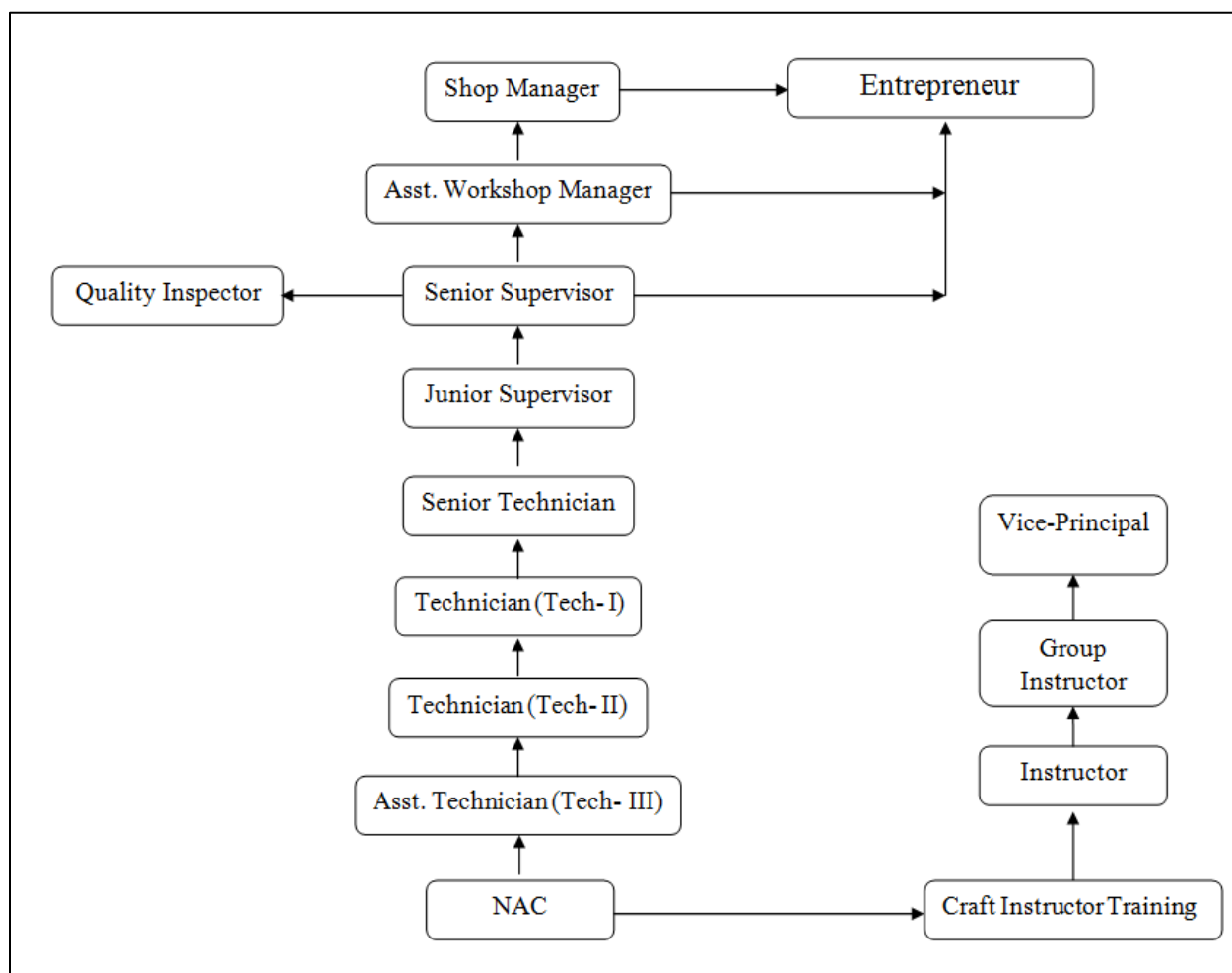
Refrigeration and Air Conditioning Mechanic trade under ATS is one of the most popular courses delivered nationwide through different industries. The course is of two years (02 Blocks) duration. It mainly consists of Domain area and Core area. In the Domain area Trade Theory & Practical impart professional - skills and knowledge, while Core area - Workshop Calculation and science, Engineering Drawing and Employability Skills imparts requisite core skills & knowledge and life skills. After passing out the training programme, the trainee is being awarded National Apprenticeship Certificate (NAC) by NCVT having worldwide recognition.

Broadly candidates need to demonstrate that they are able to:

- Read & interpret technical parameters/document, plan and organize work processes, identify necessary materials and tools in Refrigeration and Air-conditioning.
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations regarding with handling of gas, pressure testing and electrical works.
- Apply professional skill, knowledge, core skills & employability skills while performing jobs and solve problem during execution.
- Check the job/assembly as per drawing for functioning, identify and rectify errors in job/assembly.
- Document the technical parameters related to the task undertaken in Refrigeration and Air-conditioning.

2.2 CAREER PROGRESSION PATHWAYS:

- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Indicative pathways for vertical mobility.



2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two years (*Basic Training and On-Job Training*): -

Total 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

Refrigeration & Air-conditioning Mechanic

A. Basic Training

For 02 yrs. Engg. Course :- (Total 06 months: 03 months in 1st yr. + 03 months in 2nd yr.)

For 01 yr. Engg. course :- (Total 03 months: 03 months in 1st yr.)

Sl. No.	Course Element	Total Notional Training Hours	
		For 02 yrs. course	For 01 yr. course
1	Professional Skill (Trade Practical)	550	275
2	Professional Knowledge (Trade Theory)	240	120
3	Workshop Calculation & Science	40	20
4	Engineering Drawing	60	30
5	Employability Skills	110	55
	Total (including Internal Assessment)	1000	500

B. On-Job Training:-

For 02 yrs. Engg. Course :- (Total 18 months: 09 months in 1st yr. + 09 months in 2nd yr.)

Notional Training Hours for On-Job Training: 3120 Hrs.

For 01 yr. Engg. course :- (Total 12 months)

Notional Training Hours for On-Job Training: 2080 Hrs.

C. Total training hours:-

Duration	Basic Training	On-Job Training	Total
For 02 Engg. yrs. course	1000 hrs.	3120 hrs.	4120 hrs.
For 01 yr. Engg. course	500 hrs.	2080 hrs.	2580 hrs.

2.4 ASSESSMENT & CERTIFICATION:

The trainee will be tested for his skill, knowledge and attitude during the period of course and at the end of the training programme as notified by Govt of India from time to time. The Employability skills will be tested in first two semesters only.

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a) The **Internal assessment** during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline (section-2.4.2). The marks of internal assessment will be as per the template (Annexure – II).

b) The final assessment will be in the form of summative assessment method. The All India Trade Test for awarding NAC will be conducted by NCVT on completion of course as per guideline of Govt of India. The pattern and marking structure is being notified by govt of India from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check individual trainee's profile as detailed in assessment guideline (section-2.4.2) before giving marks for practical examination.**

2.4.1 PASS REGULATION

The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects 40%. The candidate pass in each subject conducted under all India trade test.

2.4.2 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 should be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitivity to environment and regularity in training. The sensitivity towards OSH and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work

Evidences of internal assessments are to be preserved until forthcoming semester examination for audit and verification by examination body. The following marking pattern to be adopted while assessing:

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Performance Level	Evidence
(a) Weightage in the range of 60 -75% to be allotted during assessment	
For performance in 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.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • Below 70% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • 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	
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.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • 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	
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.	• High skill levels in the use of hand tools, machine tools and workshop equipment • Above 80% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/ job/set standards. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

Brief description of Job roles:

Mechanic, Refrigeration and Air Conditioning

Refrigeration and Air Conditioning Mechanic Unit installs and repairs refrigeration or air conditioning plant by replacing defective parts, re-seating valves, refitting coils, insulting, requiring electrical connections, soldering etc. Installs at site assembled air conditioning unit and refrigerators giving necessary power connections and making changes to units as necessary to attain desired results. Examines faulty equipment to ascertain nature and location of defects. Dismantles equipment partly or completely according to nature of defects to remove damaged or worn out parts. Replaces or repairs defective parts. Replaces or repairs defective parts to units by re-seating valves, refitting coils, re-insulating system, etc. over hauls units and reassembles them after cleaning components and replacing defective or worn out parts of pumps, compressors, motors, etc., Removes faulty sealed units or sub-units of refrigerators or air conditioning plants and obtains replacements. Conducts vacuum and pressure test of pipe lines and charges system with fresh refrigerant. Sets plant to desired cooling conditions, prevents leakage and ensures attainment and maintenance of required temperature. Gets burnt out motors or generators repaired by Electrician or Electrical Winder and installs repaired ones to plant giving necessary electrical connections. May work in ice factory, cold storage plants, specialized air conditioning units or domestic refrigerators.

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

Reference NCO: 7127.0100 - Mechanic, Refrigeration and Air Conditioning

4. NSQF LEVEL COMPLIANCE

NSQF level for Refrigeration and Air Conditioning Mechanic trade under ATS: **Level 5**

As per notification issued by Govt. of India dated- 27.12.2013 on National Skill Qualification Framework total 10 (Ten) Levels are defined.

Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

- a. Process
- b. Professional Knowledge,
- c. Professional Skill,
- d. Core Skill and
- e. Responsibility.



The Broad Learning outcome of Mechanic Refrigeration & Air Conditioning trade under ATS mostly matches with the Level descriptor at Level- 5.

The NSQF level-5 descriptor is given below:

Level	Process Required	Professional Knowledge	Professional Skill	Core Skill	Responsibility
Level 5	Job that requires well developed skill, with clear choice of procedures in familiar context.	knowledge of facts, principles, processes and general concepts, in a field of work or study	a range of cognitive and practical skills required to accomplish tasks and solve problem by selecting and applying basic methods, tools, materials and information.	Desired mathematical skill, understanding of social, political and some skill of collecting and organizing information, communication .	Responsibility for own work and Learning and some responsibility for other's works and learning.

5. GENERAL INFORMATION

Name of the Trade	MECHANIC REFRIGERATION & AIR CONDITIONING
NCO-2015	7127.0100
NSQF Level	Level – 5
Duration of Apprenticeship Training (Basic Training + On-Job Training)	Two years (02 Blocks each of one year duration).
Duration of Basic Training	a) Block –I : 3 months b) Block – II : 3 months Total duration of Basic Training: 6 months
Duration of On-Job Training	a) Block–I: 9 months b) Block–II : 9 months Total duration of Practical Training: 18 months
Entry Qualification	Passed 10 th Class under 10+2 system of Education or its equivalent
Selection of Apprentices	The apprentices will be selected as per Apprenticeship Act amended time to time.
Instructors Qualification for Basic Training	As per ITI instructors qualifications as amended time to time for the specific trade.
Infrastructure for Basic Training	As per related trade of ITI.
Examination	The internal examination/ assessment will be held on completion of each block. Final examination for all subjects will be held at the end of course and same will be conducted by NCVT.
Rebate to Ex-ITI Trainees	01 year
CTS trades eligible for MRAC Apprenticeship	1. 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.
- For imparting Basic Training the industry to tie-up with ITIs having such specific trade and affiliated to NCVT.

6. LEARNING OUTCOME

6.1 GENERIC LEARNING OUTCOME

The following are minimum broad Common Occupational Skills/ Generic Learning Outcome after completion of the Refrigeration and Air Conditioning Mechanic course of 02 years duration under ATS.

Block I & II:-

1. Recognize & comply safe working practices, environment regulation and housekeeping.
2. Understand and explain different mathematical calculation & science in the field of study including basic electrical. *[Different mathematical calculation & science –Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure]*
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol]*
4. Select and ascertain measuring instrument and measure dimension of components and record data.
5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.
6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.
8. Plan and organize the work related to the occupation.

6.2 SPECIFIC LEARNING OUTCOME

Block – I

1. Identify RAC tools, instruments and equipments and care and maintenance.
2. Identify and operations of hand tools and power tools used in fittings, able to do fitting job i.e. sawing, filing, drilling, taping and dieing, counter sinking and boring. E
3. Identify and handling of sheet metal tools and equipments, Sheet metal cutting, bending, riveting and soldering, making duct.
4. Aware of electrical safety and different wire joints. Able to measure current, volts, power, and earth resistance etc. Able to make single phase connection of motors.

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5. Able to identify the terminals of sealed compressor and their windings and use of DOL starter with different types of motors, testing and connection of relays used in sealed motors.
6. Identify the electronic components and their testing of resistors, transistor, capacitor, diode, amplifier, I.C and PCB and able to work soldering and de soldering.
7. Construction of half wave and full wave rectifiers.
8. Aware of gas and Arc welding and safety. Able to do brazing, welding (Gas & Arc).
9. Identify RAC tools and equipments and familiarize with different parts of RAC system. Able to do copper tube cutting, flaring, swaging, bending, pinching and brazing.
10. Identify refrigerant and its safety. Able to do leak test, vacuuming, gas charging, wiring & installation of refrigerator.
11. Able to do door alignment. Door gasket fitting, replacing door gasket.
12. Test compressor motor terminal, start compressor Direct with relay & without relay, technique of flushing, leak testing, replacing capillary & filter drier, evacuation & gas charging.
13. Familiarizing with frost free refrigerator, checking electrical components, wiring of frost free freeze & air distribution in refrigerator sector. Leak detection, evacuators & gas charging.
14. Check and repair the electrical wiring system of window Air Conditioner.
15. Installation, service and maintenance of window A.C
16. Leak test, evacuation, gas charging and performance testing of window A.C.
17. Check and repair the electrical wiring system of Split Air Conditioner.(Duct and Multi)
18. Installation, service and maintenance of Split A.C (Duct and Multi)
19. Leak test, evacuation, gas charging and performance testing of window A.C.

Block – II

20. Able to dismantle and assembling of hermetic compressor & test performance.
21. Selection of hermetic compressor for different appliances, starting methods, testing controls & safety cut out used in sealed compressor.
22. Servicing & de-scaling of Condenser used in different appliances (internals & externals)
23. Fitting & adjustment of drier, filter & refrigerant control used in different refrigeration system.
24. Servicing of different evaporator used in different appliances.
25. Recovery and Recycling of Refrigerant used, alternative of CFC, HFC re-cover, transfer & handling of gas cylinders.
26. Retrofit CFC/HFC machine with ozone friendly refrigerant.
27. Packing thermal insulation material and prevent cooling leakage.
28. Servicing and preventive maintenance of walk in cooler & Reach in cabinet.

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- 29. Servicing and preventive maintenance of cold storage.
- 30. Fault diagnosis, servicing, leak test, evacuation, gas charging, check magnetic clutch and wiring of Car A.C. Test performance.
- 31. Servicing, dismantling, checking different part, re-placing worn out parts, check lubrication system, Assemble & check performance of commercial compressors.
- 32. Servicing of water cooled condensers.
- 33. Servicing of cooling tower and performance test.
- 34. Service and maintenance of Ice plant/Candy.

NOTE: Learning outcomes are reflection of total competencies of a trainee and assessment will be carried out as per assessment criteria.



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7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING OUTCOME	
LEARNING OUTCOMES	ASSESSMENT CRITERIA
1. Recognize & comply safe working practices, environment regulation and housekeeping.	1. 1. Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
	1. 2. Recognize and report all unsafe situations according to site policy.
	1. 3. Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
	1. 4. Identify, handle and store / dispose off dangerous/unsalvageable goods and substances according to site policy and procedures following safety regulations and requirements.
	1. 5. Identify and observe site policies and procedures in regard to illness or accident.
	1. 6. Identify safety alarms accurately.
	1. 7. Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to site accident/injury procedures.
	1. 8. Identify and observe site evacuation procedures according to site policy.
	1. 9. Identify Personal Protective Equipment (PPE) and use the same as per related working environment.
	1. 10. Identify basic first aid and use them under different circumstances.
	1. 11. Identify different fire extinguisher and use the same as per requirement.
	1. 12. Identify environmental pollution & contribute to avoidance of same.
	1. 13. Take opportunities to use energy and materials in an environmentally friendly manner
	1. 14. Avoid waste and dispose waste as per procedure
	1. 15. Recognize different components of 5S and apply the same in the working environment.
2. Understand, explain different mathematical calculation & science in the field of study including basic	2.1 Explain concept of basic science related to the field such as Material science, Mass, weight, density, speed, velocity, heat & temperature, force, motion, pressure, heat treatment, centre of gravity, friction.

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electrical and Apply in day to day work.[<i>Different mathematical calculation & science –Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure</i>]	2.2	Measure dimensions as per drawing
	2.3	Use scale/ tapes to measure for fitting to specification.
	2.4	Comply given tolerance.
	2.5	Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.
	2.6	Ensure dimensional accuracy of assembly by using different instruments/gauges.
	2.7	Explain basic electricity, insulation & earthing.
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. [<i>Different engineering drawing- Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol</i>]	3.1.	Read & interpret the information on drawings and apply in executing practical work.
	3.2.	Read & analyse the specification to ascertain the material requirement, tools, and machining /assembly /maintenance parameters.
	3.3.	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
4. Select and ascertain measuring instrument and measure dimension of components and record data.	4.1	Select appropriate measuring instruments such as micrometers, vernier callipers, dial gauge, bevel protector and height gauge (as per tool list).
	4.2	Ascertain the functionality & correctness of the instrument.
	4.3	Measure dimension of the components & record data to analyse the with given drawing/measurement.
5. Explain the concept in productivity, quality tools,	5.1	Explain the concept of productivity and quality tools and apply during execution of job.

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and labour welfare legislation and apply such in day to day work to improve productivity & quality.	5.2 Understand the basic concept of labour welfare legislation and adhere to responsibilities and remain sensitive towards such laws.
	5.3 Knows benefits guaranteed under various acts
6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using Available resources.	6.1 Explain the concept of energy conservation, global warming, pollution and utilize the available resources optimally & remain sensitive to avoid environment pollution.
	6.2 Dispose waste following standard procedure.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	7. 1. Explain personnel finance and entrepreneurship.
	7. 2. Explain 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.
	7. 3. Prepare Project report to become an entrepreneur for submission to financial institutions.
8. Plan and organize the work related to the occupation.	8. 1. Use documents, drawings and recognize hazards in the work site.
	8. 2. Plan workplace/ assembly location with due consideration to operational stipulation
	8. 3. Communicate effectively with others and plan project tasks
	8. 4. Assign roles and responsibilities of the co-trainees for execution of the task effectively and monitor the same.
SPECIFIC OUTCOME	
<u>Block-I & II (Section:10)</u>	
<i>Assessment Criteria i.e. the standard of performance, for each specific learning outcome mentioned under block – I & block – II(section: 10) must ensure that the trainee achieves well developed skill with clear choice of procedure in familiar context. Assessment criteria should broadly cover the aspect of Planning (Identify, ascertain, estimate etc.); Execution (perform, illustration, demonstration etc. by applying 1) a range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information 2) Knowledge of facts, principles, processes, and general concepts, in a field of work or study 3)Desired Mathematical Skills and some skill of collecting and organizing information, communication) and Checking/ Testing to ensure functionality during the assessment of each outcome. The assessments parameters must also ascertain that the candidate is responsible for own work and learning and some responsibility for other's work and learning.</i>	

BASIC TRAINING (Block – I)
Duration: (03) Three Months

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
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	<u>FITTING</u> - 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.	<u>FITTING</u> 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	<u>SHEET METAL</u> - 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.	<u>SHEET METAL</u> 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	<u>ELECTRICAL</u> - Use of electrical hand tools Instruments. - Joints on single and stranded	<u>ELECTRICAL</u> Electrical hand tools & measuring instruments, types, specifications, use, care and safety. Common terms used in the trade. Conductors and insulators.

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	conductors and soldering.	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 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.	Introduction to Electricity, 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, 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
6	<u>ELECTRONICS</u> • 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,	<u>ELECTRONICS</u> 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. SCR Photo diodes, photo transistors, multi – vibrator, CR & LR circuit. SCRs, UJTs, Ics.

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	soldering, de-soldering practice	
7	<u>WELDING</u> • 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) O₂-LPG c) Oxy Acetylene plant with safety. C) O₂-C₂H₂. 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.	<u>WELDING</u> Introduction to basic principles of commonly used Welding processes, Arc welding, oxy fuel gas welding, brazing. 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. • 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 and evaporator etc • Working on soft copper tubing like, cutting, bending, flaring, swaging, brazing cu to cu and cu to steel, pinching & preparing flare joints. REFRIGERANT • Identification of refrigerant cylinders. • Identification of unknown refrigerants, Recovery & Transfer of refrigerant, safe handling Cylinders and Valves, Leak testing, Evacuation, Charging refrigerants in Refrigerator.	BASIC REFRIGERATION 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 functions and applications of components. REFRIGERANT Classification of refrigerants, Properties, Chemical name and formulas, HFC, CFC. Ozone rule, substitute of CFC, Montreal protocol & India's CFC/HCFE phase out schedules. Ozone rules 2000. Substitute refrigerants in lieu of CFC'S their properties & comparison with CFCs, HFCs and HCs.

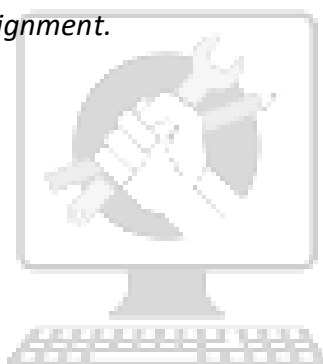
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9	REFRIGERATOR (SINGLE DOOR) • Direct cooled Domestic Refrigerator stripping accessories & cleaning, Checking Door alignment & replacing of gaskets. Tracing the electrical and mechanical components of sealed refrigerator. • Testing Thermostats & semi-automatic 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) 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 : • 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 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 • Identify the electrical and mechanical components, servicing and maintenance, tracing wiring circuit, evacuation, leak testing, gas charging.	WINDOW AIR CONDITIONER 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.

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12	SPLIT A.C (Duct)& MULTI SPLIT A.C Identifying various components, electrical circuits, testing components, evacuation, gas charging, Installation.	SPLIT A.C (Duct) & 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. VRV & VRF system.
13	Internal Assessment/Examination 03days	

NOTE: - More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of related industry operations may be shown to the trainees to give a feel of Industry and their future assignment.



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BASIC TRAINING (Block – II)

Duration: (03) Three Months

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1	COMPRESSOR • 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 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 • 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, calculating Capacity of air cooled Condenser. Effect of choked condenser. Advantages, decaling air cooled condenser.
3	EVAPORATOR • Identification 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.
4	EXPANSION VALVE AND DRIER • Replacing drier, capillary tube, in refrigerator and window AC.	EXPANSION VALVE AND DRIER Function of drier & Expansion valve used in domestic refrigeration and air conditioning systems. Capillaries, Automatic and Thermostatic Ex. Valves.

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5	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.
6	WALK IN COOLER & REACH IN CABINET Identify parts, Controls & accessories Specification of Walk in cooler & Reach in cabinet preventive maintenance of attach components, wiring circuit. Cleaning, leak testing, Evacuation, charging.	WALK IN COOLER & REACH IN CABINET Details about components, their functioning, working principle, Circuit diagram, capacity & types. Care and maintenance.
7	COLD STORAGE - Identify parts, Controls & accessories of Cold storage and Specification understanding. - Add oil, add refrigerant, test leak, evacuation, gas charging, plant operation.	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.
8	CAR AIR CONDITIONING 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 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 Dismantling of Commercial type reciprocating compressor, centrifugal compressor, checking of components &	COMMERCIAL COMPRESSOR Types, Construction & applications of Open type compressor and working, Performance of reciprocating

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	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.	compressor volumetric efficiency, Capacity control, factor influencing volumetric efficiency. 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 • Checking leakage, De Scaling of condenser. • Checking, repairing and testing, Pump down of gas.	WATER COOLED CONDENSER& Evaporator 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 • 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 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 • Identify parts, Controls & accessories Specification, Checking ice candy plant	ICE PLANT/ CANDY Function, construction, working principle, Circuit diagram, capacity & types of compressor used. Brine

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	temperature maintaining. • Preparing Brine solution, Checking wiring circuit, test components, replacing components, evacuation, gas charging, Installation, testing performance.	composition to maintain required temperature. Operation, maintenance.
13	Internal Assessment/Examination 03days	

NOTE: - More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of related industry operations may be shown to the trainees to give a feel of Industry and their future assignment.



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9. SYLLABUS - CORE SKILLS

9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERING DRAWING

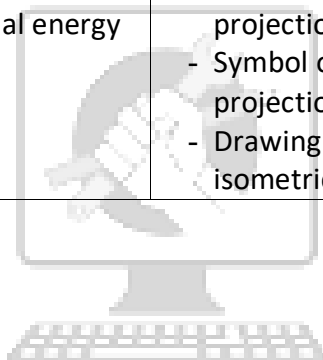
Block – I		
Sl. No.	Workshop Calculation and Science (Duration: - 20 hrs.)	Engineering Drawing (Duration : - 30 hrs.)
1.	Unit: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units	Engineering Drawing: Introduction and its importance - Viewing of engineering drawing sheets. - Method of Folding of printed Drawing Sheet as per BIS SP:46-2003
2.	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.	Drawing Instruments : their uses Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.
3.	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.	Lines : - 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.	Average: Problems of Average.	Drawing of Geometrical Figures: Drawing practice on: - Angle: Measurement and its types, method of bisecting. - Triangle –different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.

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5.	<u>Ratio & Proportion</u> : Simple calculation on related problems.	<u>Dimensioning:</u> - Definition, types and methods of dimensioning (functional, non-functional and auxiliary) - Types of arrowhead - Leader Line with text
6.	<u>Mass, Weight and Density:</u> Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density.	<u>Free hand drawing of</u> - Lines, polygons, ellipse, etc. - geometrical figures and blocks with dimension - Transferring measurement from the given object to the free hand sketches.
7.	<u>Percentage:</u> Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa. - Forces definition. - Definition and example of compressive, tensile, shear forces, axial and tangential forces. Stress, strain, ultimate strength, factor of safety for MS.	<u>Method of presentation of Engineering Drawing</u> - Pictorial View - Orthogonal View - Isometric view
8.	<u>Speed and Velocity:</u> Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation.	<u>Symbolic Representation (as per BIS SP:46-2003) of :</u> - Fastener (Rivets, Bolts and Nuts) - Bars and profile sections - Weld, brazed and soldered joints. - Electrical and electronics element - Piping joints and fittings
9.	<u>Mensuration:</u> Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle. Volume of solids – cube, cuboids, cylinder and Sphere. Surface area of solids – cube, cuboids, cylinder and Sphere. - Area of cut-out regular surfaces: circle and segment and sector of circle. - Volume of cut-out solids: hollow cylinders, frustum of cone, block	<u>Dimensioning practice:</u> - Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003) - Symbols preceding the value of dimension and dimensional tolerance.

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	section. - Volume of simple solid blocks.	
10.	Algebra : Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables). - Circular Motion: Relation between circular motion and Linear motion, Centrifugal force, Centripetal force.	Construction of Geometrical Drawing Figures: - Polygons and their values of included angles. Conic Sections (Ellipse)
11.	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.	Projections: - Concept of axes plane and quadrant. - Orthographic projections - Method of first angle and third angle projections (definition and difference) - Symbol of 1 st angle and 3 rd angle projection as per IS specification. - Drawing of Orthographic projection from isometric/3D view of blocks



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

9.2 EMPLOYABILITY SKILLS**(DURATION: - 110 HRS.)**

Block – I (Duration – 55 hrs.)		
1. English Literacy		Duration : 20 Hrs. Marks : 09
Pronunciation	Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)	
Functional Grammar	Transformation of sentences, Voice change, Change of tense, Spellings.	
Reading	Reading and understanding simple sentences about self, work and environment	
Writing	Construction of simple sentences Writing simple English	
Speaking / Spoken English	Speaking with preparation on self, on family, on friends/ classmates, on know, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Cardinal (fundamental) numbers ordinal numbers. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.	
2. I.T. Literacy		Duration : 20 Hrs. Marks : 09
Basics of Computer	Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.	
Computer Operating System	Basics of Operating System, WINDOWS, The user interface of Windows OS, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc, Use of Common applications.	
Word processing and Worksheet	Basic operating of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & creation of Tables. Printing document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets.	
Computer Networking	Basic of computer Networks (using real life examples), Definitions of	

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and Internet	Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks), Meaning of World Wide Web (WWW), Web Browser, Web Site, Web page and Search Engines. Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites and its implication. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.
3. Communication Skills	
Duration : 15 Hrs. Marks : 07	
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
Block – II	
Duration – 55 hrs.	
4. Entrepreneurship Skills	
Duration : 15 Hrs. Marks : 06	

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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	
Duration : 10 Hrs. Marks : 05	
Benefits	Personal / Workman - Incentive, Production linked Bonus, Improvement in living standard.
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	
Duration : 15 Hrs. Marks : 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

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	measures.
First Aid	Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person.
Basic Provisions	Idea of basic provision legislation of India. 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	
Duration : 05 Hrs. Marks : 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.
8. Quality Tools	
Duration : 10 Hrs. Marks : 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.

10. DETAILS OF COMPETENCIES (ON-JOB TRAINING)

BROAD LEARNING TO BE COVERED IN INDUSTRY FOR RAC TRADE:

1. Safety and best practices /Basic Industrial Culture (5S, KAIZEN, etc.)
2. Record keeping and documentation.
3. Testing components, observing different faults and rectification, and check the performance of refrigeration systems.
4. Assembling of different Refrigeration and Air Conditioning components as per requirement and check functionality.
5. Carryout maintenance of different domestic and commercial Refrigeration and Air conditioning machines.

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

The **competencies/ specific outcomes** on completion of On-Job Training are detailed below: -

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.

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13. Servicing of bottle cooler and visi-cooler, preventive maintenance, and 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. Servicing of Window air-conditioner with water and air (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. Servicing of split air-conditioner with water and air [outer]
25. Recovery of refrigerant, cleaning, flushing, evacuation & charging of split air-conditioner with new eco friendly refrigerants.
26. Fault finding & performance testing of split air-conditioner.
27. Installation of split air-conditioner. [gas top up charging procedure]
28. Trace out electrical wiring , disconnect & rewiring of multi duct type split air-conditioner and VRV / VRF system
29. Servicing of multi duct type Split air conditioner with water and air and VRV / VRF system
30. Pump down refrigerant, cleaning, flushing, evacuation & charging of multi duct type split air-conditioner and VRV /VRF system
31. Fault finding & performance testing of multi duct type split air-conditioner and VRV /VRF system
32. Installation of multi duct type split air-conditioner and VRV /VRF system

Block – II

33. Checking and fitting- shaft seal, bearing of commercial compressor
34. Servicing large air cooled commercially used condenser.
35. Servicing large water cooled commercially used condenser.
36. Servicing large Evaporative commercially used condenser.
37. Servicing Cooling tower- Care and maintenance.
38. Installation of different types of cooling tower.
39. Servicing of Water softening plant- Care and Routine maintenance, checking of water hardness, Ph value.
40. Servicing large air fins cooled commercially used Dx Evaporator.
41. Erection, testing and commissioning of Central air-conditioning plant, Electrical wiring with all electrical accessories including safety cutouts, control panel board microprocessor, transducer, thermistor etc.
42. Servicing of Package air-conditioning system (water cooled condenser)
43. Servicing, overhauling, log book maintenance of central air condition plant.
44. Cold storage plant (Ammonia system) Servicing, overhauling, log book maintenance.
45. Installation of Package air conditioning system, pipe laying, electrical wiring with electrical accessories like all Safety cut outs including control panel board, microprocessor, transducer, thermistor etc.
46. Installation of Walk in cooler. Electrical wiring with all electrical accessories, Safety cut outs, control panel board microprocessor, transducer, thermistor etc.
47. Checking and testing installation of automobile Air Conditioning, magnetic clutch operation, wiring system, leak testing, evacuation and gas charging.

Note:

1. Industry must ensure that above mentioned competencies are achieved by the trainees during their on job training.
2. In addition to above competencies/ outcomes industry may impart additional training relevant to the specific industry.

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

MECHANIC REFRIGERATION & AIRCONDITIONING			
LIST OF TOOLS AND EQUIPMENT for Basic Training (For 20 Apprentices)			
Sl. no.	Name of the Tool & Equipments	Specification	Quantity
A. TRAINEES TOOL KIT			
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]		17 nos.
24	Leather Apron [Treated as consumable]		17 nos.
B : INSTRUMENTS & GENERAL SHOP OUTFIT			
25.	Surface plate	45 x45 cms	1 no.
26.	Oil can	500 ml	5 nos.
27.	Surface Gauge universal	150 mm	5 nos.
28.	Bench vice	300mm jaw	10 nos.
29.	Hack saw tubular metal frame adjustable	300mm	10 nos.

Refrigeration & Air-conditioning Mechanic

30.	Snip sheet metal straight nose	200 mm	10 nos.
31.	Snip sheet metal curved nose	200 mm	10 nos.
32.	Anvil	100X200mm	1no.
33.	Stakes [different Types]	100mm	1 no each
34.	Tin smith	400mm	1 No.
35.	Wooden mallet /Nylon mallet	500 gm good finish	5 Nos.
36.	Round Punch	3mm,4mm,6mm	5 Nos. each
37.	Grover set	4mm forming	1 set
38.	Electrical drill portable drill with chuck and key,	capacity 6.4mm	5 nos.
39.	Tape measuring graduation in mm	2 m	5nos.
40.	Screw driver, plastic handle,	6mm TIP length 100mm to 150mm	6nos.
41.	Screw driver, plastic handle, Flat tip	10mm TIP length 200mm & 250mm	6 nos. each
42.	Philips screw driver –	complete set in leather case	5 nos.
43.	Screw driver, plastic handle, Flat tip	handle 3mm TIP length 100mm to 150mm insulated	5 nos.
44.	Soldering iron exchangeable copper tip	65 watts	10 nos.
45.	Knife folded stainless steel –	150mm	10 nos.
46.	Tong tester (clamp on multi meter)	0-10-30 amps 0-500 v	5 nos.
47.	Voltmeter, AC/DC portable precision grade Digital Panel board type	0 to 500 volt	5nos.
48.	Ammeter, AC/DC portable precision grade Digital Panel board type	belt 0 to 5 amp	5nos.
49.	Ammeter, AC/DC portable precision grade Digital Panel board type	0 to 30 amp	5nos.
50.	Megger	1000v	5nos.
51.	Wattmeter multi-range up to	1 KW	1no.
52.	Multi meter digital type		5nos.
53.	Tenon saw	250 mm	5nos.
54.	Firmer chisel	6,12,25mm	2 nos.
55.	Rawal plug tool	6 mm	2 nos.
56.	K.W. meter	0 -1 K w	4 no.
57.	Fire extinguisher	ABC dry powder type2 kg capacity	1 no.
58.	Fire buckets	10 Litre	1 no.
59.	D.E spanner	6-32 mm	5 set
60.	Ring spanner	6 -32 mm	5 set
61.	Diagonal cutter	15 cm	5 nos.
62.	Service Oscillator		1 no.
63.	C.R.O Single beam	5 MHZ	2 nos.
64.	C.R.O Dual trace/ Double beam	60 MHZ	2 nos.

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

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97.	Hammer ball peen	450 gms	5nos.
98.	Puller 3 legged with flexible arm	300mm	5nos.
99.	Hand blower portable complete	1/10 HP	2nos.
100.	Spirit level precision metallic	200mm	2nos.
101.	Stop watch		2nos.
102.	Tap set with matching drills	3 mm to 16mm	3nos.
103.	Tap set with matching drills	¼" to 5/8"	3nos.
104.	Refrigerant cylinder	2.5 Kg	3nos.
105.	Vernier caliper	length 250mm	2nos.
106.	Micrometer outside measurement	0 to 25mm	2nos.
107.	Heating kit with infrared bulb	(200 w capacity)	2nos.
108.	Plumbing hammer weight	200 gm	2nos.
109.	Multi meter analogue type		5nos.
110.	Tachometer digital, multi range	0 r m p to 3000 r m p. Portable small size in leather case	2nos.
111.	Micron vacuum gauge	capable of reading up to 20 microns	2nos.
112.	Sensor thermometer (digital)	-50 degree Celsius to 150 degree Celsius	2nos.
113.	Fin straightened/fin comb.	With strong steel wire based combing on wood	3nos.
114.	Filler gauge	0.05 mm – 1 mm	3nos.
115.	Wire gauge metric and with worth	Steel plate embossing converse of British & Metric	2nos.
116.	Dial thermometer remote control, armored capillary dial	75mm – 50C to +50 C	3nos.
117.	Anemometer Digital type		1no.
118.	Compressors testers for small hermetic compressors	Fixed with electrical input/output indicating facilities	2nos.
119.	Electrical accessories [Treated as consumable]	current and potential relays, start & run capacitors, PTCs overload protectors', relays contactors	As required
120.	Engineers square	150mm with 5' tolerance	5nos.
121.	Digital thermometer [Treated as consumable]	Graduated disc analogy type	1no.
122.	Temperature & Humidity recorder	Capacity to record 24 hrs record	1no.
123.	Electronic leak detector Digital type	Capable to detect of R134a, HC, R-22	2nos.
124.	Instrumentation screw driver set	100mm	5nos.

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125.	Digital weighing machine	100 kg	1no.
126.	Recycling unit		1 no.
127.	Quick couplers/Self sealing coupler [Treated as consumable]	1/4 - 3/8"	2 pairs for each
128.	Schrader valve [Treated as consumable]		1 each
129.	Cylinder 134 a	5 kg	1 no.
C : GENERAL MACHINERY INSTALLATIONS:-			
130.	Split phase induction motor	¼ hp, 230 V	1 no.
131.	Capacitor start induction motor	½ Hp, 230 V	1 no.
132.	AC 3 Phase motor, 400/50 Hz	2 Hp	1 no.
133.	Star delta starter	2 hp	1 no.
134.	Auto Transformer starter	3 hp	1 no.
135.	D.O.L Starter	2 hp	1 no.
136.	Portable air – LPC brazing kit	2 kg. LPC cylinder, torches, houses, stand make	1 no.
137.	Oxy-acetylene welding set complete	cylinders, regulators welding torches with difference nozzles	1 no.
138.	Refrigerator	165L carrying with HFC-134a, & HC	2 Each
139.	Frost free refrigerator	200L carrying with HC blend	2 nos.
140.	Three/four door refrigerator	300L carrying with HC R-600a	2 nos.
141.	Bench Drilling machine	20 mm capacity, 200-2500rpm	1 no.
142.	Grinding Machine	200mm, 3000rpm, Double ended 1/2 hp	1 no.
143.	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 +/-1 g for charging hydrocarbons)	1 no.
144.	Two stage rotary vacuum pump	capacity approx. 60 – 10rpm	1 no.

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		capable of evacuating to 50 microns of Hg and fitted with gas ballast, anti such back valve and single phase motor	
145.	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.
146.	Reciprocating compressor	Provision of capacity control etc. for demonstration. Capacity 9000Kcal/hr. semi hermetic open type.	1 no.
147.	Dry N2 in cylinder	2 stage regular or commercial N 2 in cylinder with drier unit and 2 stage regular 7meter cube	1 no.
148.	Window A.C	1 Ton with R-22 or HFC Blend reciprocating compressor	2 nos.
149.	Split A.C	1.5 Ton with R134a or R-22 reciprocating compressor	2 nos.
150.	Duct able split A.C 1.5 ton	1.5 Ton with R134a or R-22 reciprocating compressor	1 no.
151.	Recovery unit with cylinders	CFC & 134 a	1 each
152.	Heat pump	3000 Kcal/hr	1 no.
153.	Cassette Air conditioner	4500 kcal/hr with R-404 .	1 no.
154.	De scaling pump set	with stainless steel impeller and housing complete with motor 1/2 hp and accessories	1 no.
155.	Small capacity shell and tube condenser	5 Ton with Cu tubing only	1 no.
156.	Fan coil unit	with water valves (2 & 3 way)	1 no.
157.	Shell and tube, DX chillers (small)	5 Ton with Cu tubing only	1 no.
158.	Circulating water pump (small)	0.5 H.P with stainless steel tank capacity 20 liters with in let/ outlet provision.	1 no.
159.	Shell and tube type condenser	5 Ton	1 no.
160.	Rotary hermetic compressor	2 Ton	1 no.
161.	Screw compressor	5Ton	1 no.

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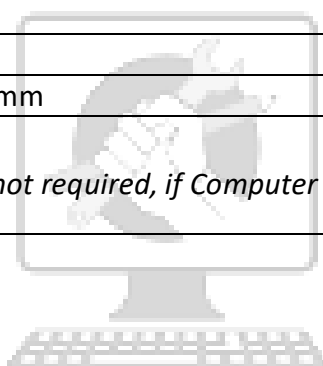
162.	scroll compressor	1Ton	1
163.	Bottle cooler visible	200 L carrying with HFC-134a& reciprocating compressor	1 no.
164.	Deep freezer	200 L carrying with HFC-134a& reciprocating compressor	1 no.
165.	Water cooler storage type	200 L carrying with HFC-134a& reciprocating compressor	1 no.
166.	Ice candy plant	2 ton with capacity to make 32 ice candy at a time with Forma tray, stainless steel tank on trolley	1 no.
167.	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.
168.	Air-conditioning, direct and indirect water chiller.	Complete with all controls including humidity control capacity 15000Kcal/hr	1 no.
169.	Package A/C	7.5 ton capacity, Water cooled type with open type compressor reciprocating type	1 no.
170.	Car A.C components(full kit) a) Wobble plate compressor with mounting brackets. b) Serpentine Evaporator c) Parallel Flow Condenser d) Hoses, tubes, Receiver, Ex. valve. e) Electrical components & wiring Harness		1 Set
171.	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 Refrigeration & Air-conditioning****LIST OF TOOLS& EQUIPMENTS FOR -20APPRENTICES****1) Space Norms : 45 Sq. m.(For Engineering Drawing)****2) Infrastructure:**

A : TRAINEES TOOL KIT:-			
Sl. No.	Name of the items	Specification	Quantity
1.	Draughtsman drawing instrument box		20+1 set
2.	Set square celluloid 45°	(250 X 1.5 mm)	20+1 set
3.	Set square celluloid 30°-60°	(250 X 1.5 mm)	20+1 set
4.	Mini drafter		20+1 set
5.	Drawing board	(700mm x500 mm) IS: 1444	20+1 set
B : Furniture Required			
Sl. No.	Name of the items	Specification	Quantity
1	Drawing Board		20
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

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.
<i>Note: - Above Tools & Equipments not required, if Computer LAB is available in the institute.</i>		



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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 :			Semester:			Duration of the Trade/course:									
Learning Outcome:															
Sl. No	Candidate Name	Father's/Mother's Name	Maximum Marks (Total 100 Marks)	15	5	10	5	10	10	5	10	15	15	Total internal assessment Marks	Result (Y/N)
				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															