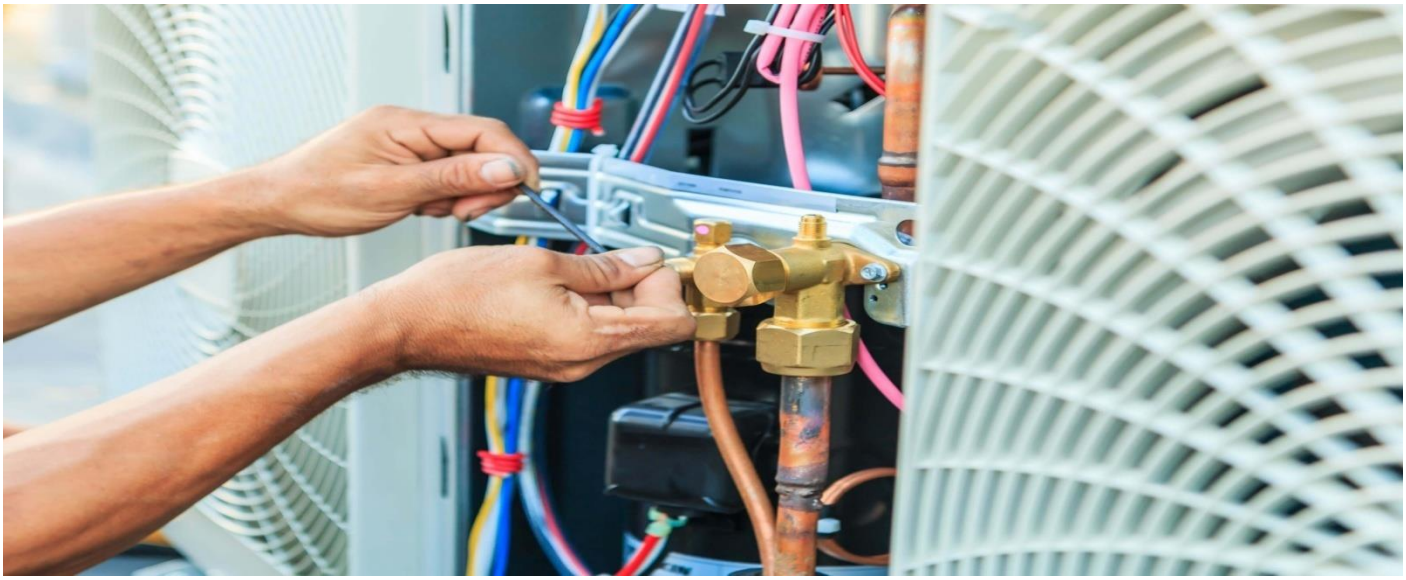
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

REFRIGERATION AND AIR CONDITIONING TECHNICIAN

(Duration: Two Years)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)



NSQF LEVEL- 4

SECTOR – CAPITAL GOODS & MANUFACTURING

Directorate General of Training

REFRIGERATION AND AIR CONDITIONING TECHNICIAN

(Engineering Trade)

(Revised in July 2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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1. COURSE INFORMATION

During two-year duration of "Refrigeration and Air Conditioning Technician" trade a candidate is trained on professional skill, professional knowledge and Employability skill related to job role. In addition to this a candidate is entrusted to undertake project work, extracurricular activities and on job training to build up confidence. The broad components under Professional Skill subject are as below: -

FIRST YEAR: The trainee learns about personal safety and machinery safety, manipulating tools, instruments and equipment in refrigeration workshop. The trainee is able to perform fitting and sheet metal works related to repair refrigeration and air conditioning equipment. The trainee is able to work in electrical area to measure current, voltage, resistance and able to connect star and delta connections. The trainee is able to check and rectify the electrical defects in refrigerators. He will be able to identify the electronic components in refrigerator and rectify the defects. The trainee is able to operate gas welding machines for brazing in refrigeration systems. The trainee shall be able to repair, maintenance, Install, servicing, trouble shooting, fault detection, leak testing and gas charging, diagnosis & remedial measures in Refrigerator (Direct cool), Frost free refrigerator and Inverter technology Refrigerator.

The trainee shall be able to identify different compressor, dismantling and assembling compressors. The trainee shall be able to start the motor through DOL, Star Delta starter and changing DOR. The trainee shall be able to service condensers. The trainee shall be able to fix refrigerant controls and service evaporator. The trainee shall be able to Recover and Recharge of Refrigerant used in systems, transfer & handling of gas cylinders. The trainee shall be able to Retrofit CFC/HFC machine with ozone friendly refrigerant. The trainee shall be able to fix thermal insulation. The trainee shall be able to install window AC, test Electrical, electronic components, Fault diagnosis & remedial measures in window A.C. The trainee shall be able to Install, servicing, trouble shooting, fault detection, leak testing and gas charging in Split A.C (wall mounted),Split A.C (floor, ceiling /cassette mounted Split A.C),Split A.C (ducted), multi Split A.C and Inverter Split A.C. The trainee shall be able to Installation, servicing, trouble shooting, fault detection, leak testing and gas charging in Car Air Conditioner.

SECOND YEAR: The trainee learns about different commercial compressor and its dismantling, assembling, fault finding and rectification. They will be able to descaling in water cooled condensers**,** Evaporative condenser and Cooling tower, Selection of Expansion valves and its installations, Service air cooled evaporator and blower. The trainee shall be able to Install, service, maintenance, trouble shooting, fault finding and rectification, leak testing, evacuation and gas charging, electrical circuit repairing in water cooler & water dispenser, visible cooler, bottle cooler, deep freezer / display cabinet, ice cube machine and softy machine. They will be able to Service, operate, test electrical controls, test leak, evacuation and gas charging ,

Periodic maintenance in Ice candy plant, Ice plant, walk in cooler & reach in cabinet and cold storage.

The trainee learns about HVAC (study of psychrometry, blowers& fans, static and velocity pressure measurements). The trainee shall be able to make duct designing, duct making, insulating in ducts. The trainee shall be able to clean and fix air filters. The trainee shall be able to identify various components, Leak testing, evacuation, gas charging, Commissioning and troubleshooting of package A.C with air- and water-cooled condenser, split package. The trainee shall be able to trace electrical circuit, testing components, gas charging, Servicing AHU including fire dampers, Checking airflow, damper, temperature and pressure, operation, De-scaling condenser and cooling tower of central AC plant (Direct and Indirect). The trainee shall be able to Identify VRF / VRV system, Check and service of VRF / VRV system, connect master unit and IDU, identify the location of ODU, identify the size of piping's and laying work, Check control system and identify error code. The trainee shall be able to service and maintain the mobile A.C (bus, train).

The trainee also undergoes project work and Industrial visit/ In plant training at the end of each year which gives them more practical exposure and helps to build up confidence level.

2. TRAINING SYSTEM

2.1 GENERAL

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

Refrigeration and Air Conditioning Technician trade under CTS is one of the most popular courses delivered nationwide through a network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) imparts professional skills and knowledge, while Core area (Employability Skills) imparts requisite core skill & knowledge and life skills. After passing out of the training programme, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Candidates broadly need to demonstrate that they are able to:

- Read and interpret technical parameters/ documentation, plan and organize work processes, identify necessary materials and tools.
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations.
- Apply professional knowledge & employability skills while performing the job and modification & maintenance work.
- Check the components as per drawing for functioning, identify and rectify errors in components.
- Document the technical parameter related to the task undertaken.

2.2 PROGRESSION PATHWAYS

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship Certificate (NAC).

- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of two years:

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
	Total	**1200**	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

4	On the Job Training (OJT)/ Group Project	150	150

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The **Continuous Assessment** (Internal) 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. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines.

The pattern and marking structure is being notified by DGT 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 before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

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 teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/wastage as per procedure, behavioral attitude, sensitivity to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.
Assessment will be evidence based, comprising some of 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
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examination body. The following marking pattern to be adopted for formative assessment:

Performance Level	Evidence

(a) Marks in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish. • Occasional support in completing the project/job.
(b) Marks in the range of above75% - 90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices.	• Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish • Little support in completing the project/job.
(c) Marks 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% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Mechanic Refrigeration and Air Conditioner; installs and repairs refrigeration or air conditioning plant by replacing or repairing 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. Repair and service in refrigerator, water cooler, bottle cooler, deep freezer, Visi Cooler, Walk in Cooler, Ice candy plant, Cold storage, Ice plant, Split Air Conditioner, Package Air Conditioner, Central Air Conditioner, mobile Air Conditioner.

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-2015:

i) 7127.0100 - Mechanic Refrigeration and Air Conditioner

Reference NOS: -- ELE/N1002, ELE/N3114, ELE/N3112, ELE/N 3108, CSC/N9413, CSC/N9414, ELE/N3140, ELE/N3141, CSC/N9415, CSC/N9416, CSC/N9417, CSC/N9418, CSC/N9419, CSC/N9420, CSC/N9421, CSC/N9422, CSC/N9423, CSC/N9401, CSC/N9402.

4. GENERAL INFORMATION

Name of the Trade	**REFRIGERATION AND AIR CONDITIONING TECHNICIAN**
Trade Code	DGT/1010
NCO - 2015	7127.0100
NOS Covered	ELE/N 1002, ELE/N3114, ELE/N3112, ELE/N 3108, CSC/N9413, CSC/N9414, ELE/N3140, ELE/N3141, CSC/N9415, CSC/N9416, CSC/N9417, CSC/N9418, CSC/N9419, CSC/N9420, CSC/N9421, CSC/N9422, CSC/N9423, CSC/N9401, CSC/N9402.
NSQF Level	Level-4
Duration of Craftsmen Training (Instructional Hours)	Two Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD,CP,LC,DW,AA,,LV,DEAF,HH
Unit Strength (No. of Student)	24 (There is no separate provision of supernumerary seats)
Space Norms	80 Sq. m
Power Norms	6.82 KW
Instructors Qualification for	
(i) Refrigeration and Air Conditioning Technician Trade	B.Voc/Degree in Mechanical Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Mechanical Engineering from AICTE recognized board of technical education or relevant Advanced Diploma

	(Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/NAC passed in the trade of "Mechanic Refrigeration & Air-conditioner" with three years' experience in the relevant field. **Essential Qualification:** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) under DGT. ***NOTE: - Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.***
(ii) Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
(iii) Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience.

	Essential Qualification: Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants of NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
(iv) Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
(v) Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

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

5.1 LEARNING OUTCOMES

FIRSTYEAR

1. Identify trade related hazards and safety procedures following safety precautions. NOS: ELE/N 1002
2. Produce fitting jobs as per drawing (Range of operations: marking, sawing, filing, drilling, reaming, taping and dieing etc.). NOS: ELE/N3114
3. Produce Sheet metal components (range of operation – marking, metal cutting, bending, riveting and soldering etc.). NOS: ELE/N3114
4. Identify electrical safety. Join different wire, measure power, currents, volts and earth resistance etc. Connect single phase, 3 phase motors i.e. star and delta connections.NOS: ELE/N 1002
5. Identify the electronic components and their colour code i.e. transistor, capacitor, diode, amplifier, I.C and able to work soldering. NOS: ELE/N3112
6. Perform gas welding, brazing, soldering observing related safety. NOS: ELE/N3112
7. Identify RAC tools and equipment and recognise different parts of RAC system. Perform copper tube cutting, flaring, swaging, brazing. NOS ELE/N 3108
8. Test mechanical & electrical components. Perform leak test, vacuuming, gas charging, wiring & installation of refrigerator. NOS: ELE/N3112
9. Identify electrical and mechanical components of a refrigerator. NOS: ELE/N3112
10. Test compressor motor terminal, start compressor Direct with relay & without relay, technique of flushing, leak testing, replacing capillary & filter drier, evacuation & gas charging. NOS: ELE/N3112
11. Check components of frost-free refrigerator (electrical / mechanical), wiring of frost-free freeze & air distribution in refrigerator sector. Leak detection, evacuators & gas charging. NOS: ELE/N3112
12. Dismantle, repair and assemble hermetic, fixed and variable speed compressor, and test performance. NOS: ELE/N3112
13. Identify the terminals of sealed compressor and their wiring and measure current, volts, watts and use of DOL starter with different types of motors. NOS: ELE/N3112
14. Perform selection of Hermetic compressor for different appliances, starting methods, testing controls & safety cut out used in sealed compressor. NOS: ELE/N3112
15. Identify the components of control system of Inverter A.C and wiring of control system NOS ELE/N3114

16. Perform servicing & de-scaling of condenser (internals &externals) used in different appliances NOS ELE/N3114
17. Perform fitting & adjustment of drier, filter & refrigerant controls used in different refrigeration system. NOS: CSC/N9413
18. Perform servicing of different evaporator used in different appliances. NOS: CSC/N9414
19. Carry out Recovery and Recycling of Refrigerant used, alternative of CFC, HFC re-cover, transfer & handling of gas cylinders. NOS ELE/N3114
20. Retrofit CFC/HFC machine with ozone friendly refrigerant with understanding of the compatibility. NOS ELE/N3114
21. Pack thermal insulation and prevent cooling leakage. NOS ELE/N3114
22. Install window AC, test Electrical & electronics components & Fault diagnosis & remedial measures. NOS ELE/N3114
23. Perform servicing of electrical & electronic control test, installation, wiring, fault finding & remedial measures of different split AC. NOS ELE/N3114
24. Perform servicing of car AC. Fault diagnosis & remedial measures NOS ELE/N3114
25. Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401
26. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS CSC/N9402

SECOND YEAR

27. Carry out servicing, dismantling, checking different parts of different types of commercial compressor, re-placing worn out parts, Check lubrication system. Assemble & check performance. NOS- ELE/N3140
28. Perform servicing of different types of water-cooled condenser. NOS- ELE/N3140
29. Perform servicing and performance test of Cooling tower NOS- ELE/N3141
30. Conduct Servicing, backwash & re-generate Water treatment plant of circulating water. NOS CSC/N9415
31. Perform Fitting of expansion valve, adjustment of refrigerant flow according to heat load. NOS- ELE/N3140
32. Perform servicing of evaporator & chillers. NOS- ELE/N3140
33. Carry out servicing and retrofit of Water cooler and dispenser. NOS CSC/N9416
34. Service, retrofit of visible cooler and bottle cooler and test performance. NOS CSC/N9417
35. Conduct servicing of deep freezer and test performance. NOS CSC/N9418
36. Install, service, repair, gas charging and testing performance of Ice Cube machine. NOS CSC/N9419
37. Repair, servicing & retrofit of ice candy plant. NOS CSC/N9420

38. Perform servicing of Ice plant and evaporative condenser. NOS CSC/N9421
39. Perform Servicing and preventive maintenance of walk in cooler & cold storage. NOS CSC/N9422
40. Study psychrometric chart and measure psychrometric properties using psychrometric, anemometer i.e. DBT, WBT, RH, air flow etc. NOS- ELE/N3140
41. Perform servicing of motor and blowers used in different air conditioning system. NOS-ELE/N3141
42. Construct, install, pack thermal and acoustic insulation of different air ducts. NOS-ELE/N3141
43. Perform servicing and maintenance of different types of air filters. NOS- ELE/N3141
44. Perform servicing, installation, fault diagnosis and remedial measures on Package AC with Air cooled condenser. NOS CSC/N9423
45. Carry out Servicing, installation, fault diagnosis and remedial measures in Package A.C. with water cooled condenser. NOS- ELE/N3140
46. Identify the various components of central AC test electrical components and make wiring. Servicing of A.H.U, damper, check air flow, De-scaling of condenser and CT servicing. NOS- ELE/N3141
47. Pump down the system, top up oil and gas and check temperature and pressure. NOS-ELE/N3140
48. Identify components of DX system. Test components, make wiring of DX system. Test leak and evacuate, gas charge the system and check the performance. Maintenance, trouble shoot and operate the plant. NOS- ELE/N3140
49. Identify the different parts of VRF/VRV system, check and service VRF/VRV system. NOS-ELE/N3141
50. Identify different parts of indirect or chillers system. Check components and make wiring, leak test, evacuate and gas charge/ top up. Servicing the plant and trouble shoot. NOS- ELE/N3141
51. Identify chilled water pipe line. Servicing of dampers, FCU and water control valves. NOS- ELE/N3141
52. Troubles shoot both Central A.C. plant DX and indirect system. Check different control system, installation of other major components, servicing of all parts including cooling tower and water treatment plant. NOS- ELE/N3141
53. Perform Servicing, fault diagnosis, repair and maintenance of mobile A.C. leak test, evacuation, gas charging, check magnetic clutch and make wiring. Test performance after start. NOS- ELE/N3141
54. Perform preventive maintenance of different plants. Maintain log book based on daily operation. NOS- ELE/N3141

55. Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401
56. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS CSC/N9402

6. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENT CRITERIA
FIRST YEAR	
1. Identify trade related hazards and safety procedures following safety precautions. NOS ELE/N 1002	Demonstrate Safety precautions.
	Demonstrate First aid.
	Demonstrate firefighting.
	Demonstrate working at height using PPE's.
2. Produce fitting jobs as per drawing (Range of operations: marking, sawing, filing, drilling, reaming, taping and dieing etc.) . NOS ELE/N3114	Fix saw blade and cut materials as per requirements.
	Filing flat surface on M.S. plates.
	Marking as per drawing.
	Make the job as per drawing by filing, drilling, taping, etc.
	Make external thread by die.
	Check the job for its dimensional accuracy.
3. Produce Sheet metal components (range of operation – marking, metal cutting, bending, riveting and soldering etc.) NOS ELE/N3114	Mark sheet as per drawing
	Cut G.I. sheet as per drawing.
	Bend the sheet, fold, rivet and / or solder to join the sheet as per drawing.
	Check the job for its dimensional accuracy.
4. Identify electrical safety. Join different wire, measure power, currents, volts and earth resistance etc. Connect single phase, 3 phase motors i.e. star and delta connections. NOS ELE/N 1002	Cut wire and prepare different types of joints.
	Measure current, voltage, resistance, power, frequency, energy using analog and digital meter and identify the terminals of motor.
	Test continuity, insulation and earthing using megger.
	Make star and delta connection and show line voltage, line current, phase voltage and phase current.
	Measure power and power factor.
5. Identify the electronic components and their colour code i.e. transistor, capacitor, diode, amplifier, I.C and able to work soldering. NOS ELE/N3112	Identify the electronic components and their colour code.
	Verify Ohm's Law
	Construct and test full wave rectifier, bridge rectifier, series voltage regulator circuit, power supply, electronic timer
6. Perform gas welding, brazing, soldering observing	Setting of Oxy-acetylene cylinders, regulators etc and gas flame with proper pressure.

related safety. NOS ELE/N3112	Perform brazing between Cu to Cu and Cu to MS, Cu to aluminum pipe.
	Join metal plates by using gas welding (lap joint, butt joint, etc)
	Check the welded component and its measurements.
7. Identify RAC tools and equipment and recognise different parts of RAC system. Perform copper tube cutting, flaring, swaging, brazing. NOS ELE/N 3108	Identify the RAC tools and equipment.
	Identify the condensing and cooling unit.
	Copper pipe cutting, bending, swaging, flaring and brazing as per requirements and test pressure.
8. Test mechanical & electrical components. Perform leak test, vacuuming, gas charging, wiring & installation of refrigerator. NOS ELE/N3112	Leak testing of RAC unit use dry nitrogen.
	Evacuation the unit and test vacuum level.
	Gas charging unit.
	Make wiring of refrigerator.
	Install, run and check the performance.
9. Identify electrical and mechanical components of a refrigerator. NOS ELE/N3112	Install different types of electrical component of Refrigerator.
	Check and test different fault of electrical and other system of refrigerator
10. Test compressor motor terminal, start compressor Direct with relay & without relay, technique of flushing, leak testing, replacing capillary & filter drier, evacuation & gas charging. NOS ELE/N3112	Trace and test compressor / motor terminals.
	Start the compressor Direct / without relay.
	Start the compressor with relay.
	Flushing, cleaning of condenser, Evaporator coils.
	Joining of condensers, Evaporator capillary fitter drier by brazing.
	Test leakage, Evacuation and charge gas
	Test performance.
11. Check components of frost-free refrigerator (electrical / mechanical), wiring of frost-free freeze & air distribution in refrigerator sector. Leak detection, evacuators & gas charging. NOS ELE/N3112	Identification of frost-free refrigerator parts.
	Check electrical components and make wiring.
	Check air distribution duct and door cooling system.
	Leak test, evacuation, gas charging and test performance
12. Dismantle, repair and	Remove oil and cut the compressor dome.

assemble hermetic, fixed and variable speed compressor, and test performance. NOS ELE/N3112	Separate the compressor assembly from dome.
	Dismantle and check worn out parts.
	Clean the parts and assemble.
	Welds the dome and pressure check test the welded joints.
13. Identify the terminals of sealed compressor and their wiring and measure current, volts, watts and use of DOL starter with different types of motors. NOS ELE/N3112	Measure starting current and running current of hermetic compressor motor.
	Measure starting current and running current and changing of DOR of CSIR motor.
	Measure starting current and running current and changing of DOR of shaded pole motor.
14. Perform selection of Hermetic compressor for different appliances, starting methods, testing controls & safety cut out used in sealed compressor. NOS ELE/N3112	Select and Install hermetic compressor in the system.
	Braze the major mechanical components.
	Test Pressure.
	Test electrical components and safety cut outs.
	Make wiring, run the machine and check performance.
15. Identify the components of control system of Inverter A.C and wiring of control system. NOS ELE/N3114	Identify components of control system of Inverter ACs.
	Make wiring of the control system.
16. Perform servicing & de-scaling of condenser (internals &externals) used in different appliances. NOS ELE/N3114	Perform servicing of Air-cooled condenser (external and internal bycleaning, flushing and leak test)
	Remove Water cooled condenser head.
	De- scaling by brush and chemical cleaning.
	Re assembles and test performance.
17. Perform Fitting & adjustment of drier, filter & refrigerant controls used in different refrigeration system. NOS CSC/N9413	Clean filter/strainer and refill desiccates in drier.
	Install different diameter capillary tube used in different type of cooling machines.
	Install with different types of expansion valves.
	Make adjustment of refrigerant feeding as per the heat load. Use A.E.V./T.E.V in RAC unit.
	Test and adjust the expansion valves fitted with machines.

18. Perform servicing of different evaporator used in different appliances. NOS CSC/N9414	Service evaporator coil: Strip out the evaporator coil from the system.
	Perform leak test, Flush and clean by dry Nitrogen.
	Re-Join the coil after removing oil and debris and test performance.
19. Carry out Recovery and Recycling of Refrigerant used, alternative of CFC, HFC re-cover, transfer & handling of gas cylinders. NOS ELE/N3114	Recover refrigerant (CFC/HFC).
	Transfer of refrigerant from cylinders to cylinders.
	Measure pressure-temperature of refrigerants and Identify flammability and toxicity of A3 and A2L of refrigerants.
	Demonstrate Good servicing practices onTest leak, evacuation and charge refrigerant in refrigerator by weight in capillary system.
20. Retrofit CFC/HFC machine with ozone friendly refrigerant with understanding of the compatibility. NOS ELE/N3114	Retrofit CFC/HFC unit by ozone friendly refrigerants.
	Run the machine and check the cooling performance.
21. Pack thermal insulation, prevent cooling leakage. NOS ELE/N3114	Pack thermal insulation in RAC unit.
	Check heat leakage and sweating problem.
22. Install window AC, test Electrical & electronics components &Fault diagnosis & remedial measures. NOS ELE/N3114	Test Electrical controls of Window AC.
	Test electronic components / PCB.
	Install, make wiring of window A.C and run the machine.
	Diagnosis the faults, remedies and check performance.
23. Perform servicing of electrical & electronic control test, Installation, wiring, fault finding & remedial measures of different split AC. NOS	Test electrical components of split A.C.
	Test electronic components / PCB.
	Install, make wiring and run the machine.
	Diagnosis the faults, remedies and check performance.

ELE/N3114	
24. Perform servicing of car AC. Fault diagnosis & remedial measures. NOS ELE/N3114	Make wiring and install car A.C.
	Servicing of Car A.C and test run.
	Diagnosis Fault, remedial measures and check performance
25. Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
26. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS CSC/N9402	Solve different mathematical problems
	Explain concept of basic science related to the field of study
SECOND YEAR	
27. Carry out servicing, dismantling, checking different parts of different types of commercial compressor, re-placing worn out parts, Check lubrication system. Assemble & check performance. NOS-ELE/N3140	Identify different parts of commercial compressor
	Dismantling of compressor parts.
	Servicing of different parts and check. (Gasket making, lapping valve parts etc.)
	Replace/ renew the defective parts.
	Check lubrication system/ pump.
	Check / service capacity control system.
	Assemble and check performance.
28. Perform servicing of different types of water-cooled condenser. NOS- ELE/N3140	Service water-cooled condenser.
	Remove head, Pump down gas, cut gasket, test leakage, and De-scale.
	Assemble and check performance.
29. Perform servicingand	Service cooling tower, clean sump, nozzle, screws, pipe line.

performance test of Cooling tower. NOS- ELE/N3141	Check water supply and delivery pipe line.
	Service water pump.
	Assemble and Test performance.
30. Conduct Servicing, backwash & re-generate Water treatment plant of circulating water. NOS CSC/N9415	Dismantle, Servicing of impeller of water treatment plant.
	Repair defective parts of water treatment plant back wash and re-generate.
	Assemble and test performance.
31. PerformFitting of expansion valve, adjustment of refrigerant flow according to heat load. NOS- ELE/N3140	Install refrigerant control device as per head load.
	Adjust refrigerant flow.
	Check cooling performance.
32. Perform servicing of evaporator & chillers. NOS-ELE/N3140	Service coil evaporator.
	Service flooded chiller.
	Identify feeding device used in flooded chiller (Float valve, level master control, EXV etc.)
33. Carry out servicing and retrofit of Water cooler and dispenser. NOS CSC/N9416	Service water cooler (Pressure type/Storage type.)
	Service water cooler (Instant cooling type)
	Make wiring, thermostat setting, fault diagnosis and remedies.
	Retrofit CFC/HFC charged water cooler.
34. Service, retrofit of visible cooler and bottle cooler and test performance. NOS CSC/N9417	Service, Evacuation, flushing and retrofit with refrigerant the visible cooler.
	Service, Evacuation, flushing and retrofit with refrigerant the bottle cooler.
	Check wiring circuit, test components, replace and Test performance of the machine.
35. Conduct servicing of deep freezer and test performance. NOS CSC/N9418	Service and troubleshooting of deep freezer.
	Check wiring circuit, test and replace defective components.
	Retrofit CFC charged deep freezer and test performance.
36. Install, service, repair, gas charging and testing	Service different components of Ice cube machine
	Check Electric circuit, solenoid valve, pressure cut out,

performance of Ice Cube machine. NOS CSC/N9419	thermostat etc. of ice cube machine.
	Check and service flow system of gases, Test leakage, evacuation and charge gasat set pressure.
	Check defrosting system and overall performance
37. Repair, servicing & retrofit of ice candy plant. NOS CSC/N9420	Service, test, trouble shoot, and replace defective components of ice candy plant.
	Check function of agitator.
	Check wiring circuit, Test different electrical and mechanical controls, motor bets.
	Retrofit CFC charged ice candy (R22with R134a) and Test performance.
38. Perform servicing of Ice plant and evaporative condenser. NOS CSC/N9421	Check function of agitator.
	Check motor and wiring circuit, service and trouble shoot, Test components and replace defective parts.
	Service evaporative condenser.
	Service brine tank and descale of chilling pipe line.
	Evacuate and charge gas.
	Run the plant and record different parameters of performance.
39. Perform Servicing and preventive maintenance of walk in cooler & cold storage. NOS CSC/N9422	Service and trouble shoot, check wiring circuit, Test component and replace defective parts of walk in cooler / cold storage.
	Install gauge manifold, leak test, evacuate and charge gas.
	Service, Diagnosis faults and remedial measures.
	Preventive maintenance and record the log sheet
40. Study psychrometric chart and measure psychrometric properties using psychrometric, anemometer i.e. DBT, WBT, RH, air flow etc. NOS- ELE/N3140	Read Psychrometric chart and identify the different properties.
	Use Psychrometric and measure properties of air.
	Measure air velocity by anemometer.
41. Perform servicing of motor and blowers used in different air conditioning system. NOS-	Service blower motor and test performanceon power Input.
	Service blower and fans and check performance.

ELE/N3141	
42. Construct, installation, pack thermal and acoustic insulation of different air ducts. NOS- ELE/N3141	Construct and install duct as per layout drawing.
	Check air flow through Duct.
	Pack / Insulate duct, check for proper insulation and observe the noise.
43. Perform servicing and maintenance of different types of air filters. NOS-ELE/N3141	Disassemble and Service Air filters.
	Check performance and replace Air filter
44. Perform servicing, installation, fault diagnosis and remedial measures on Package AC with Air cooled condenser. NOS CSC/N9423	Service, Leak test, evacuate, charge gas on Package AC with Air cooled condenser.
	Install, run the A.C. and diagnose faults and rectify defects.
45. Carry out servicing, installation, fault diagnosis and remedial measures in Package A.C. with water cooled condenser. NOS-ELE/N3140	Service, descale, Leak test, evacuate, charge gas on Package AC with water cooled condenser.
	Install, run the A.C. and diagnose faults and rectify defects.
46. Identify the various components of central AC test electrical components and make wiring. Servicing of A.H.U, damper, check air flow, De-scaling of condenser and CT servicing. NOS-ELE/N3141	Check electrical accessories and make wiring with the safety cut outs and accessories.
	Service A.H.U., damper and check air circulation.
	De-scaling of condenser and cooling tower.
	Run and check the performance.
47. Pump down the system, top up oil and gas and check temperature and pressure. NOS- ELE/N3140	Pump down gas from central A.C. system.
	Top up oil and gas.
	Run the machine and check pressure and temperature.
48. Identify components of DX	Service DX system.

system. Test components, make wiring of DX system. Test leak and evacuate, gas charge the system and check the performance. Maintenance, trouble shoot and operate the plant. NOS-ELE/N3140	Test controls and re-connect the cut out and controls.
	Run the machine and check operation.
	Pump down the less cooling machine for repair.
	Leak test, evacuate, gas charge and test performance.
49. Identify the different part of VRF/VRV system, check and service VRF/VRV system. NOS- ELE/N3141	Identify the parts of VRF/VRV machine.
	Check and service VRV/VRF machine.
	Identify error code
50. Identify different part of indirect or chillers system. Check components and make wiring, leak test, evacuate and gas charge/ top up. Servicing the plant and trouble shoot. NOS-ELE/N3141	Service indirect (chiller) system.
	Run and check the performance.
	Top up oil/refrigerant.
	Diagnosis faults and rectify.
51. Identify chilled water pipe line. Servicing of dampers, FCU and water control valves. NOS- ELE/N3141	Check chill water line insulation and water flow.
	Service F.C.U. and related controls.
	Run and check performance.
52. Troubles shoot both central A.C. plant DX and indirect system. Check different control system, installation of other major components, servicing of all parts including cooling tower and water treatment plant. NOS-ELE/N3141	Service and Fault diagnosis of central A.C.
	Check machine and electrical controls, cut outs.
	Service cooling tower and pumps.
	Identify the water treatment plant components.
	Service water softening plant, re-generate, back wash and check the performance.
	Run the machine and check the performance.

53. Perform Servicing, fault diagnosis, repair and maintenance of mobile A.C. leak test, evacuation, gas charging, check magnetic clutch and make wiring. Test performance after start. NOS- ELE/N3141	Identify the parts of mobile A.C.
	Run the machine and check the different parameters i.e. pressure, temperature etc.
	Check magnetic clutch and other controls.
	Observe the cooling performance, air velocity inside the compartment.
	Check leakage.
	Evacuate and charge gas.
	Test run and check the cooling performance.
54. Perform Preventive maintenance of different plants. Maintain log book based on daily operation. NOS- ELE/N3141	Preventive maintenance of central A.C. DX system.
	Maintain operation data on log sheet.
	Preventive maintenance of central A.C. indirect system (Chiller system).
	Record chiller water in and out temperature.
	Cooling tower functioning data, i.e. CT range, Approach, condenser in and out water temperature.
	Condense and cooling tower pump maintenance water pressure check.
	A.H.U and Damper functioning servicing air filter and check air velocity etc.
55. Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
56. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS CSC/N9402	Solve different mathematical problems
	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS FOR REFRIGERATION & AIR CONDITION TECHNICIAN TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hrs..**	**Professional Knowledge (Trade Theory)**
Professional Skill 25 Hrs.; Professional Knowledge 04 Hrs.	Identify trade related hazards and safety procedures following safety precautions. NOS ELE/N 1002	1. Identify workshop & machineries. (10 hrs.) 2. Demonstrate Safety precautions and First aid. (05 hrs.) 3. Demonstrate firefighting (05 hrs.) 4. Demonstrate working at height using PPE's and identify the hazards and take personal safety precautions. (5 hrs.)	Introduction to trade and related industries. General safety precautions and first aids, firefighting equipment and electrical safety. History of Refrigeration and Air conditioning. Grooming of technicians.(04 hrs..)
Professional Skill 25Hrs.; Professional Knowledge 5 Hrs.	Produce fitting jobs as per drawing (Range of operations, marking, sawing, filing, drilling.) NOS ELE/N3114	5. Identify general tools, instruments & equipment. Care and maintenance of tool, instruments and equipment. (10 hrs.) 6. Perform measuring, marking, punching, hacksawing and flat filing, to make a job as per drawing. (15 hrs.)	**Fitting** Different types of Fitting hand tools,- their use. Function, construction, working and Specification. Machineries and equipment used in fittings like drilling machine and grinding machine. (05 hrs)
Professional Skill 25 Hrs.; Professional Knowledge 04 Hrs.	Produce Sheet metal components (range of operation marking, metal cutting, bending, riveting and soldering etc.) NOS ELE/N3114	7. Perform Sheet Cutting by straight snip as per drawing. (07 hrs.) 8. Perform Sheet Cutting by bent snip as per drawing. (07 hrs.) 9. Bend, fold and join metal sheets in different process. (06 hrs.) 10. Join sheet metal by using rivet set and snap. (05 hrs.)	**Sheet Metal** Function, construction, working, use, and application, specification of Sheet metal tools, instruments and equipment. Care and maintenance of tools. Rivet & riveting- their types and use. (04 hrs..)
Professional	Identify electrical	11. Demonstrate electrical	**Electrical**

Skill 35 Hrs.; Professional Knowledge 06 Hrs.	safety. Join different wire, measure power, currents, volts and earth resistance etc. Connect single phase motors. NOS ELE/N 1002	safety precautions and first aid. (05 hrs.) 12. Identify, use and maintain electrical tools. (05 hrs.) 13. Measure current, voltage, resistance ,power, energy using analog and digital meter through a single phase circuit. (25 hrs.)	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. Series and parallel circuit, open circuit, short circuit, etc. Measuring Instruments such as voltmeter, ammeter, ohm meter, watt meter, energy meter and frequency meter. Earthing and its importance. Earth resistance. Insulation and continuity test.(06 hrs..)
Professional Skill 47 Hrs.; Professional Knowledge 10 Hrs.	Identify the electronic components and their colour code i.e. transistor, capacitor, diode, amplifier, I.C and able to work soldering. NOS ELE/N3112	14. Identify basic electronic components, tools & instrument. (08 hrs.) 15. Colour coding of resistors. (05 hrs.) 16. Use voltmeter, ammeter and multimeter. (8 hrs.) 17. Practice soldering & de-soldering. (8 hrs.)	**Electronics** Introduction to Electronics. Basic Principles of semiconductors, Principles and application of Diodes. Solder – its composition and paste. (05 hrs..)
		18. Identify transistors, resistors, capacitors, diodes, S.C.R., U.J.T., amplifier and I.C. (08hrs.) 19. Construct and test full wave rectifier using diodes. (05hrs.) 20. Construct and test a bridge rectifier. (05hrs.)	Rectification, Zener diode as voltage regulator – transistors parameters- diodes, ICs. (05 hrs..)
Professional Skill 39 Hrs.; Professional Knowledge 7 Hrs.	Perform gas welding, brazing, soldering Observing related safety. NOS ELE/N3112	21. Identify gas welding equipment & accessories. (05 hrs.) 22. Demonstrate safety precaution in handling of Oxy-acetylene cylinders, regulators etc. (04 hrs.)	**Welding** Introduction to basic principles of commonly used Welding processes, oxy fuel gas welding / cutting, brazing & soldering, nozzles, base metal and filler metal. Use of flux.

		23. Setting up of AIR-LPG, O2-LPG and O2-C2H2 using can type portable flame set. (04 hrs.) 24. Oxy-acetylene gas welding, brazing and cutting on thin sheet metal. (7 hrs.) 25. Demonstrate Care & Safety of welding tools and equipment. Back fire arrester. (03 hrs.) 26. Set Oxy-acetylene plant, use two stage regulator, adjustment of flame, gas pressure – O2 and DA. (07 hrs.) 27. Perform brazing between Cu to Cu and Cu to MS, Cu to aluminum pipes. (9 hrs.)	Difference between soldering and Brazing in terms of temperatures, filler materials, joint strengths and application. Use of Oxy Acetylene, Oxy LPG, Air LPG and two stage regulators for brazing/soldering. Description of back fire arrester. (7 hrs..)
Professional Skill 100Hrs.; Professional Knowledge 15Hrs.	Identify RAC tools and equipment and recognize different parts of RAC system. Perform copper tube cutting, flaring, swaging, brazing. NOS ELE/N 3108	**Basic Refrigeration** 28. Identify & use of general hand tools, instruments & equipment used in refrigeration work. (12hrs.) 29. Identify & use of special tools, instruments & equipment used in refrigeration work.(13hrs.)	**Basic Refrigeration** Basic principle of refrigeration, working, use, specifications of refrigeration tools, instruments and equipment. Fundamentals Thermodynamics law.(05hrs..)
		30. Identify various refrigeration equipment and components of vapour compression system like compressor, condenser, expansion device 31. Unroll, cut and bend soft copper tubes. (04 hrs.) 32. Swage and make a brazed joint on copper tubing. (10 hrs.) 33. Make flare joints and test	Science related to refrigeration, work, power, energy, force, Heat and Temperature, Different temperature scales, Thermometers, Units of heat, sensible heat, latent heat, super heating and sub-cooling, saturation temperature, pressure, types, units. Types of Refrigeration systems, including vapour absorption refrigeration cycle

		them with flare fittings. (10 hrs.) 34. Pinch off copper tubing. (04 hrs.) 35. Use lock ring tool and various fittings of lock ring for servicing of appliances. (10 hrs.). 36. Brazing of Cu to Cu, Cu to steel, Cu to brass using AIR LPG suitable in RAC machine. (07 hrs.) 37. Brazing of Cu to Cu, Cu to steel, Cu to brass using Oxy- LPG. (07 hrs.) 38. Brazing of Cu to Cu, Cu to steel, Cu to brass using Oxy-Acetylene. (11 hrs.)	(VARC), water – combination. Study the construction and working of vapor compression cycle, low side & high side of vapour compression system. Applications of vapour compression cycle. Coefficient of Performance (COP), Ton of Refrigeration.(7 hrs..) Construction and working of V.C Cycle, fundamental operations, sub cooling and super heating.(03 hrs..)
Professional Skill 49 Hrs.; Professional Knowledge 10 Hrs.	Test mechanical & electrical components. Perform leak test, vacuuming, gas charging, wiring in refrigerator. NOS ELE/N3112	39. Identify electrical and mechanical components of refrigerator direct cool and frost free. (05 hrs.) 40. Check and replace electrical components of refrigerators. (14 hrs.) 41. Leak test, evacuation, gas charging in a refrigerator. (15 hrs.) 42. Wiring circuit of refrigerator. (15 hrs.)	**Refrigerator (Direct cool & Frost free)** Function, construction, working of single door direct cool refrigerator, frost free refrigerator, specifications, trouble shooting. Heat Insulation materials. Care and maintenance of refrigerators. (10 hrs.)
Professional Skill 16Hrs.; Professional Knowledge 03 Hrs.	Identify electrical and mechanical components of a refrigerator. NOS ELE/N3112	43. Installation of refrigerator. (8 hrs.) 44. Check, Find Fault and test the electrical and other system components of refrigerator. (8 hrs.)	**Refrigerator (Direct cool & Frost free)** Study the electrical components of refrigerator.
Professional Skill 30 Hrs.; Professional Knowledge 07 Hrs.	Test compressor motor terminal, start compressor with relay & without relay, technique of flushing, leak testing, replacing	45. Testing of compressor. (05 hrs.) 46. Identification of motor terminals. (05 hrs.) 47. Start the compressor with and without relay. (05 hrs.) 48. Test performance of	Importance of flushing in evaporator and condenser, use of dry nitrogen for flushing, necessity of replacing capillary and drier. Evacuation, leak testing, gas charging method in refrigerator, (07 hrs..)

	capillary & filter drier, evacuation & gas charging. NOS ELE/N3112	direct start refrigerator. (05 hrs.) 49. Cleaning and flushing of evaporator and condenser with dry nitrogen. (05 hrs.) 50. Replacement of capillary tube and drier. (05 hrs.)	
Professional Skill 42 Hrs.; Professional Knowledge 10 Hrs.	Check components of frost-free refrigerator (electrical mechanical), wiring of frost-free freeze & air distribution in refrigerator sector. Leak detection, evacuators & gas charging. NOS ELE/N3112	51. Tracing electrical circuit of Frost-Free refrigerator. (10 hrs.) 52. Checking, fault finding and testing of electrical accessories like thermostat, timer, defrost heaters, bi- metal, air louvers etc. and other system components. (10 hrs.) 53. Checking air distribution system. (03 hrs.) 54. Servicing of refrigerator. (07 hrs.) 55. Testing the performance of refrigerator. (02 hrs.)	**Frost Free Refrigerator** Study the construction and working of Frost Free (2 or 3 door) Refrigerator parts particularly, the forced draft cooling, Air Duct circuit, temperature control in Freezer & cabinet of Refrigerator, air flapper / louver used in refrigerator section, automatic defrost system. Study of Electrical accessories & their functions (Timer, Heater, Bimetal, Relay, OLP, T/S etc.) Refrigerator cabinet volume calculation. 5hrs..)
		56. Identify three and four door no frost refrigerator. (07 hrs.) 57. Testing components of three/four door refrigerator. (03 hrs.)	**Refrigerator (Inverter Technology)** Study the construction and its working of two and three door frost free refrigerator with inverter technology Care and maintenance. (05 hrs..)
Professional Skill 39 Hrs.; Professional Knowledge 10 Hrs.	Dismantle, repair and assemble hermetic, fixed and variable speed compressor, and test performance. NOS ELE/N3112	58. Identify different types of compressor. (09 hrs.)	**Compressor** Function, construction, working, application of hermetic compressor,(Fixed speed and variable speed compressor)like Reciprocating, rotary, scroll and inverter type. 5 Hrs..)
		59. Dismantle /assembling reciprocating/rotary compressor. (15 hrs.) 60. Identify different parts of	Study the construction & working of reciprocating, rotary, scroll, wobble & swash plate compressor. wet compression,

		dismantled compressor. (15 hrs.)	oil, properties, lubrication methods. (05 hrs..)
Professional Skill 50 Hrs.; Professional Knowledge 8 Hrs.	Identify the terminals of sealed compressor and their wiring and measure current, volts, watts and use of DOL starter with different types of motors NOS ELE/N3112	61. Identify terminal sequence of hermetic compressor motor by using digital multimeter and measure starting current and running current by using ammeter and AVO meter. (12 hrs.) 62. Identification of terminal sequence of CSIR motor by using digital multimeter and measure starting current and running current by using Ammeter and AVO meter. (13 hrs.)	AC motors and their types. Advantages of AC motor over DC motor. Split phase induction motors, working principle and construction. Starting winding and running winding. Starting current and running current. Study the shaded pole motor, RSIR, CSIR, CSR and PSC motors. 6 Hrs..)
		63. Start CSR motor and measure starting current and running current. (07 hrs.) 64. Start shaded pole motor and measure starting current (18 hrs.)	Centrifugal switch and its function. Common faults, causes and remedies in motors. (02 hrs..)
Professional Skill 25 Hrs.; Professional Knowledge 4 Hrs.	Perform selection of Hermetic compressor for different appliances, starting methods, testing controls & safety cut out used in sealed compressor. NOS ELE/N3112	65. Test open, short, continuity and earth of a hermetic compressor. (04 hrs.) 66. Start the compressor motor by RSIR, CSIR, PSC & CSR method by using different type relay, capacitors, OLP's, etc. (10 hrs.) 67. Check and Test different type relay, Capacitors, OLP's, find out faults and rectification(11 hrs.)	**Motors** Function of Starting relay, Capacitors, OLP's.(04 hrs..)
Professional Skill 16Hrs.; Professional Knowledge 04	Identify the Components of control system of Inverter AC and wiring of control	68. Check control circuit of variable speed air conditioners (Inverter ACs). (08 hrs.) 69. Identify components of	Working principle of inverter technology, advantages of variable speed technology over fixed speed. Working principle of control system for inverter

Hrs.	system. NOS ELE/N3114	control system of Inverter ACs including printed circuit board (PCB) NTC,PTC e.g. Power PCB, Filter PCB, Heat sink reactor. (08 hrs.)	Air Conditioners (ACs). (04 hrs..)
Professional Skill 46 Hrs.; Professional Knowledge 10 Hrs.	Perform servicing & de scaling of condenser (internals &externals) used in different appliances. NOS CSC/N9413 Perform Fitting &adjustment of drier, filter & refrigerant controls used in different refrigeration system. NOS ELE/N3114	70. Familiarize with different types of condensers used in refrigerators, Bottle coolers, visible coolers, deep freezers, Window and Split AC. (10 hrs.) 71. Clean, flush, service and leak test different type of air- cooled condensers, micro channel condensers. Remove dust from fins in air cooled condenser, micro channel condensers. (10 hrs.) 72. Identify different items necessary for de-scaling like diluted Hcl, Pump & motor, hose, etc. (07 hrs.)	**Condenser** Function of condenser, types, Construction of air-cooled condenser. Effect of chocked condenser. Advantages, de scaling of air-cooled condenser, application, and advantages. Liquid receiver, pump down, application, types, function and working. **Drier** Function of drier, types, application and its advantage. Description of desiccants.
		73. Identify drier and capillary tube used in different cooling machines. (09 hrs.) 74. Replace drier and capillary tube at the time of gas charging according to manufacturer's direction. (10 hrs.)	**Expansion Valve** Expansion valve used in domestic refrigeration and air conditioning
Professional Skill 16 Hrs.; Professional Knowledge 05 Hrs.	Perform servicing of different evaporator used in different appliances. NOS CSC/N9414	75. Identify and service different types of evaporators like plate and tube type, Fin and tube type, etc. fitted in refrigerators, Bottle coolers, water cooler, Window and split AC. (08 hrs.) 76. Perform leak test, flush to remove oil by dry nitrogen	**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. (05 hrs..)

		in evaporator. (08 hrs.)	
Professional Skill 30 Hrs.; Professional Knowledge 06 Hrs.	Carry out Recovery and Recycling of Refrigerant used, alternative of CFC, HFC re-cover, transfer & handing of gas cylinders. NOS ELE/N3114	77. Identify and explain different colour code of different type refrigerant cylinder like HCFCs (HCFC-22, HCFC-123). HFCs (HFC-134a, HFC-32, R- 410A, R-407C and R-404A) and low-Global Warming Potential (GWP) refrigerants like ammonia, R-290, HFC- 32, blends of HFCs (R-410A, R-404A, R-407C etc.) and hydro Fluor olefins (HFOs: HFO-1234yf, HFO-1234ze, HFO-1233zd, HFO-1336mz), blends of HFCs and HFOs. (10 hrs.) 78. Recover refrigerant from a faulty machine. (07 hrs.) 79. Transfer refrigerant from one cylinder to another using ice. (04 hrs.) 80. Measure pressure and temperature of refrigerants including HCFC-22, ammonia, R-290, HFC-32, HFC-134a, R-404A, R-407C and R-410A, HFOs. Identify flammability and toxicity of A3 and A2L of refrigerants. (09 hrs.)	**Refrigerant** Classification of refrigerants, nomenclature of refrigerants including chemical name and formulas, hydrochlorofluorocarbons (HCFCs), hydro fluorocarbons (HFCs) and hydro fluoroolefins (HFOs), blends of HFCs and blends of HFCs/HFOs. Climatic impact of refrigerants: Stratospheric ozone depletion, global warming, mechanism of ozone depletion; the Montreal Protocol phase-out schedule of ozone depleting refrigerants (HCFCs) and high global warming refrigerants (HFCs). Brief introduction of Ozone Depleting Substances (Regulation and Control) Rules, 2000 and its amendments. Introduction of properties of refrigerants; environment related properties: Ozone Depleting Potential (ODP), GWP; ODP and GWP of various refrigerants, thermo chemical properties: flammability and toxicity of refrigerants, lower flammability limit (LFL) and upper flammability limit of A3 and A2L refrigerants. Thermo physical properties: pressure temperature of different refrigerants.(06 hrs..)
Professional Skill 22 Hrs.; Professional Knowledge 07 Hrs.	Retrofit CFC/HFC machine with ozone friendly refrigerant with understanding of	81. Demonstrate safe handling of refrigeration cylinders. (10 hrs.) 82. Recover CFC by recovery pump and cylinder on CFC filled domestic	Safe handling of flammable refrigerants. Refrigerant leak detection methods, evacuation and charging of refrigerant, temperature glides of refrigerant blends, procedure

	the compatibility. NOS ELE/N3114	refrigerator. (12 hrs.)	of charging of refrigerant blends especially the zeotropic blends, hydrocarbon blends, HFC blends (R-404A, R-407C, R-410A) and blends of HFC/HFO. **Retrofitting** Changes of components & practices while retrofitting CFC appliances with HC Refrigerants. Properties of HCs (07 hrs..)
Professional Skill 13 Hrs.; Professional Knowledge 02 Hrs.	Pack thermal insulation and prevent cooling leakage. NOS ELE/N3114	83. Identify different insulating materials.(polyurethane rigid foam and polystyrene). (03 hrs.) 84. Fill with insulation material like PUF and glass wool. (10hrs.)	**Thermal Insulation** Function, types, thermodynamic properties of heat insulation materials used in refrigeration and Air Conditioning systems. (02 hrs..)
Professional Skill 50 Hrs.; Professional Knowledge 7 Hrs.	Install window AC, test Electrical & electronics components & Fault diagnosis & remedial measures. NOS ELE/N3114	85. Acquainting with mechanical and electrical components (electrical components like selector switch, thermostat switch, relay, starting capacitor, running capacitor, overload protector, remote and PCB control, etc.) used in window air-conditioner. (15 hrs.) 86. Troubleshooting, installation, tracing wiring circuit. (5 hrs..) 87. Leak testing, evacuation and gas charging, Show discharge pressure and suction pressure during running time. (15 hrs.) 88. Hands on practice on installation of window AC following step by step procedure. (15 hrs.)	**Window Air Conditioner** Study

Professional Skill 100 Hrs.; Professional Knowledge 18Hrs.	Perform servicing of electrical& electronic control, test, Installation, wiring, fault finding & remedial measures of different split AC. NOS ELE/N3114	**Split AC (wall/floor/Cassette)** 89. Identify various components of split AC like wall mounted, floor and ceiling mounted, duct able and multi split AC. (04hrs.) 90. Identify electrical circuits of wall mounted split AC. (04hrs.) 91. Test different components and fault finding. (03 hrs.) 92. Leak testing of the system, evacuation and gas charging. (03hrs.) 93. Trouble shooting in split AC. (06hrs.)	**Split AC (wall/floor/Cassette)** Construction
		94. Install IDU and ODU of wall mounted split AC. (16hrs.)	**Split AC (Wall Mounted)** Construction and working principle, types, trouble shooting. Description of electrical components used in split A.C. Study the wiring circuit.
		95. Install IDU of floor, Ceiling /Cassette mounted Split AC. (16hrs.)	**SPLIT A.C (floor, Ceiling /Cassette mounted Split A.C)** Construction and working principle, types, trouble shooting. Description of electrical components used in split A.C. Study the wiring circuit.
		96. Install IDU and Duct of Ductable split AC. (16hrs.)	**SPLIT A.C (Ducted**) 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.
		97. Servicing of Multi Split AC. (16hrs.)	**MULTI SPLIT A.C** Study the construction and working, various components,

			electrical circuits, testing components, fault detection
		98. Identify the parts of Inverter Split AC. (16hrs.)	**INVERTER SPLIT A.C.** Study of construction and working principle of inverter AC and its components, electrical circuit and controls, installation, servicing, trouble shooting, fault detection, leak testing and gas charging. Concept of Indian Seasonal Energy Efficiency Ratio ISEER). Energy Efficiency leveling on inverter AC.(18 hrs..)
Engineering Drawing: 40 Hrs.			
Professional Knowledge ED: 40 Hrs.	Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401	**ENGINEERING DRAWING:** **1.Introduction to Engineering Drawing and Drawing Instruments** • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument **2.Lines- Types and applications in drawing** **Free hand drawing of –** Geometrical figures and blocks with dimension Transferring measurement from the given object to the free hand sketches. • Free hand drawing of hand tools and measuring tools. **3.Drawing of Geometrical figures** Angle, Triangle, Circle, Rectangle, Square, Parallelogram. Lettering & Numbering – Single Stroke. 4.**Dimensioning** • Types of arrowhead • Leader line with text •Position of dimensioning 5.(**Unidirectional, Aligned)** **Symbolic representation –** • Different symbols used in the related trades. **6.Concept and reading of Drawing in** • Concept of axes plane and quadrant • Concept of Orthographic and Isometric projections • Method of first angle and third angle projections (definition and difference) **Reading of Job drawing related to trades.**	
Workshop Calculation & Science: 38			

Professional Knowledge WCS: 38Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS CSC/N9402	**WORKSHOP CALCULATION & SCIENCE:** **Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, substraction, multiplication & division Decimal fractions - Addition, subtraction, multiplication & division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and square root Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non ferrous metals Physical and mechanical properties of metals Introduction of iron and cast iron Difference between iron & steel, alloy steel and carbon steel Properties of insulating materials **Mass, Weight, Volume and Density** Mass, volume, density, weight and specific gravity, **numerical related to L,C,O section only** Related problems for mass, volume, density, weight and specific gravity **Speed and Velocity, Work, Power and Energy** Work, power, energy, HP, IHP, BHP and efficiency **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Scales of temperature, Celsius, Fahrenheit, kelvin and conversion between scales of temperature Heat &Temperature - Temperature measuring instruments, types of thermometer, pyrometer and transmission of heat - Conduction, convection and radiation Co-efficient of linear expansion and related problems with assignments Problem of heat loss and heat gain with assignments Thermal conductivity and insulators Concept of pressure - Units of pressure, atmospheric pressure,

		absolute pressure, gauge pressure and gauges used for measuring pressure **Basic Electricity** Introduction and uses of electricity, electric current AC,DC their comparison, voltage, resistance and their units **Mensuration** Area and perimeter of square, rectangle and parallelogram Area and perimeter of Triangles
In-plant training / Project work: **Broad Area:** a) Assemble a car A.C Cycle b) Assemble window AC / Split AC		

SYLLABUS FOR REFRIGERATION & AIR CONDITION TECHNICIAN TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hrs.**	**Professional Knowledge (Trade Theory)**
Professional Skill 95 Hrs.; Professional Knowledge 20 Hrs.	Carry out Servicing, dismantling, checking different parts of different types of commercial compressor, re-placing worn out parts, Check lubrication system. Assemble & check performance. NOS-ELE/N3140	99. Familiarization with commercial type reciprocating compressor and centrifugal compressor. (04 hrs.) 100. Dismantling and checking of compressor & accessories. (10 hrs.) 101. Check and service valve plate and piston assembly. (05 hrs.) 102. Lapping valve plate, and refit. (05 hrs.) 103. Check belt tension and replace. (04 hrs.)	**COMMERCIAL COMPRESSOR (Fixed & Variable)** Function, types, Construction & working, applications of compressors used in commercial refrigeration. Volumetric efficiency, Capacity control. (05 hrs.)
		104. Check and test lubricating system. (05hrs.) 105. Servicing of filter and oil pump. (08 hrs.) 106. Cutting gasket. (04 hrs.)	Compressor lubricant oil, types, properties, types of lubrication methods such as splash, forced feed. Study the Construction and working principle of different commercial compressor, open type, (Reciprocating, centrifugal (05 hrs.)
		107. Assemble compressor and Test overall efficiency. (07 hrs.) 108. Star & Delta connection on a three-phase motor and show line voltage, line current, phase voltage and phase current insulation	Screw compressor. Star and Delta connection and their comparison. Production of rotating magnetic field by three phase AC supply. Working principle of three phase induction motor. Terms such as torque, slip, rotor

		test,and continuity. (10 hrs.) 109. Identify the terminals of a Squirrel cage induction motor. (06 hrs.) 110. Start the motor through DOL starter and measure starting current, running current and show changing of DOR. (06 hrs.) 111. Start the motor through Star Delta or Auto transformer starter and measure starting current, running current and show changing of DOR. (06 hrs.) 112. Familiarise with Slip-ring induction motor and identify it's terminals. (04 hrs.) 113. Start the Slip-ring induction motor through Rotor resistance starter and measure starting current, running current and show changing of DOR. (03 hrs.) 114. Rectify fault through insulation test, continuity, open circuit and short circuit test. (8 Hrs)	frequency and their relation. Construction of squirrel cage induction motor. Importance of phase sequence. Construction of slip ring induction motor Comparison between SCIM and SRIM. Three phase motor starters such as DOL starter, Star – Delta starter, Auto transformer starter and Rotor resistance starter. Common faults, causes and remedies in three phase AC motors. (10 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 15	Perform Servicing of different types of water-cooled condenser. NOS-ELE/N3140	115. Servicing of water-cooled condenser and receiver. (13 hrs..) 116. Testing its performance by inlet and outlet	**WATERCOOLED CONDENSER** Study the water-cooled Condenser, its type and capacity, construction and

Hrs.		pressure and temperature. (13 hrs.) 117. De-scaling by diluted HCl to increase efficiency. (12 hrs.)	working, de scaling, application. (08 hrs.)
		118. Pump down the gas for necessary servicing and repairing. (12 hrs.)	Evaporative condenser, function, construction and application. Liquid receiver, function. Drier, types and application. (07 hrs.)
Professional Skill 15 Hrs.; Professional Knowledge 06 Hrs.	Perform servicing of and performance test of Cooling tower. NOS-ELE/N3141	119. Servicing of natural draft, forced draft and induced draft cooling tower. (15 hrs.)	**COOLING TOWER** Cooling tower, types, Construction, capacity advantage & disadvantages of different types of cooling tower. Efficiency, approach and Cooling tower range. (06 hrs.)
Professional Skill 10 Hrs.; Professional Knowledge 06 Hrs.	Conduct servicing, & re- generate water treatment plant of circulating water. NOS CSC/N9415	120. Dismantle and Assemble water circulating pump. (10 hrs.)	**WATERTREATMENT** Causes for water contamination and water treatment. (6 Hrs)
Professional Skill 20 Hrs.; Professional Knowledge 11 Hrs.	Perform fitting of expansion valve, Adjustment of refrigerant flow according to heat load. NOS- ELE/N3140	121. Familiarize with thermostatic and Electronic expansion valve.(10 hrs.)	**EXPANSION VALVE** Types and function, construction, working principle, & their advantage& disadvantages. Thermostatic Expansion Valves (TXV), Automatic Expansion Valves (AXV), Float valves, fixed and modulating orifice controls & electronic Expansion Valves, LMC(level master control).(07 hrs.)
		122. Identify automatic expansion valve.(10 hrs.)	Selection of Expansion valves and capillaries for various Refrigeration and Air-conditioning applications. (04 hrs.)

Professional Skill 60 Hrs.; Professional Knowledge 13 Hrs.	Perform servicing of evaporator & chillers. NOS- ELE/N3140	123. Identify extended surface forced air-cooled evaporators.(05 hrs.) 124. Service air cooled evaporator by blower.(15 hrs.) 125. Service water cooled or brine cooled chiller.(15 hrs.) 126. Check de-frosting system and anti-freeze thermostat.(10 hrs.) 127. Oil removing from coil.(05 hrs.)	**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. (06 hrs.)
		128. Servicing of liquid suction heat exchanger used in central plant.(10 hrs.)	Liquid-suction-liquid Heat-exchanger, their function, construction, application & advantages. Study of Accumulator and Oil separator. (07 hrs.)
Professional Skill 40 Hrs.; Professional Knowledge 05 Hrs.	Carry out Servicing and retrofit of Water cooler and dispenser. NOS CSC/N9416	129. Identify parts, control, electric circuit, accessories of storage type water cooler and Bubble type water dispenser.(03 hrs.) 130. Trouble shoot of commonly faced problems like condenser fan motor failure, corrosion etc. (10 hrs.) 131. Install gauge manifold, Leak test and refrigerant charging after evacuation. (15 hrs.) 132. Installation, servicing and maintenance of water cooler and dispensers. (12 hrs.)	**WATER COOLER & WATER DISPENSER** Study the refrigeration cycle of storage type water cooler and dispenser types. Construction & working, Capacity & applications. Study the electrical and mechanical components of storage type water cooler. (05 hrs.)

Professional Skill 45 Hrs.; Professional Knowledge 05 Hrs.	Service, retrofit of visible cooler and bottle cooler and test performance. NOS CSC/N9417	133. Checking and servicing of visible cooler and bottle cooler and its parts.(10 hrs.) 134. Preventive maintenance and trouble shooting (05 hrs.) 135. Evacuation, flushing with dry nitrogen, Retrofit the machine with HFC 134a, R- 600a, R-290.(10 hrs.) 136. Check wiring circuit, test components & replace.(10 hrs.) 137. Install and Test performance of the machine. (10 hrs.)	**VISIBLE COOLER AND BOTTLE COOLER** Visible cooler & bottle coolers. Description, construction & working, with HFC-134a and hydrocarbons, safety especially for flammable refrigerants, maintenance, testing of mechanical and electrical components including sealed electrical components fitted in appliances using flammable refrigerants. (05 hrs.)
Professional Skill 35 Hrs.; Professional Knowledge 05 Hrs.	Conduct servicing of deep freezer and test performance. NOS CSC/N9418	138. Checking and servicing of horizontal and vertical deep freezer / display cabinet and their different parts. (10 hrs.) 139. Preventive maintenance and trouble shooting.(05 hrs.) 140. Check wiring circuit, test and replace defective components. (10 hrs.) 141. Install and test performance. (10 hrs.)	**DEEP FREEZER / DISPLAY CABINET** Description, Construction, working, specifications, function, care and maintenance, faults and remedies. (05 hrs.)
Professional Skill 15 Hrs.; Professional Knowledge 05 Hrs.	Install, service, repair, gas charging and testing performance of Ice Cube machine. NOS CSC/N9419	142. Checking and servicing of ice cube machine and its different components. (15hrs.)	**ICE CUBE MACHINE-** Description, Construction, working, reverse cycle functioning & Circuit diagram, installation method. **SOFTY MACHINE -**

			Description, Construction and function. (05 hrs.)
Professional Skill 20 Hrs.; Professional Knowledge 05 Hrs.	Repair, servicing & retrofit of ice candy plant. NOS CSC/N9420	143. Identify different parts, controls and accessories used in ice-candy plant. (10 hrs.) 144. Prepare brine solution, function of agitator and temperature maintained in brine. (10 hrs.)	**ICE CANDY PLANT-** Function, construction, working principle, Circuit diagram, capacity& types of compressor used. Brine composition to maintain required temperature. Operation, maintenance, retrofit. (05 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 06 Hrs.	Perform servicing of Ice plant and evaporative condenser. NOS CSC/N9421	145. Identify parts, accessories and controls of ice plant. (10 hrs.) 146. Check, service and operate ice plant (15 hrs.)	**ICE PLANT-** Details about components of Ice plant their functioning, (06 hrs.)
Professional Skill 55 Hrs.; Professional Knowledge 12 Hrs.	Perform Servicing and preventive maintenance of walk in cooler & cold storage. NOS CSC/N9422	147. Identify parts, accessories, controls and operation of walk in cooler and reach in cabinet. (10 hrs.) 148. Preventive maintenance, trouble shooting and servicing of components. (10 hrs.)	**WALK IN COOLER & REACH IN CABINET** Details about components, their functioning, working principle, Circuit diagram, capacity & types. Care and maintenance. (03 hrs.)
		149. Identify parts, controls and accessories of Cold storage plant. (05 hrs.) 150. Service and operation of cold storage plant. (10 hrs.)	**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. (05 hrs.)

		151. Check the refrigeration system of the cold storage plant.(05hrs.) 152. Measure pressure and temperature.(05hrs.) 153. Evacuation by two stage rotary vacuum pumps and gas charging. (10hrs.)	capacity and specification. Use of vibration eliminator and shock absorber, Study the lay out . Cold storage plant operation, its common trouble & remedies. Deep freezing, freezing tunnel, blast freezer its function and working, its application.(04 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 11 Hrs.	Study psychrometric chart and measure psychrometric properties using psychrometric, anemometer i.e. DBT, WBT, RH, air flow etc. NOS- ELE/N3140	154. Find out DBT, WBT, RH & other properties by using psychrometric chart. (15 hrs.) 155. Use psychrometer for finding DBT and WBT.. (15 hrs.)	**HVAC (Plant) –** Introduction to HVAC, Fundamentals of Central Air Conditioning / HVAC plant, requirements of comfort A.C, study of psychometric terms, DBT, WBT, RH, enthalpy, dew point, and specific humidity. (05 hrs.)
		156. Use Anemometers for measuring air flow. (20 hrs.)	Types of Central air conditioning (Direct and indirect system) Construction, working, components, faults, care and maintenance. (06hrs.)
Professional Skill 20 Hrs.; Professional Knowledge (07 hrs)	Perform servicing of motor and blowers used in different air conditioning system. NOS- ELE/N3141	157. Service of fans and blowers used in air-conditioning system. (20 hrs.)	Description of blowers& fans, function and types, static and velocity pressure measurements. (07 hrs.)
Professional Skill 30 Hrs.; Professional Knowledge 05 Hrs.	Construct, install, pack thermal and acoustic insulation of different air ducts. NOS-ELE/N3141 Perform servicing and maintenance of different types of air filters. NOS- ELE/N3141	158. Construct Ducts as per duct layout drawing. (10 hrs.) 159. Insulate Ducts. (05hrs.) 160. Service and maintain different filters. (10 hrs.) 161. Placing of filters. (05 hrs.)	**DUCT** Function, types, materials, duct designing, duct insulation, properties o **AIR FILTERS** Function of air filters, types, construction, maintenance, effect of chocked Air filter, (05 hrs.)

Professional Skill 35 Hrs.; Professional Knowledge 6 Hrs.	Perform servicing, installation, fault diagnosis and remedial measures on Package AC with Air cooled condenser. NOS CSC/N9423	162. Identify various components of Package AC (Air Cooled Condenser). (15 hrs.) 163. Check electrical circuit of Package AC (Air Cooled Condensers). (20 hrs.)	**PACKAGE AC (with Air Cooled Condenser)** Study the Package AC (with Air Cooled Condensers),its construction and working principle, types, trouble shooting. (6hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 15 Hrs.	Carry out servicing, installation, fault diagnosis and remedial measures in Package A.C. with water cooled condenser. NOS-ELE/N3140	164. Identify various components of package AC, (Water cooled condenser). (06hrs.) 165. Identify various components of split package AC. (07 hrs.) 166. Electrical circuit of split package AC. (12 hrs.)	**PACKAGE A.C WITH WATER COOLED CONDENSER** Study Package AC, construction and working principle, Duct system, AHU. Care and maintenance. (15 hrs.)
Professional Skill 30 Hrs.; Professional Knowledge 07 Hrs.	Identify various components of central AC, test electrical components and make wiring. Servicing of A.H.U, damper, check air flow, De-scaling of condenser and CT servicing. NOS-ELE/N3141	167. Identify various components of central AC plant.(Direct) (04 hrs.) 168. Electrical circuit of central AC plant. (10 hrs.) 169. Servicing AHU including fire dampers. (06hrs.) 170. Checking airflow, damper, temperature and pressure. (10 hrs.)	**CENTRAL/ INDUSTRIAL AIRCONDITIONING.** Construction and working principle, types, maintenance of Industrial Air-conditioning plant. Humidification and dehumidification methods. Description of AHU and FCU (07 hrs.)
Professional Skill 10 Hrs.; Professional Knowledge 07 Hrs.	Pump down the system, top up oil and gas and check temperature and pressure. NOS-ELE/N3140	171. Pump down gas from central AC plant. (05 hrs.) 172. Check temperature and pressure control. (05 hrs.)	Temperature and pressure controls used in AC plant, its construction, working, safety devices, piping lines. (07 hrs.)
Professional Skill 20 Hrs.; Professional Knowledge 05 Hrs.	Identify components of DX system. Test components, make wiring of dx system. Test leak and evacuate, gas charge the system and check the performance.	173. Identify various components of direct expansion type central AC plants. (10 hrs.) 174. Electrical circuit of direct expansion type central AC plants. (10 hrs.)	**DIRECT EXPANSION SYSTEM** Study Direct expansion system. Operation & Preventive Maintenance Schedule of central AC plant. Maintain log book

	Maintenance, trouble shoot and operate the plant. NOS- ELE/N3140		for daily operation. (05 hrs.)
Professional Skill 20 Hrs.; Professional Knowledge 6 Hrs.	Identify the different part of VRF/VRV system, check and service VRF/VRV system. NOS-ELE/N3141	175. Identify VRF / VRV system. (05 hrs.) 176. Check and service VRF / VRV system. (10 hrs.) 177. Identify error code. (05 hrs.)	VRF / VRV system – description and function of different parts. Details of piping have and controls system, Common reason for error code, types of ODU and IDU. (6hrs.)
Professional Skill 15 Hrs.; Professional Knowledge 07 Hrs.	Identify different part of indirect or chiller system. Check components and make wiring, leak test, evacuate and gas charge/ top up. Servicing the plant and trouble shoot. NOS-ELE/N3141	178. Service various components of indirect expansion type central AC plants. (05 hrs.) 179. Check electrical circuit of indirect expansion type central AC plants. (10 hrs.)	**INDIRECT/CHILLER SYSTEM** Study central station AHU and FCU, **Air washers** used in chilled water system, understanding lay out, modulating valves for temperature control. Expansion valves & other related control – description and function. (07 hrs.)
Professional Skill 20 Hrs.; Professional Knowledge 05 Hrs.	Identify chilled water pipe line. Servicing of dampers, FCU and water control valves. NOS- ELE/N3141	180. Insulate chilled water piping's. (08 hrs.) 181. Servicing of FCU and water control valves. (12 hrs.)	Study of Humidification & De-humidification. Humidifiers & De-humidifier's. Humidity control. Use of hygrometer. (05 hrs.)
Professional Skill 20 Hrs.; Professional Knowledge 10 Hrs.	Troubles shoot of both central A.C. plant Dx and indirect system. Check different control system installation of other major components, servicing of all parts including cooling tower and water treatment plant. NOS- ELE/N3141	182. Check Vibration eliminator and water proofing insulation. (5 hrs.) 183. Check different controls used in central AC system. (10 hrs.) 184. Trouble shooting of central AC. (5hrs.)	Construction and study of commercial A.C plant, package chillers, screw chillers, reciprocating chillers. (5 hrs.) Controls used in AC system, Electromechanical, pneumatic and electronic. Detail study of heat load calculation for commercial and industrial buildings. (5 hrs.)
Professional Skill 35 Hrs.;	Perform servicing of car AC. Fault diagnosis	185. Identify various mechanical and	**CAR AIR CONDITIONING** Study various components

Professional Knowledge 10 Hrs.	& remedial measures. NOS- ELE/N3141	electrical components used in car AC. (03 hrs.) 186. Testing of system components & fault finding (08 hrs.) 187. Install gauge manifold to check suction and discharge pressure in charging time and running time. (04 hrs.) 188. Leak testing using dry nitrogen, evacuation and gas charging (HFC-134a, HFO- 1234yf and blends of HFCs and HFOs). (04 hrs.)	and cycle of Car AC, electrical circuits , Study of good service practice, trouble shooting, Magnetic clutch operation, free movement of flywheel (nonfunctioning of clutch),care and maintenance. (05 hrs..)
	Perform Servicing, fault diagnosis, repair and maintenance of mobile A.C. leak test, evacuation, gas charging, check magnetic clutch and make wiring. Test performance after start. NOS- ELE/N3141	189. Installation and trouble shooting (08 hrs.) 190. Testing magnetic clutch, compressor overhauling, condenser cleaning and add refrigerant Regular maintenance (08 hrs.)	**MOBILE AC (Bus, train)** Construction and working of bus AC. Construction & working of train AC and its operation. Trouble shooting in train A.C. (5 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Perform preventive maintenance of different plants. Maintain log book based on daily operation. NOS-ELE/N3141	191. Study/execute repair of different commercial units at site. (13 hrs.) 192. Study/execute preventive maintenance of different commercial units at site. (12 hrs.)	Planning for Preventive maintenance and scheduling of maintenance activities in large AC and Refrigeration plant. (05 hrs.)
Engineering Drawing: 40 Hrs.			
Professional Knowledge ED: 40 Hrs.;	Read and apply engineering drawing for different application in the field of work. NOS-CSC/N9401	**ENGINEERING DRAWING:** Reading of Electrical, Electronic & Mechanical Sign and Symbols used in RAC. Sketches of Electrical, Electronic & Mechanical components used in RAC. Reading of Electrical wiring diagram and Layout diagram Drawing of Electrical circuit diagram used in RAC.	

		Drawing of Block diagram of Instruments & equipment of trades.
Workshop Calculation & Science: 40 Hrs.		
Professional Knowledge WSC: 40 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS- CSC/N9402	**<u>WORKSHOP CALCULATION & SCIENCE: (40 Hrs.)</u>** **Friction** Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction Friction - Lubrication Friction - Co- efficient of friction, application and effects of friction in workshop practice **Centre of Gravity** Centre of gravity - Centre of gravity and its practical application **Area of cut out regular surfaces and area of irregular surfaces** Area of cut out regular surfaces - circle, segment and sector of circle Related problems of area of cut out regular surfaces - circle, segment and sector of circle Area of irregular surfaces and application related to shop problems **Elasticity** Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus Elasticity - Ultimate stress and working stress **Heat Treatment** Heat treatment and advantages Heat treatment - Different heat treatment process – Hardening, tempering, annealing, normalising and case hardening **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade Estimation and costing - Problems on estimation and costing
Project Work/ Plant Visit: - **Broad area:** a) Central AC plant visit where direct chilling system available. b) Central AC plant visit where indirect chilling system available. c) Survey a heat load of a commercial/industrial building. d) Make a duct for central A.C		

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all trades) (120 Hrs + 60 Hrs)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in/ dgt.gov.in

ANNEXURE-I

LIST OF TOOLS AND EQUIPMENT			
REFRIGERATION AND AIR CONDITIONING TECHNICIAN (For batch of 24 candidates)			
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-21 is required additionally)			
S No.	**Name of the Tool & Equipment**	**Specification**	**Quantity**
1.	File flat rough double cut	200mm	5+ 1 nos.
2.	File, half round, fine double cut	length 150mm	5+ 1 nos.
3.	File, round, fine double cut	length 150mm	5+ 1 nos.
4.	File flat, fine double cut	length 150mm	5+ 1 nos.
5.	File square, fine double cut	length 150mm	5+ 1 nos.
6.	File triangular fine double cut	length 150mm	5+ 1 nos.
7.	Scriber	150mm length	5+ 1 nos.
8.	Centre punch	length 100mm	5+ 1 nos.
9.	Try square	150 mm	5+ 1 nos.
10.	Divider spring joint	length 150mm	5+ 1 nos.
11.	Caliper spring joint in side	length 150mm	5+ 1 nos.
12.	Caliper, odd leg, spring joint	length 150mm	5+ 1 nos.
13.	Hammer ball pane	220 gms	5+ 1 nos.
14.	Cold Chisel flat and cross cut	length 150mm	5+ 1 nos.
15.	Engineers rule	300mm long	5+ 1 nos.
16.	Tape measuring	10m graduation in mm	5+ 1 nos.
17.	Pliers combination insulated	length 200mm	5+ 1 nos.
18.	Pliers long nose	200 mm	5+ 1 nos.
19.	Pliers flat nose	150mm	5+ 1 nos.
20.	Line tester	500 v heavy duty	5+ 1 nos.
21.	Tweezers	10 cm	5+ 1 nos.
B. INSTRUMENT AND GENERAL SHOP OUTFIT			
GENERAL SHOP OUTFIT			
22.	Surface plate	45 x45 cms	1no.
23.	Oil can	500 ml	5 nos.

24.	Surface Gauge universal	150 mm	2 nos.
25.	Bench vice	150 to 300mm jaw	12 nos.
26.	Hack saw tubular metal frame adjustable	300mm	12 nos.
27.	Snip sheet metal straight nose	200 mm	6 nos.
28.	Snip sheet metal curved nose	200 mm	6 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.	Electrical drill portable drill with chuck and key	capacity 6.4mm	5 nos.
35.	Screw driver, plastic handle,	6mm TIP length 100mm to 150mm	6nos.
36.	Screw driver, plastic handle, Flat tip	10mm TIP length 200mm & 250mm	6 nos. each
37.	Philips screw driver -	complete set in leather case	5 nos.
38.	Screw driver, plastic handle, Flat tip	handle 3mm TIP length 100mm to 150mm insulated	5 nos.
39.	Soldering iron exchangeable copper tip	65 watts	12 nos.
40.	Knife folded stainless steel -	150mm	12 nos.
41.	Tong tester (clamp on multi meter)	0-10-30 amps 0-500 v	5 nos.
42.	Tenon saw	250 mm	5nos.
43.	Firmer chisel	6,12,25mm	2 nos.
44.	Rawal plug tool	6 mm	2 nos.
45.	Fire extinguisher	ABC dry powder type2 kg capacity	2 no.
46.	Fire buckets	10 Litre	3 nos.
47.	D.E spanner	6-32 mm	5 set
48.	Ring spanner	6 -32 mm	5 set
49.	Quick couples, process tube adopter	¼" & 3/8" 5/16",3/16"	4 nos. each
50.	Tong Close mouth and pick		1 no.

51.	Welding table for gas/Arc	1200x760	1no. each
52.	Flaring tool set, single type for tube.	4.7mm to 16mm O.D	5 nos.
53.	Swaging tool, punch type, set of size for tube.	4.7mm to 16mm O.D	5sets
54.	Bending spring external type, for copper tube	3mm to 16mm DIA	5sets
55.	Pipe cutter miniature for copper tube	3mm to 16mm DIA	5sets
56.	Pinch of tool, for copper tube,	6mm to 18mm DIA	5sets
57.	Ratchet spanner	6.4 sq.mm reversible	5sets
58.	Capillary plug gauge		5sets
59.	Piercing pliers & reversing valve with access fitting	6-18mm	5sets
60.	Spanner double ended	4.7mm to 16mm	5sets
61.	Ring spanner off set	4.7mm to 16mm	5sets
62.	Wrench adjustable	length 150mm	5sets
63.	Wrench adjustable	length 200mm	5sets
64.	Wrench adjustable	length 250mm	5sets
65.	Valve key handle[Treated as consumable]	4.7mm & 6.4mm sq.	5sets
66.	(Hollo) Punch hole for cutting gasket	4.7-16mm die	2sets
67.	Scissor, gasket cutting stainless steel	length 25mm	5sets
68.	L-Allen key	set size 1.5mm to 6.4mm	5 sets
69.	T-Allen key set	size 5/32" to 1/8"	5sets
70.	Pipe cutter with built in reamer and space cutter, for copper tube	3mm to 32mm	5nos.
71.	Pipe /Tube bender lever type	3-16 mm	1 no each
72.	Spanner double ended	19mm to 31.8 mm	5nos.
73.	Pipe wrench	size 50mm to 150mm	5nos.
74.	Lapping plate	250mm x 200mm	2nos.
75.	Hammer ball peen	450 gms	5nos.

76.	Puller 3 legged with flexible arm	300mm	5nos.
77.	Hand blower portable complete	1/10 HP	2nos.
78.	Spirit level precision metallic	200mm	2nos.
79.	Tap set with matching drills	3 mm to 16mm	3nos.
80.	Tap set with matching drills	V to 5/8"	3nos.
81.	Refrigerant cylinder	2.5 Kg	3nos.
82.	Heating kit with infrared bulb	(200 w capacity)	2nos.
83.	Plumbing hammer weight	200 gm	2nos.
84.	Cylinder 134 a	5 kg	1 no.
85.	Torque Wrench	300mm-12.7mm	1 no.
86.	Piercing Valve	¼ Inch	2 nos.
87.	Feeler gauge	0.05mm to 1mm	3 nos.
88.	Four way reversible valve		1 no.
INSTRUMENT			
89.	Vernier height gauge	300mm, LC 0.02	1 set
90.	Tape measuring graduation in mm	2 m	5nos.
91.	Voltmeter, AC/DC portable precision grade Digital Panel board type	0 to 500 volts	5nos.
92.	Ammeter, AC/DC portable precision grade Digital Panel board type	0 to 30 amp	5nos.
93.	Megger	1000v	5nos.
94.	Wattmeter multi-range up	1 KW	1no.
95.	Multi meter digital type		5nos.
96.	K.W. meter	0 -1 K w	4 no.
97.	Service Oscillator		1 no.
98.	C.R.O Single beam	5 MHZ	2 nos.
99.	C.R.O Dual trace/ Double beam	60 MHZ	2 nos.
100.	A.F.O Oscillators		2 nos.
101.	Pressure gauge Digital type	diameter 63mm with recalibration set	5sets

102.	Compound gauge, Digital type	diameter 63mm, with recalibration set screw, scale vacuum 760mm. Pressure 15 Kg/sq.cm	5sets
103.	Service man thermometer in metal case	- 30^0C to +110^0 C	5sets
104.	Gas leak detector for halogen gas		2nos.
105.	Electronic leak detector		2 nos.
106.	Sling psychrometer mounted on aluminum back,	scale -10^0 C to +110^0 C	5nos.
107.	Stop watch		2nos.
108.	Vernier caliper	length 250mm	2nos.
109.	Micrometer outside measurement	0 to 25mm	2nos.
110.	Multi meter analogue type		5nos.
111.	Tachometer digital, multi range	0 r m p to 3000 r m p. Portable small size in leather case	2nos.
112.	Micron vacuum gauge	capable of reading up to 20 microns	2nos.
113.	Sensor thermometer (digital)	-50 degree Celsius to 150 degree Celsius	2nos.
114.	Fin straightened/fin comb.	With strong steel wire-based combing on wood	3nos.
115.	Filler gauge	0.05 mm - 1 mm	3nos.
116.	Wire gauge metric & British.	Steel plate embossing converse of British & Metric	2nos.
117.	Dial thermometer remote control, armored capillary dial	75mm - 50C to +50 C	3nos.
118.	Anemometer	Digital type	1no.
119.	Compressors testers for small hermetic compressors	Fixed with electrical input/ output indicating facilities	2nos.
120.	Digital thermometer	Graduated disc analogy type	1no.
121.	Temperature &Humidity recorder	Capacity to record 24 hrs. record	1no.
122.	Instrumentation screw driver set	100mm	5nos.
123.	Digital weighing machine	100 kg	1no.
GENERAL MACHINERY SHOP OUTFIT			
124.	Split phase induction motor	1hp, 230 V	1 no.
125.	BLDC motor with controller	15 – 30 watts,315 Volt DC	2 nos.

126.	IDU Pulse Generation type motor	15watt,230volt A.C	2 nos.
127.	Capacitor start induction motor	1 Hp, 230 V	1 no.
128.	AC 3 Phase motor, 400/50 Hz	2 Hp	1 no.
129.	Star delta starter	2 hp	1 no.
130.	Auto Transformer starter	3 hp	1 no.
131.	D.O.L Starter	2 hp	1 no.
132.	Portable air - LPG brazing kit	2 kg. LPG cylinder, torches, houses, stand make	1 no.
133.	Oxy-acetylene welding set complete	cylinders, regulators welding torches with difference nozzles	1 no.
134.	Single door direct cool refrigerator, carrying with HFC and HC	185 L / R 600/ HFC	1 each
135.	Frost free refrigerator	200L carrying with HC blend	2 nos.
136.	Three/four door refrigerator (Inverter type)	300L carrying with HC R-600a	2 nos.
137.	Core drill machine.		1 no
138.	Bench Drilling machine	20 mm capacity,200-2500rpm	1 no.
139.	Grinding Machine	200mm,3000rpm,Double ended1/2 hp	1 no.
140.	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	(CAP. 2 kg. In lieu of (b)above and with accuracyof + / - g for charging hydrocarbons)	1 no.
141.	Evacuating and charging station as above but fitted with weighing scale		1 no.
142.	Two stage rotary vacuum pump,3or 4 CFM.	capacity approx. 60 - 10rmp capable of evacuating to 50 microns of Hg and fitted with gas ballast,	1 no.

		anti-such back valve and single-phase motor	
143.	Dry N_2 cylinder	2 stage regulator or commercial N_2 in cylinder with drier unit and 2 stage regulator & meter cube	1 no.
144.	Window A.C	1 Ton with R-22 Blend reciprocating compressor	2 nos.
145.	Split A.C	1.5 Ton with R134a or R-22 reciprocating compressor	2 nos.
146.	Duct able split A.C 1.5 ton	1.5 Ton with R134a or R-22 reciprocating compressor	1 no.
147.	Recovery unit with cylinders	CFC, HFC&HCFC	1 each
148.	Decibel meter	30-100 db	1 no
149.	Cassette Air conditioner	4500 kcal/hr	1 no.
150.	De scaling pump set	with stainless steel impeller and housing complete with motor 1/2 hp and accessories	1 no.
151.	Fan coil unit	with water valves (2 & 3 way)	1 no.
152.	Shell and tube, DX chillers (small)	5 Ton with Cu tubing only	1 no.
153.	Circulating water pump (small)	0.5 H.P with stainless steel tank capacity 20 liters within let/ outlet provision.	1 no.
154.	Refrigerant Cylinder	10 kg capacity	2 nos.
155.	Gauge manifold with gauges	Different size of hoses for R 134a,R22 and R 410.	3 nos. each
156.	Shell and tube type condenser	5 Ton	1 no.
157.	Rotary hermetic compressor	2 Ton	1 no.
158.	Bottle cooler visible	200 L carrying with HFC-134a& reciprocating compressor	1 no.
159.	Deep freezer	200 L carrying with HFC-134a& reciprocating compressor	1 no.
160.	Display Cabinet	2 ton capacity	1 no.
161.	Water cooler storage type	200 L carrying with HFC-134a& reciprocating compressor	2 no.
162.	Water dispenser bubble type (Hot and Cold)	2.5 to 3ltr. Delivery capacity per hour	1 no.
163.	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.
164.	Air-conditioning, direct system.	Complete with all controls including humidity control	1 no.

165.	Air-conditioning, indirect system. (water cooled)	Complete with all controls including humidity control	1 no.
166.	Package A/C	5-ton capacity, Air cooled type with open type compressor reciprocating type	1 no.
167.	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
168.	CAR AC tutorial model		1 set
169.	Bus AC tutorial model		1 set
170.	Automatic ice cube m/c	50 kg/hour	1 no.
171.	Storage type water cooler (hot and cold)		1 no.
172.	Visi cooler	185 L	
173.	VRF/VRV unit with two indoor units 2.5TR each and 5TR capacity out door unit complete with air cooled condenser, accessories and controls.		1 no.
174.	Split A/C (inverter technology)	1.5 TR	2 nos.
175.	Walk in cooler PUF insulated for cold room 6X4.5X8 cft.	temperature 0^0-5^0 c	1 complete set
176.	Absorption system	Small size	1 no
WORKSHOP FURNITURE			
177.	Class room table	One table for each trainee size of 2.5 provisions with open rack. Frame square conduit of1”. top sun mica ply board	24 nos.
178.	Work bench	2000 x1000 x 700 mm with 2" pipe frame. Top with teak slab and fixing with3/4" good quality rubber sheet.	6 nos.
179.	Almirah	195 x90 x 48 cm outer sheet 20 SWG inner partition with four selves of 22Swg	4 nos.
180.	Lockers	195 x 90 x 48 set six locker in one	2 nos.

		structure	
181.	Glass board portable	2.5'X4' with stand	2 nos.
182.	Instructor table	4'X2'X2.5' with steel tubular frame & sun mica top	1 no.
183.	Instructor chair	Standard revolving with wheel	1 no.
184.	Computer table	Standard with drawers & self to accommodate UPS&CPU	1 no.
185.	Computer chair	Revolving type metal based & metal wheel standard one	1 no.
186.	White board	4'X3' ferrous base sheet to hold magnetic duster with white finish surface.	1 no.
187.	Chart stand	6'X3' providing with hanging clip top & bottom plate	1 no.
188.	Desktop Computer	CPU: 32/64 Bit i3/i5/i7 or latest processor, Speed: 3 GHz or Higher. RAM:-4 GB DDR-III or Higher, Wi-Fi Enabled. Network Card: Integrated Gigabit Ethernet, with USB Mouse, USB Keyboard and Monitor (Min. 17 Inch. Licensed Operating System and Antivirus compatible with trade related software.	1 no.
189.	LCD Projector / LED / LCD TV	Big Size	1 no.
190.	Laptop	Latest version	1 no.
191.	UPS		As Required
192.	Copier machine.		1 no
193.	Interactive Board	Latest version	1 no
194.	Stool	2’ x 1.5’	24 nos.
195.	Book Self with glass panel	6’ x 3’	1 No.
196.	Storage rack	6’ x 3’	2 nos.
197.	Storage shelf	6’ x 3’	2 nos.

Note:

1. *Tools and equipment items if not available as per specification may be procured similar item nearer to the specification.*

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्