



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

COMPETENCY BASED CURRICULUM

CERTIFICATE COURSE ON

FUNDAMENTAL OF HEATING VENTILATION AND AIR CONDITIONING



NSQF LEVEL- 3.5

SECTOR - CAPITAL GOODS AND MANUFACTURING

FUNDAMENTAL OF HEATING VENTILATION AND AIR CONDITIONING

Duration: 240 Hours

NSQF LEVEL- 3.5
(Version: 1.0)

Designed in 2024

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

&

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

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1. COURSE INFORMATION

1.1 GENERAL

This course has been developed for CTS/CITS trainees to take up as optional courses during course of study for technical and behavioural upgradation of trainees to meet industry related job roles. During the 240 hours duration of HEATING VENTILATION AND AIR CONDITIONING BASICS course, a candidate is trained on professional skills & knowledge related to job role. The Broad components covered during the course are given below:

Heating, Ventilation and Air Conditioning (HVAC) Technician is a professional who installs and repairs various home heating and cooling systems year-round. HVAC Technicians work with furnaces as well as thermostats and air conditioning systems to ensure everything runs smoothly throughout a customer's home or office building.

1.2 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of 6 weeks: -

S No.	Course Element	Notional Training Hours
1.	Professional Skill (Trade Practical)	180
2.	Professional Knowledge (Trade Theory)	60
	Total	240

1.3 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through assessment at the end of the course through skill testing at Training Center & CBT through examination conducted by DGT.

The minimum pass percentage for skill test is 60% and for theory will be 33% as in main CTS examination.

2. 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, insulating, 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

Mapped NOS:

- i) CSC/N9633

3. GENERAL INFORMATION

Name of the Trade	FUNDAMENTAL OF HEATING VENTILATION AND AIR CONDITIONING
Reference NCO - 2015	7127.0100
NOS Covered	CSC/N9633
NSQF Level	Level – 3.5
Duration of Craftsmen Training	240 Hours
Entry Qualification	10 th Class passed and pursuing/ passed out CTS in RAC Technician/ CITS in Mechanic RAC
Unit Strength (No. of Student), Space & Power Norms	As per RAC Technician trade under CTS
Instructors Qualification	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 Refrigeration and Air Conditioning Technician (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.
List of Tools and Equipment	As per Annexure – I

4. LEARNING OUTCOME

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

4.1 LEARNING OUTCOMES

1. Recognize & comply safe working practices, HVAC tools & equipment and concept of HVAC plant layout.
2. Identify Eco-friendly gas & energy saving machines in HVAC industries.
3. Plan & carryout installation, fault detection and service of HVAC system.
4. Test, perform & maintain indoor air quality (IAQ) in HVAC.
5. Test, service the various components & maintain air cycles in HVAC.
6. Carryout faults diagnosis, preventive and breakdown maintenance in HVAC.

SYLLABUS – FUNDAMENTAL OF HEATING VENTILATION AND AIR CONDITIONING			
Duration: 240 Hours			
Duration Weeks	Reference Learning outcome	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
Practical 20 Hrs Theory 10 Hrs	Recognize & comply safe working practices, HVAC tools & equipment and concept of HVAC plant layout	1. Identification of HVAC equipment (Domestic & Central Air conditioning system), tools & different parts. 2. Study of indoor & outdoor units air quality (IAQ) by using psychrometer and psychrometric chart. 3. Service indoor & outdoor units with check cooling coil, heating coil, damper operation.	- Standard Safety precautionary measures for HVAC. - Basic thermodynamic cycle of HVAC - Heat load calculation. - Reverse cycle, heat pump - HVAC conception to provide good indoor quality of air (IAQ). - Types of HVAC. - Description of HVAC - Eco-friendly & Energy saving machineries & gases. - Psychrometric, study of air - Psychrometric chart, comfort chart, different cycle in HVAC. - Different terminology & capacity (TR/LTR)
Practical 35 Hrs Theory 10 Hrs	Identify Eco-friendly gas & energy saving machines in HVAC industries	4. Practical measurement and understanding of COP, EER & IKW/TR by using various instruments.	- Air conditioner systems, domestic, commercial, semi commercial, industrial. - Heating & cooling. COP, EER & IKW/TR calculations. - Description of various parts, major components of HVAC. - Eco-friendly refrigerants. - Properties, pressure, temperature relation. - PH charts, Pv charts operating pressure & temperature.

Practical 35 Hrs Theory 10 Hrs	Plan & carryout installation, fault detection and service of HVAC system	5. Assemble the major components. 6. Pressure test by Dry Nitrogen. 7. Leak detection and rectification. 8. Pump down the system stripping of major components. 9. Evacuate & hold the vacuum. 10. Gas charge 11. Test running performance pressure, temperature, noise level. 12. Calibrate EEV or other feeding device.	• IAQ maintain in A/C room • Detail of air circulation in AHV, FCU, heating, cooling, filtering, damping of air & supply, through ducts. • Description of EEV/TXV & other liquid control • Basic Digital Electronics measuring instruments.
Practical 35 Hrs Theory 10 Hrs	Test, perform & maintain indoor air quality (IAQ) in HVAC	13. Service blowers, fans, pumps check wiring/circuits of inverter/ BLDC motors. 14. Check inverter compressor, controller PCB, sensors. 15. Inverter circuit input output voltage, frequency checking.	• Description of blowers, fans, pumps, inverter technology BLDC compressors motors. • Description of PCB, sensors & controller & safety cut outs. • Description of VFD/VRF. Introduction of Central A/C system, Dx & indirect chiller A/C system.
Practical 20 Hrs Theory 10 Hrs	Test, service the various components & maintain air cycles in HVAC	16. Service VFD, VRF system 17. Service central system water pump/ Float valve, casset air conditioning system. 18. Check air circulation in ductable and non ductable system diffusers & return grills.	• Air circulation through duct. • Description of diffusers, supply & return grill, damper, air filters. Types of different filters. • Description of caustic insulate, centrals vibration absorber • Introduction to air changes requirement.
Practical 35 Hrs Theory 10 Hrs	Carryout faults diagnosis, preventive and breakdown maintenance in HVAC.	19. Faults diagnosis & remedial measures. 20. Service of major coils filters, dampers of AHU (Air Handling Unit) 21. Descaling of coils, pipe lines, cooling tower & chiller, condenser check	• Description of commercial compressor, chiller, condenser, safety controls preventive maintain & log sheet maintain.

		multi -indoor and single outdoor unit. 22. Check safety cut outs and controls/ sensors. 23. Preventive maintenance safety checkup, maintain observation sheet/records (Log sheet)	

6. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENT CRITERIA
1. Recognize & comply safe working practices, HVAC tools & equipment and concept of HVAC plant layout	Identify tools and instruments for testing of HVAC tools & equipment
	Identified the major parts & components of HVAC system
	Check the parts of indoor & out door units
	Identified the leaks by nitrogen pressure
	Repair the leaks & service the indoor & out door coils
	Service filter & damper of An air Handling Unit (AHU)
	Use psychrometer & check the properties of air by the help of psychometric chart.
2. Identify Eco-friendly gas & energy saving machines in HVAC industries.	Ascertain and select tools and materials for Eco-friendly gas & energy saving machines
	Leak test of different coils & pipe line
	Repair leak
	Evacuate the unit
	Measure the vacuum by micron gauge
	Gas charge by different methods
	Check operating pressure temperature
	Observe the performance
3. Plan & carryout installation, fault detection and service of HVAC system.	Service the HVAC system
	Check air velocity of different parts by anemometer
	Check voltage, current, wattage by the meters
	Check noise level & IAQ (indoor air quality)
	Calibrate & adjust the EEV & others feeding
	Check safety cut outs & controls
	Check PCB & Sensors
4. Test, perform & maintain indoor air quality (IAQ) in HVAC.	Pump down the system
	Strip out the components
	Service the coils by flashing & remove contaminants & deposited oil.
	Clean & wash the coil fins.
	Service blowers, fans, pumps & motors, heating coils
	Check inverter compressor BLDC motors
	Make wiring with PCB, Sensors, Controls, Cutouts.
5. Test, service the various components & maintain air cycles in HVAC.	Service VFD, VRF system
	Check pump, plot valves cut outs in VRV system
	Check air circulation in ductable, non ductable system
	Check air circulation in AHV return, diffuser and fresh air mixture zone
	Check insulation in duct
	Identify the vibration & noise reasons. Check canvas & mounting of

	supply air.
	Check conditioned supply air temperature from canvas.
6. Carryout faults diagnosis, preventive and breakdown maintenance in HVAC.	Check chiller incoming, outgoing water temperature
	Check dx system AHU return & supply air temperature
	Check & find cooling tower range & approach
	Run the plant & check the operation. (Temperature & pressure)
	Carefully service & routine maintenance of different parts
	Check components, feeding device, solenoids & safety cut outs.
	Record & maintain the operational data in log book regularly

LIST OF TOOLS & EQUIPMENT			
FUNDAMENTAL OF HEATING VENTILATION AND AIR CONDITIONING			
S No.	Name of the Tools and Equipment	Specification	Quantity
Same as RAC Technician Trade under CTS			
Additional Tools & Equipment required			
1.	Multimeter digital		2 Nos.
2.	Hand held digital temperature & hygrometer		2 Nos.
3.	Tachometer digital	Upto 3000 rpm	2 Nos.
4.	Micron vacuum gauge	Up to 100 microns	2 Nos.
5.	Dial type thermometer (digital)	-50°C to 50°C	2 Nos.
6.	Two stage high vacuum pump	Up to 50-micron level	2 Nos.
7.	Weighing machine digital	Up to 100 kg.	2 Nos.
8.	Charging station with calibration cylinder		1 No.
9.	Nitrogen cylinder with 2 stage regulator		1 No.
10.	Air-conditioner direct system with controls	5 TR	1 No.
11.	Air-conditioner indirect system with control	5 TR	1 No.
12.	Cassette air conditioner	1.5 RT	1 No.
13.	Shell & Tube condenser	5TR capacity	1 No.
14.	Shell & Tube chiller	5TR capacity	1 No.
15.	VRF/VRV with 2 indoor	1.5 TR each	1 No.
16.	VRF/VRV with 1 out door (complete with air coolers/ water coolers condenser)	5TR capacity	1 No.
17.	Walk in cooler (mini cold storage) complete with other accessories	0-5°C	1 No.
18.	D.B meter	30-100 db	1 No.
19.	Gauge manifold with hose		1 No.
20.	Air blower		1 No.

ANNEXURE-II

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts and all others who contributed in designing/ revising the curriculum. Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

Trade committee meeting to finalize the syllabus of “Fundamental of Heating Ventilation and Air Conditioning” held on 16.04.2024 at CSTARI.			
Sl. No.	Name and Designation (Shri/Smt./Kumari)	Organization with Address	Remarks
1.	G C Saha, Jt. Director	CSTARI, Kolkata	Chairman
2.	Brindaban Das, Dy. Director	CSTARI, Kolkata	Member
3.	Joydeb Roy Chowdhury, Instructor	Govt. ITI, Tollygaunge	Member
4.	Binoy Krishna Biswas, Asst. Professor	B.P.P. Institute of Management & Technology, Kolkata – 700 052	Member
5.	Dilip Kumar Chattopadhyay, Ex-ADT	46 A/8, Shibpur Road, Howrah – 2	Member
6.	Rounak Bandopadhyay,	Zreyas Technology. New Town, Kolkata	Member
7.	Subrata Pully, Supervisor	Govt. ITI, Gariahat	Member
8.	Jayanta Koley,	ITI Durgapur	Member
9.	Jaharlal Maity, Instructor (RAC)	Govt. ITI, Gariahat	Member
10.	Atanu Ghosh, Training Officer	NSTI, BBSR, Odisha	Member
11.	Anurag Chakraborti, Asst. Professor	Techno Engineering Collage, Banipur, Habra	Member
12.	Subhankar Bhattacharjee, Asst. Professor	Techno Engineering Collage, Banipur, Habra	Member
13.	Amaresh Naskar, Instructor	Govt. ITI, Tollygaunge	Member
14.	Md. Waseem Siddiqui,	VECC/DAE I/AF Bidhannagar, Kolkata – 64	Member
15.	Atanu Bhuniya, Instructor (RAC)	Govt. ITI, Howrah Homes, Santaragachi, Howrah	Member
16.	Prodip Mukhopadhyay, Former MD – Webel and Sr. Advisor - MAKAUT	Webel MAKAUT	Member
17.	B. Sharanappa, AD	CSTARI, Kolkata	Member
18.	Sk. Altaf Hossain, AD	CSTARI, Kolkata	Member
19.	Murari Barui, AD	CSTARI, Kolkata	Member
20.	Akhilesh Pandey, AD	CSTARI, Kolkata	Member
21.	Nirmalya Biswas, PA to Dir.	CSTARI, Kolkata	Member
22.	B. Biswas, TO	CSTARI, Kolkata	Member
23.	P.K. Bairagi, TO	CSTARI, Kolkata	Member

24.	B K Nigam, TO	CSTARI, Kolkata	Member
25.	K.V.S. Narayana, TO	CSTARI, Kolkata	Member
26.	Pradip Biswas, Jr. D/man	CSTARI, Kolkata	Member
27.	Hemant Kujur, Jr. D/man	CSTARI, Kolkata	Member
28.	Abhisek Mitra, HOD INCHARGE	Asansol institute of engineering and management polytechnic Kalipahari Asansol	Member
29.	SUNIL SITARAM CHORE, CMD, SIMUSOFT TECHNOLOGIES, PUNE	SIMUSOFT TECHNOLOGIES B11-1204, NEAR IBM INFOCITY, KUMAR INFENIA, PHURSUNGI, PUNE 412308	Member
30.	Makarand Joshi, Product Manager	Grok Learning Pvt. Ltd. Plot No. 29, Amba Bhavan, 3rd Floor, 'A' Wing, Sion Circle (West), Mumbai	Member
31.	Kunal Sharad Bhagat, Development Engineer	Grok Learning Pvt Ltd 3rd Floor, A-wing, Amba Bhavan, Plot No 29, Next to Bharat Petrol Pump, Sion Circle (west), Mumbai 400022	Member
32.	MANOHAR SADASHIV DESAI, Technical Head	SKILL BAHN LLP. UNIT NO. 912 / Plot-B, Lodha Supremus, Lodha Business District, Kolshet Rd, Thane, Maharashtra 400607	Member
33.	Mandar Bhate, Associate Manager	Tata Technologies Ltd Hinjewadi, Ph-1, Pune, Maharashtra	Member
34.	Ashish Kulkarni, Industrial Skill Consultant	Bhan skill Mumbai Thane Mumbai	Member