

CBSE | DEPARTMENT OF SKILL EDUCATION

CURRICULUM FOR SESSION 2022-2023

AIR CONDITIONING & REFRIGERATION (SUB. CODE – 827)

JOB ROLE: SERVICE TECHNICIAN

Class XI & XII

OBJECTIVES OF THE COURSE

After successfully completing these two years of Senior Secondary skill course, the student would have acquired relevant appropriate and adequate technical knowledge together with the professional skills and competencies in the field of Air conditioning and Refrigeration Technology so that they will be able to properly equipped to take up gainful employment in this sector.

Thus he should have acquired:

A. Understanding of

- a) The relevant basic concepts and principles in basic science subjects (Physics, Chemistry and Mathematics) so that he/she is able to understand the different vocational subjects.
- b) The basic concepts in engineering drawing.
- c) The concepts and principles of working of refrigeration and air- conditioning equipment.
- d) The knowledge of testing, faults, identification and repair procedures in respect of refrigeration and air conditioning equipment.
- e) The knowledge to prepare estimates for cost of repair/ installation/ maintenance/ overhauling jobs.

B. Adequate Professional Skills and Competencies in

- a) Testing, fault location and repairing of refrigeration and air-conditioning equipment.
- b) Installing and commissioning of refrigeration and air-conditioning equipment.
 - c) Carrying out preventive maintenance of refrigeration and air-conditioning equipment.
 - d) Dismantling, overhauling and reassembling of refrigeration and air-conditioning equipment.

C. A Healthy and Professional Attitudes of that. He/ She has

- a) An analytical approach while working on a refrigeration or air-conditioning equipment.
- b) An open mind while locating/ rectifying faults in refrigeration or air-conditioning equipment.
- c) Respect for working with his/her own hands.
- d) Respect for honesty, punctuality and truthfulness.

SCHEME OF UNITS

This course is a planned sequence of instructions consisting of units meant for developing employability and vocational competencies of students of Class XII opting for skill subject along with other education subjects.

The unit-wise distribution of hours and marks for class XII is as given on the next page

AIR CONDITIONING & REFRIGERATION (SUBJECT CODE - 827)**Class XI (Session 2022-2023)****Total Marks: 100 (Theory – 60+ Practical – 40)**

	UNITS	NO. OF HOURS for Theory and Practical		MAX. MARKS for Theory and Practical
Part A	Employability Skills			
	Unit 1 : Communication Skills-III	10		2
	Unit 2 : Self-Management Skills-III	10		2
	Unit 3 : ICT Skills-III	10		2
	Unit 4 : Entrepreneurial Skills-III	15		2
	Unit 5 : Green Skills-III	05		2
	Total	50		10
Part B	Subject Specific Skills	Theory (In Hours)	Practical (In Hours)	Marks
	Unit 1: Meaning of Air Conditioning and Refrigeration etc.	35	10	07
	Unit 2 : Vapour Compression Cycle, Working of a Domestic	30	10	10
	Unit 3 : Meaning of Compressors, Compressor construction	20	08	08
	Unit 3 : Meaning of Compressors, Compressor construction	07	02	02
	Unit 4 : Meaning of Alternating Current etc., Wiring circuit diagrams	22	08	08
	Unit 5 : Psychometrics– Composition of air, Human comfort etc.	24	06	08
	Unit 6 : Applications of Air Conditioning, Measurement of air velocity	22	08	07
	Total	160	50	50
Part C	Practical Examination			15
	Written Test			10
	Viva Voce			05
	Total			30
Part D	Project Work/Field Visit/ Practical File/Student Portfolio			10
	Total			10
	GRAND TOTAL	260		100

DETAILED CURRICULUM/TOPICS FOR CLASS XI

PART-A: EMPLOYABILITY SKILLS

S. No.	Units	Duration in Hours
1.	Unit 1: Communication Skills-III	10
2.	Unit 2: Self-management Skills-III	10
3.	Unit 3: Information and Communication Technology Skills-III	10
4.	Unit 4: Entrepreneurial Skills-III	15
5.	Unit 5: Green Skills-III	05
	TOTAL DURATION	50

NOTE: Detailed Curriculum/ Topics to be covered under Part A: Employability Skills can be downloaded from CBSE website.

PART-B – SUBJECT SPECIFIC SKILLS

- ❖ Unit 1: Meaning of Air Conditioning and Refrigeration etc.
- ❖ Unit 2: Vapour Compression Cycle, Working of a Domestic Refrigerators
- ❖ Unit 3: Meaning of Compressors, Compressor construction
- ❖ Unit 4: Meaning of Alternating Current etc., Wiring circuit diagrams
- ❖ Unit 5: Psychometrics– Composition of air, Human comfort etc.
- ❖ Unit 6: Applications of Air Conditioning, Measurement of air velocity and flow

1. INTRODUCTION:

Thermodynamics and Its laws, meaning of Air Conditioning and Refrigeration, Brief history of Air Conditioning and Refrigeration, general safety, Application of Refrigeration, Concept of System, its boundary, and surroundings, Unit of Refrigeration, specification and uses of Refrigeration tools, Equipment, Instruments. Basic knowledge of heat energy. Comparison of heat engine, heat pump and refrigeration machine. Rating of Refrigeration Machines & Co-efficient of performance (C.O.P).

2. REFRIGERATION CYCLE AND APPLICATIONS:

- (i) Vapour Compression Cycle, Representation of Vapour Compression Cycle on temperature– entropy and pressure– enthalpy diagram, Effect of sub-cooling, Super heating, change in suction pressure and discharge pressure on coefficient of performance, Deviation of actual cycle from the theoretical cycle.

- (ii) Working of a Domestic Refrigerator, water cooler & Deep Freezer, Refrigeration tools and materials, tubing, cutting, bending, flaring, joining, swaging, instruments and gauges.

3. COMPRESSOR:

- (i) Meaning of Compressors, Types of compressor-reciprocating (semi-hermetic, hermetic and open types), rotary, centrifugal and screwed type, working of compressor.
- (ii) Compressor construction, valves, piston, connecting rods, crankshafts, seals, oil circulation, hermetic and semi-hermetic units, cooling of windings, Mufflers.

4. BASIC ELECTRICITY:

- (i) Meaning of Alternating current, D.C. Current and difference between them, Voltage, phase difference. Knowledge of Ohm's law and its representation on V-I graph, Resistance and its unit, measurement of current, voltage and power.
- (ii) Wiring circuit diagrams of Refrigerators and Air-Conditioners.

5. PSYCHROMETRY AND HUMAN COMFORT:

- (i) Psychrometry, composition of air, moist air, vapours and gases, specific humidity, absolute humidity, degree of saturation, relative humidity, Dry Bulb Temperature, Wet bulb Temperature, wet bulb depression, Dew point temperature, dew point depression.
- (ii) Human comfort, concept of effective temperature, comfort zone.

6. APPLICATION OF AIR CONDITIONING, MEASUREMENT OF AIR VELOCITY AND FLOW:

- (i) Applications of Air Conditioning, comfort, industrial and process Air Conditioning, study of window type air conditioners, package units, Central Air conditioning plants.
- (ii) Measurement of air velocity and flow.

PRACTICALS

Time: 3 Hours

Marks: 40

1. To learn proper techniques of cutting, fitting, reaming, bending, flaring of soft and hard copper Tubing, swaging etc.
2. To learn brazing of copper tubing.

3. To understand the construction and functions of reciprocating compressors, condensers and evaporators.
4. To study a hermetic unit and its testing.
5. Study of various types of compressors, dismantling and assembling of compressors.
6. Testing of reciprocating compressors.
7. To study Domestic Refrigerator and water cooler.
8. Study of window, split and package type air-conditioner.
9. Charging and testing of Air-Conditioner.
10. Measurement of voltage, current, power etc.
11. Making electric circuit diagrams for refrigerators and Air-conditioner.
12. Study of tools and materials, instruments and gauges.
13. To study the safety measures to be taken in a workshop

LIST OF EQUIPMENT AND MATERIALS

List of Equipment used in Air-Conditioning & Refrigeration work-shop:

1. Window type Air-Conditioner
2. Split type Air-Conditioner
3. Refrigerator
4. Water-cooler
5. Deep-freezer
6. Refrigerant charging machine
7. Vacuum-pump
8. Pressure gauge
9. Compound gauge
10. Charging line
11. Shut-off valves
12. Service valves
13. Gauge-manifolds
14. Refrigerant-Cylinders
15. Condensing unit
16. Cut-model of hermetically sealed compressor

Tools:

1. Plier

2. Nose-plier
3. Screw Driver
4. Punching-tool
5. Flaring Tool
6. Swaging tool
7. Tube-cutter
8. Tube-bender
9. Wrench seteeler-gauge
10. Brazing-tool kit.
11. Different sizes of flaring nuts.
12. Allen key set.
13. Thimbles
14. Wire-cutter
15. Spanner-Set
16. Tommy set
17. Bench-Vice
18. Files (Triangular and flat files etc.)
19. Round file
20. Hand Hack-Saw
21. Portable Drill-machine

Raw-Materials for Air-Conditioning &Refrigeration work-shop:

1. Different sizes of copper tube (1/4", 3/8", 5/8", 1/2" etc.)
2. Compressor oil.
3. Brazing rods
4. Flux
5. Filler-materials
6. Emery paper
7. Hake-Saw blade
8. Different sizes drills (2mm, 4mm etc.)
9. Refrigerants.

CAREER OPPORTUNITIES

After completing this two year A.C.& Ref. skill course of CBSE at +2 level a student has the following career opportunities: -

1. Student shall be gainfully employed in Domestic, Ice-factory, cold storage plant, specialized A/C units and Refrigerator and A/C manufacturing plants.
2. 'Easy to employ in different government, semi-government and private sector such as: - Public Health, Railways, Hospitality, Health-department, Air-lines and many other engineering departments.
3. They can start their own enterprise by setting up manufacturing or servicing work-shops etc.
4. They can get franchisee of different renowned companies like: - Voltas, Godrej, Samsung, whirlpool etc.
5. More employment opportunities at International level.

VERTICAL MOBILITY

1. Great opportunities for higher study in National & International level.
2. A student can get admitted in 2nd year of 3-year Engineering Diploma course in the respective field like- Mech. Engg, Electrical Engg. etc. and further in 2nd year of 4-year B. tech course through lateral entry.
3. A student can get admission in Bachelor of Vocational (B.Voc.) course of 3-year duration in various universities.
4. Also eligible to continue in degree course of academics from various universities.

AIR CONDITIONING & REFRIGERATION (SUB. CODE – 827)
CLASS XII

Total Marks: 100 (Theory-60 + Practical-40)

	UNITS	NO. OF HOURS for Theory and Practical		MAX. MARKS for Theory and Practical
Part A	Employability Skills			
	Unit 1 : Communication Skills-III*	10		-
	Unit 2 : Self-Management Skills-III	10		3
	Unit 3 : ICT Skills-III	10		3
	Unit 4 : Entrepreneurial Skills-III	15		4
	Unit 5 : Green Skills-III*	05		-
	Total	50		10
Part B	Subject Specific Skills	Theory	Practical	Marks
	Unit 1: Psychrometry	22	08	06
	Unit 2: Heat transfer and Air Distribution	25	10	07
	Unit 3: Components of Refrigeration Systems	35	15	14
	Unit 4: Electric controls	25	10	07
	Unit 5: Commercial Applications	24	06	08
	Unit 6: Air-Conditioning Systems & Maintenance	24	06	08
	Total	155	55	50
Part C	Practical Work			
	Practical Examination			15
	Written Test			10
	Viva Voce			05
	Total			30
Part D	Project Work/Field Visit			
	Practical File/Student Portfolio			10
	Total			10
	GRAND TOTAL	260		100

Note: * marked units are to be assessed through Internal Assessment/ Student Activities. They are not to be assessed in Theory Exams

DETAILED CURRICULUM/ TOPICS FOR CLASS XII

PART-A: EMPLOYABILITY SKILLS

S. No.	Units	Duration in Hours
1.	Unit 1: Communication Skills-IV*	10
2.	Unit 2: Self-management Skills-IV	10
3.	Unit 3: Information and Communication Technology Skills-IV	10
4.	Unit 4: Entrepreneurial Skills-IV	15
5.	Unit 5: Green Skills-IV*	05
	TOTAL DURATION	50

Note: * marked units are to be assessed through Internal Assessment/ Student Activities. They are not to be assessed in Theory Exams

The detailed curriculum/ topics to be covered under Part A: Employability Skills can be downloaded from CBSE website

PART-B – SUBJECT SPECIFIC SKILLS

- ❖ Unit 1: Psychrometry
- ❖ Unit 2: Heat transfer and Air Distribution
- ❖ Unit 3: Components of Refrigeration Systems
- ❖ Unit 4: Electric controls
- ❖ Unit 5 : Commercial Applications
- ❖ Unit 6: Air-Conditioning Systems & Maintenance

UNIT 1 - PSYCHROMETRY

Psychrometric Processes – Sensible Cooling, Sensible Heating, Cooling with de-humidification, Cooling with adiabatic Humidification, Chemical-dehumidification, heating and humidification, Mixing of air- streams, **Air Washers. (To be assessed through practical only)**

UNIT 2 – HEAT TRANSFER AND AIR-DISTRIBUTION

1. Principles of heat transfer, Conduction, Convection and Radiation. Properties of insulating materials.
2. Air Distribution, Systems of air distribution, Duct systems, **cooling load and air-quantities pressure inducts, (To be assessed through practical only)** duct layout & construction.

UNIT 3 - COMPONENTS OF REFRIGERATION SYSTEMS

1. Condensers, Air cooled and water cooled, Evaporative Condensers, Heat Rejected in condensers, construction of condensers, Driers, receivers, Purging, Cleaning of Condensers.
2. Refrigerant Controls, Types of expansion devices and sensible heat factor, construction and operation of Automatic expansion valve, thermostatic expansion valve, and capillary tube, low side float valve, High Side float valve. **Solenoid valves, testing and adjusting thermostatic expansion valves. (To be assessed through practical only).**
3. Evaporators, types of evaporators- Dry and flooded, Heat absorbed in evaporators, water chillers, brine coolers, **Methods of defrosting.(To be assessed through practical only).**
4. Refrigerants, their properties and nomenclature- R11, R12, R22, R502, R113, R114, R134A, ammonia, and carbon dioxide.

UNIT 4 – ELECTRIC CONTROLS

1. Refrigeration Controls, H.P. and L.P. cutouts, **Oil Pressure failure safety switch. (To be assessed through practical only).**
2. **Motor Starters, capacitors (To be assessed through practical only),** Relays, over load protectors and **servicing of motors. (To be assessed through practical only).**

UNIT 5 – COMMERCIAL APPLICATIONS

1. Ice-Manufacture, cold-storage, **Ice-Cream manufacture (To be assessed through practical only),** Dairy refrigeration etc.

UNIT 6 – AIR-CONDITIONING SYSTEMS AND MAINTENANCE

1. Air-Conditioning systems and equipments, classification of air-conditioning systems-all air systems, all water system types, Fans, Blowers, grills, resistors, filters, compressors, cooling coils, condensers Air-Handling Units, Fan coil Units, Central Air Conditioning plants. **Ventilation Systems. (To be assessed through practical only).**
2. **Leak Detection, Pressure testing and charging. (To be assessed through practical only).**