GUJARAT TECHNOLOGICAL UNIVERSITY

BE-7 SEMESTER – OLD PAPER – S22 TO S26 – QUESTION BANK

Subject Name & Code: Refrigeration and Air Conditioning Engineering - 3171918

Chapter 1: Introduction and Refrigerants

Repeated Questions:

1. Basic Definitions & Applications:

- **Q.** Define Ton of Refrigeration, COP, and Refrigerant. **(WINTER 2023, 3 Marks; WINTER 2022, 3 Marks; SUMMER 2022, 3 Marks; WINTER 2025, 3 Marks)**
- **Q.** State important applications of refrigeration systems. **(SUMMER 2025, 3 Marks; SUMMER 2026, 4 Marks)**
- **Q.** How to calculate Total Equivalent Warming Impact (TEWI)? **(SUMMER 2023, 3 Marks)**

2. Refrigerants:

- **Q.** List/Explain desirable properties of refrigerants. **(SUMMER 2024, 4 Marks; SUMMER 2022, 4 Marks; SUMMER 2025, 4 Marks; SUMMER 2026, 4 Marks)**
- **Q.** Discuss future industrial refrigerants. **(SUMMER 2024, 4 Marks; WINTER 2024, 4 Marks; SUMMER 2026, 7 Marks OR)**

Other Important Questions:

1. Refrigeration Systems & Need:

- **Q.** Explain in brief about need of refrigeration. **(SUMMER 2026, 3 Marks)**
- **Q.** Enlist different types of refrigeration systems. **(SUMMER 2024, 3 Marks)**
- **Q.** Explain ice plant with a neat sketch. **(SUMMER 2025, 4 Marks)**

2. Refrigerants – Requirements & Classification:

- **Q.** Enlist requirement for working fluid to use as a refrigerant in vapour compression cycle. **(SUMMER 2023, 4 Marks)**
- **Q.** How the refrigerants are classified? What are the essentials properties of a good refrigerator? **(WINTER 2025, 7 Marks)**
- **Q.** Give alternate refrigerants for CFC's and HCFC's with justification. **(WINTER 2025, 3 Marks)**

Chapter 2: Air Refrigeration Systems

Repeated Questions:

1. Bootstrap & Regenerative Systems:

- **Q.** Explain Bootstrap air refrigeration system with a neat sketch. **(SUMMER 2024, 7 Marks; SUMMER 2025, 7 Marks)**
- **Q.** Explain Regenerative air refrigeration system with a neat sketch/T-s diagram. **(SUMMER 2023, 7 Marks; WINTER 2024, 7 Marks; SUMMER 2026, 7 Marks)**

2. Aircraft Refrigeration:

- **Q.** Why is air cycle refrigeration most suitable for aircraft? **(SUMMER 2023, 3 Marks)**
- **Q.** State different heat loads for Aircraft refrigeration. **(WINTER 2024, 3 Marks)**

3. Bell-Coleman / Simple Air Cycle (Numerical):

- **Q.** Numerical on Bell-Coleman / Simple Air Cycle. Example: In a Bell-Coleman plant, air is drawn at 1 bar, 10°C and compressed to 5 bar. Cooled to 25°C and expanded to 1 bar. Calculate theoretical COP and refrigeration effect per kg. [Very important numerical topic] **(SUMMER 2023, 7 Marks; WINTER 2022, 7 Marks; SUMMER 2022, 7 Marks; SUMMER 2025, 7 Marks; WINTER 2024, 7 Marks)**

Other Important Questions:

1. Air Refrigeration – Theory:

- **Q.** Write merits and demerits of Air Refrigeration System. **(WINTER 2022, 4 Marks)**
- **Q.** Explain Reduced Ambient system. **(WINTER 2024 - implied in Q2c numerical)**
- **Q.** Discuss the advantages of the dense air refrigerating system over an open air refrigeration system. **(WINTER 2025, 4 Marks)**

2. Aircraft Refrigeration:

- **Q.** Explain need of air craft refrigeration. **(SUMMER 2026, 3 Marks)**
- **Q.** Explain with neat sketch of “simple air cooling system” in aircraft refrigeration and indicate the cycle in T-S diagram. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks)**
- **Q.** A simple air cooled system is used for an aero-plane having a load of 10 tonnes. The atmospheric pressure and temperature are 0.9 bar and 10°C respectively. The pressure increases to 1.013 bar due to ramming. The temperature of the air is reduced by 50°C in the heat exchanger. The pressure in the cabin is 1.01 bar and the temperature of air leaving the cabin is 25°C. Determine: 1. Power required to take the load of cooling in the cabin; and 2. C.O.P. of the system. Assume that all the expansions and compressions are isentropic. The pressure of the compressed air is 3.5 bar. **(SUMMER 2026, 7 Marks)**

Chapter 3: Compound Compression & Advanced VCR Systems

Repeated Questions:

1. Cascade & Multi-Evaporator Systems:

- **Q.** Explain Cascade Refrigeration System with a neat sketch. **(SUMMER 2024, 7 Marks; WINTER 2023, 7 Marks; WINTER 2024, 7 Marks; SUMMER 2022, 7 Marks; WINTER 2025, 4 Marks; SUMMER 2026, 7 Marks)**
- **Q.** Explain Multi-Evaporator systems with back pressure valves and multiple expansion valves with P-h diagram. **(WINTER 2022, 7 Marks; WINTER 2023, 7 Marks; WINTER 2024, 7 Marks; SUMMER 2022, 7 Marks)**

2. Compound Compression:

- **Q.** Why is a compound system used for a large temperature lift? Explain flash intercooling. **(SUMMER 2023, 7 Marks; WINTER 2025, 7 Marks; SUMMER 2026, 4 Marks)**
- **Q.** Numerical on Multi-Stage Compression. Example: Calculate power needed to compress ammonia in a two-stage cycle with and without intercooling. **(SUMMER 2023, 7 Marks; WINTER 2025, 7 Marks OR)**

Other Important Questions:

1. Simple VCR Cycle:

- **Q.** List methods of improving COP of a simple VCR cycle. **(SUMMER 2023, 3 Marks)**
- **Q.** Mention limitations of Simple VCR cycle. Explain compound compression with flash chamber. **(SUMMER 2025, 7 Marks)**

2. Vapour Compression Refrigerator (Numerical):

- **Q.** A vapor compressor refrigerator uses methyl chloride (R-40) and operates between temperature limits of −10°C and 45°C. At entry to the compressor, the refrigerant is dry saturated and after compression it acquires a temperature of 60°C. Find the COP of the refrigerator. The relevant properties of methyl chloride are as follows: [Saturation temperature, enthalpy (kJ/kg) liquid/vapour, entropy (kJ/kg K) liquid/vapour – at −10°C: 45.4, 460.7, 0.183, 1.637; at 40°C: 133.0, 483.6, 0.485, 1.587, as printed] [Table given – refer to the original question paper of W25] **(WINTER 2025, 7 Marks OR)**

Chapter 4: Vapour Absorption Refrigeration Systems (VARS)

Repeated Questions:

1. Absorption Systems:

- **Q.** Explain Lithium Bromide-Water (LiBr-H_2O) absorption system with a neat sketch. **(SUMMER 2023, 7 Marks; SUMMER 2024, 7 Marks; WINTER 2024, 7 Marks; SUMMER 2025, 7 Marks; WINTER 2025, 7 Marks)**
- **Q.** Explain practical Ammonia-Water (H_2O-NH_3) cycle/Electrolux refrigerator. **(SUMMER 2024, 7 Marks; WINTER 2023, 4 Marks; SUMMER 2022, 4 Marks; WINTER 2022, 7 Marks; WINTER 2025, 4 Marks OR)**

2. VCR vs. VAR & Theory:

- **Q.** Compare Vapour Compression (VCR) and Vapour Absorption (VAR) systems. **(WINTER 2022, 4 Marks; WINTER 2023, 3 Marks; WINTER 2024, 3 Marks; WINTER 2025, 4 Marks)**
- **Q.** What are desirable characteristics of absorbent-refrigerant pair? **(SUMMER 2023, 7 Marks; SUMMER 2025, 3 Marks)**
- **Q.** Derive COP of an ideal VARS. **(SUMMER 2025, 4 Marks)**

Other Important Questions:

1. VARS – Working & Application:

- **Q.** Under what situation is VARS preferred over VCRS? **(SUMMER 2023, 3 Marks)**
- **Q.** Function of analyzer, rectifier, and generator in VARS. **(SUMMER 2022, 3 Marks)**
- **Q.** Discuss the function of absorber in vapour absorption refrigeration system. **(WINTER 2025, 4 Marks)**
- **Q.** Discuss merits and limitations of absorption refrigeration system. **(SUMMER 2026, 4 Marks)**

2. Numerical & Steam Jet Refrigeration:

- **Q.** Numerical on VARS. **(SUMMER 2023, 7 Marks)**
- **Q.** Define and write the expression for nozzle efficiency in steam jet refrigeration system. **(WINTER 2025, 3 Marks)**

Chapter 5: Refrigeration System Components

Repeated Questions:

1. Expansion Devices:

- **Q.** Explain Thermostatic Expansion Valve (TXV) with a neat sketch. **(WINTER 2023, 7 Marks; SUMMER 2025, 7 Marks; SUMMER 2026, 7 Marks)**
- **Q.** Explain different expansion devices. **(SUMMER 2024, 3 Marks; WINTER 2025, 3 Marks OR)**

2. Compressors & Other Components:

- **Q.** Enlist/Types of compressors and explain any one. **(SUMMER 2024, 3 Marks; SUMMER 2025, 4 Marks)**
- **Q.** Explain screw and scroll compressors. **(WINTER 2024, 4 Marks)**
- **Q.** Function of components: Oil separator, Sight glass, Drier, etc. **(SUMMER 2022, 7 Marks)**

Other Important Questions:

1. Condensers, Evaporators & Expansion:

- **Q.** Explain shell and tube condenser. **(WINTER 2022, 3 Marks)**
- **Q.** Enlist different types of condensers used in refrigeration system. **(SUMMER 2026, 3 Marks)**
- **Q.** Explain flooded type evaporator. **(SUMMER 2025, 4 Marks)**
- **Q.** Explain capillary tube and TXV. **(WINTER 2022, 4 Marks)**
- **Q.** Define throttling. **(SUMMER 2026, 3 Marks)**

2. Compressors & Charging:

- **Q.** Advantages of centrifugal compressor over reciprocating. **(WINTER 2022, 4 Marks)**
- **Q.** Define volumetric, isothermal, and adiabatic efficiency of a compressor. **(SUMMER 2025, 3 Marks)**
- **Q.** Discuss in brief about selection of compressors used in refrigeration systems. **(SUMMER 2026, 4 Marks)**
- **Q.** Explain evacuation and charging of refrigerants. **(SUMMER 2024, 4 Marks)**

Chapter 6: Cooling Load, Psychrometry and Human Comfort

Repeated Questions:

1. Human Comfort:

- **Q.** Define Human Comfort and explain factors affecting it. **(WINTER 2022, 4 Marks; WINTER 2023, 3 Marks; SUMMER 2025, 4 Marks; WINTER 2024, 3 Marks; WINTER 2025, 3 Marks OR; SUMMER 2026, 7 Marks)**
- **Q.** Define Effective Temperature and explain factors affecting it/significance. **(SUMMER 2022, 4 Marks; SUMMER 2023, 4 Marks; WINTER 2022, 4 Marks; SUMMER 2025, 7 Marks; WINTER 2025, 4 Marks OR)**

2. Building Loads & SHF:

- **Q.** Explain the Flywheel Effect of building material. **(WINTER 2022, 3 Marks; SUMMER 2022, 4 Marks; WINTER 2024, 4 Marks)**
- **Q.** Explain different types of loads (sensible, latent, solar, infiltration, etc.). **(SUMMER 2022, 7 Marks; WINTER 2023, 4 Marks; WINTER 2023, 7 Marks; SUMMER 2025, 3 Marks)**
- **Q.** Explain Sensible Heat Factor (SHF) and related numerical using Psychrometric chart. Example: Calculate SHF for an office given inside/outside conditions and loads. **(WINTER 2022, 7 Marks)**

Other Important Questions:

1. Loads, Infiltration & Site Survey:

- **Q.** What is infiltration? **(SUMMER 2025, 3 Marks; WINTER 2024, 4 Marks)**
- **Q.** Explain Instantaneous Heat Gain (IHG) and Instantaneous Cooling Load (ICL). **(WINTER 2024, 3 Marks)**
- **Q.** Explain load calculations for automobiles. **(SUMMER 2024, 7 Marks; SUMMER 2022, 7 Marks)**
- **Q.** Importance of site survey. **(SUMMER 2025, 4 Marks)**
- **Q.** Discuss effect of wall construction on cooling load. **(WINTER 2025, 3 Marks)**
- **Q.** Explain in detail about various latent heat load sources in residential buildings. **(SUMMER 2026, 7 Marks)**

2. Psychrometry, Insulation & Solar Heat Gain:

- **Q.** Define following terms: (1) Specific Humidity (2) Dew point temperature (3) Relative Humidity (4) Degree of saturation. **(WINTER 2025, 4 Marks OR)**
- **Q.** Enlist different properties of thermal insulation. **(SUMMER 2026, 3 Marks)**
- **Q.** State heat balance equation for human being. **(SUMMER 2026, 3 Marks)**
- **Q.** Explain in brief different methods of reduction of solar heat gain through glass. **(SUMMER 2026, 4 Marks)**

3. Sensible Heat Factor (Numerical):

- **Q.** A small office hall of 25 person capacity is provided with summer air conditioning system with the following data: Outside conditions = 34°C DBT and 28°C WBT; Inside conditions = 24°C DBT and 50% RH; Volume of air supplied = 0.4 m^3/min/person; Sensible heat load in room = 1,25,600 kJ/h; Latent heat load in the room = 42,000 kJ/h. Find the sensible heat factor of the plant. **(WINTER 2025, 7 Marks OR)**
- **Q.** The amount of air supplied to an air conditioned hall is 300 m^3/min. The atmospheric conditions are 35°C DBT and 55% RH. The required conditions are 20°C DBT and 60% RH. Find out the sensible heat and latent heat removed from the air per minute. Also find sensible heat factor for the system. **(SUMMER 2026, 7 Marks - second set)**

Chapter 7: Duct Design and Air Distribution

Repeated Questions:

1. Duct Design Methods & Layout:

- **Q.** Explain Duct Design Methods: Equal Friction, Velocity Reduction, Static Regain. **(WINTER 2022, 3 Marks; SUMMER 2022, 7 Marks; SUMMER 2025, 4 Marks; WINTER 2024, 7 Marks; WINTER 2025, 3 Marks OR)**
- **Q.** Explain economic factors influencing duct layout. **(SUMMER 2024, 4 Marks; SUMMER 2022, 3 Marks; WINTER 2024, 4 Marks)**

2. Duct Numerical & Air Distribution Terms:

- **Q.** Numerical on Equivalent Diameter of Ducts and Pressure Drop. Example: Find equivalent diameter for a rectangular duct for (a) same flow rate, (b) same velocity. Calculate pressure drop. [Crucial numerical topic] **(SUMMER 2023, 7 Marks; WINTER 2023, 7 Marks; WINTER 2022, 7 Marks; SUMMER 2025, 7 Marks)**
- **Q.** Define/Explain terms: Throw, Drop, Spread. **(SUMMER 2022, 3 Marks; WINTER 2024, 3 Marks)**

Other Important Questions:

1. Air Distribution & Grills:

- **Q.** Requirements of air distribution system. **(SUMMER 2024, 7 Marks)**
- **Q.** Factors affecting grill performance. **(SUMMER 2023, 3 Marks)**
- **Q.** Different pressure losses in ducts. **(WINTER 2024, 4 Marks)**

2. Ducts – Function, Materials & Friction Chart:

- **Q.** Explain in brief about function of duct in air conditioning systems. **(SUMMER 2026, 3 Marks - first set)**
- **Q.** Describe the different materials used for duct. Classify duct. **(WINTER 2025, 4 Marks)**
- **Q.** Discuss about use of friction chart in duct design. **(SUMMER 2026, 4 Marks - second set)**

3. Duct Pressure Drop (Numerical):

- **Q.** A duct of 15 m length passes air at the rate of 90 m^3/min. Assuming the friction factor as 0.005, calculate the pressure drop in the duct in mm of water when (a) the duct is circular of diameter 0.3 m; and (b) the duct is of 0.3 m square cross-section. **(WINTER 2025, 7 Marks)**

Chapter 8: Air Conditioning Systems

Repeated Questions:

1. Types of Air Conditioning Systems:

- **Q.** Differentiate/Compare: All-Air, All-Water, Air-Water systems. **(SUMMER 2023, 7 Marks)**
- **Q.** Explain Summer and Winter Air Conditioning systems with sketches. **(WINTER 2022, 4 Marks; WINTER 2023, 4 Marks; SUMMER 2022, 4 Marks; SUMMER 2026, 3 Marks - second set)**

2. Split, Package & Central AC:

- **Q.** Compare/Explain Split, Package, and Central AC systems. **(SUMMER 2023, 4 Marks; WINTER 2023, 3 Marks; SUMMER 2022, 3 Marks; WINTER 2024, 4 Marks; WINTER 2025, 7 Marks OR)**
- **Q.** Explain a Split AC system with a neat sketch. **(WINTER 2023, 3 Marks; SUMMER 2024, 4 Marks; SUMMER 2026, 7 Marks - first set)**

Other Important Questions:

1. Classification & Air Filters:

- **Q.** Classify air conditioning systems. **(WINTER 2023, 3 Marks)**
- **Q.** Why all-water system is compact? **(SUMMER 2023, 3 Marks)**
- **Q.** What do you mean by Air filter? Explain the various types of Air filter. **(WINTER 2025, 3 Marks)**

2. Packaged, Central & Room AC:

- **Q.** Explain Packaged AC plant. **(SUMMER 2024, 7 Marks)**
- **Q.** Explain Central AC for a multi-storey building. **(SUMMER 2025, 7 Marks)**
- **Q.** Explain in brief about use of room air conditioner. **(SUMMER 2026, 4 Marks - first set)**

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