

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA VIZIANAGARAM
IV B. Tech I Semester Advanced Supplementary Examinations March 2025

REFRIGERATION & AIR-CONDITIONING

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Answer any **FIVE** Questions **ONE** Question from **Each unit**

All Questions Carry Equal Marks

(Refrigeration and Psychrometric tables and charts allowed)

UNIT-I

1. a) Describe the working of Brayton refrigeration/Bell-Coleman cycle and Derive the expression for its COP with a neat sketch [7M]
b) In a Reversed Brayton cycle running on air, the temperature at the exit of refrigerator is -10°C and that at the exit of heat rejection is 50°C . The cooling capacity is one TR. Find the states at all the points of the cycle, heat transfer and work done in all the processes, mass flow rate, volume flow rates and COP. The maximum pressure ratio is 5 and the pressure at inlet to isentropic compressor is standard atmospheric pressure. Take $c_p = 1.005 \text{ kJ/kg-K}$, $R = 0.287 \text{ kJ/kg-K}$ and $\gamma = 1.4$.

(OR)

2. a) Describe the basic Aircraft Air Conditioning System with or without Evaporative Cooling [7M]
b) An aircraft is flying at a speed of 1000 km/h. The ambient temperature and pressure are -15°C and 0.35 bar respectively. The compressor and turbine and ram efficiencies are 0.8, 0.85 and 0.85 respectively. The pressure ratio of the compressor is 5.0. The heat exchanger effectiveness is 0.8 and the pressure drop in the heat exchanger is 0.1 bar. The cabin pressure is 1.06 bar and the air leaves the cabin at 25°C . Assuming simple aircraft air conditioning cycle, find the temperature and pressure at various state points, COP, mass flow rate, ram work, compressor work, expander work and volume flow rates at turbine and compressor outlets for a 1 TR capacity plant.

UNIT-II

3. a) Describe the working of simple Vapour compression refrigeration cycle and derive the expression for its COP with a neat sketch [7M]
b) Derive the expression for the Joule-Thomson coefficient (μ) and explain its physical significance [7M]

(OR)

4. a) Compare Azeotropes and Non-Azeotropes Mixtures based on their properties [7M]
b) Describe multi-stage vapor compression refrigeration system for a cryogenic application. Include a schematic diagram, explain the role of each component, and discuss the factors affecting the system's performance [7M]

UNIT-III

5. a) What are the essential properties that make a refrigerant suitable for use in refrigeration and air conditioning systems? [7M]
b) What are "green refrigerants"? How do they differ from traditional refrigerants in terms of environmental impact? [7M]

(OR)

6. a) Describe the working of vapor absorption refrigeration system, working Principle and basic components in detail? [7M]
b) Explain the principle and operation of thermoelectric refrigerator with neat diagram [7M]

UNIT-IV

7. a) Explain the following terms (a) Humidity (b) Degree of saturation (c) Absolute humidity (d) Dry bulb temperature (e) Wet bulb temperature (f) Dew point temperature. [7M]
b) Explain the use of psychrometric charts and terms involved in it with neat diagram [7M]
(OR)
8. a) What are the main differences between industrial air conditioning and residential air conditioning systems [7M]
b) The humidity ratio of atmospheric air at 28°C dry bulb temperature and 760 mm of mercury is 0.016 kg/kg of dry air. Determine: 1. Partial Pressure of water vapor; 2. Relative humidity; 3. Dew point temperature; 4. Specific Enthalpy; 5. Vapor Density. [7M]

UNIT-V

9. a) What is the difference between a grill and a register in air distribution systems? [7M]
b) Explain the role of a blower in an air conditioning system? [7M]
(OR)
10. a) Explain the concept of "bypass factor" in air conditioning systems and its significance. [7M]
b) Explain cooling, heating humidification and dehumidification with H-S diagrams [7M]
