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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: VI- THEORY EXAMINATION (2025 - 2026)

Subject: Refrigeration & Air Conditioning

Time: 3 Hours

Max. Marks: 100

General Instructions:

IMP: Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of **three Sections -A, B, & C**. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.
2. Maximum marks for each question are indicated on right -hand side of each question.
3. Illustrate your answers with neat sketches wherever necessary.
4. Assume suitable data if necessary.
5. Preferably, write the answers in sequential order.
6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION-A

20

1. Attempt all parts:-

- | | | |
|-------|--|---|
| (1.1) | In air-conditioning of Aeroplanes, using air as a refrigerant, the cycle used is (CO1, K1) | 1 |
| (a) | Reversed Carnot cycle | |
| (b) | Reversed Joule cycle | |
| (c) | Reversed Brayton cycle | |
| (d) | Reversed Otto cycle | |
| (1.2) | The cooling system used for supersonic aircrafts and rockets is (CO1, K1) | 1 |
| (a) | Simple air-cooling system | |
| (b) | Boot-strap air cooling system | |
| (c) | Reduced ambient air-cooling system | |
| (d) | Regenerative air-cooling system | |
| (1.3) | Which one of the following refrigerants has the highest critical temperature? (CO2, K1) | 1 |
| (a) | Water | |
| (b) | Carbon dioxide | |
| (c) | Freon 12 | |
| (d) | Ammonia | |
| (1.4) | In a vapour compression refrigeration system, a throttle valve is used in place of an expander because (CO2, K1) | 1 |
| (a) | It considerably reduces the system weight | |
| (b) | It improves the COP, as the condenser is small | |
| (c) | The positive work in isentropic expansion of liquid is very small | |

- (d) It leads to significant cost reduction
- (1.5) Which of the refrigerant is used as a refrigerant in Lithium Bromide Absorption Refrigeration system? (CO3, K1) 1
- (a) Ammonia
- (b) Water
- (c) Hydrogen
- (d) Bromine
- (1.6) In an Electrolux refrigerator: (CO3, K1) 1
- (a) Ammonia is absorbed in water
- (b) Ammonia is absorbed in hydrogen
- (c) Hydrogen is evaporated in ammonia
- (d) Ammonia evaporated in hydrogen
- (1.7) For which one of the following DBT, WBT and DPT has the same value? (CO4, K1) 1
- (a) 0 per cent relative humidity line
- (b) 100 per cent relative humidity line
- (c) 50 per cent relative humidity line
- (d) none of the above
- (1.8) Dew point temperature is the temperature at which condensation begins when the air is cooled at constant. (CO4, K1) 1
- (a) Volume
- (b) Pressure
- (c) Entropy
- (d) Enthalpy
- (1.9) The pressure in a capillary tube decreases due to (CO5, K1) 1
- (a) Frictional resistance offered by the tube wall
- (b) Acceleration of refrigerant in the tube
- (c) Heat transfer from the tube
- (d) Both 1 and 2
- (1.10) The condensing medium used in evaporative condensers is (CO5, K1) 1
- (a) Air only
- (b) Water only
- (c) Both air and water
- (d) None of the above

2. Attempt all parts:-

- (2.1) Write the advantages of open and closed air refrigeration system. (CO1, K2) 2
- (2.2) Write the function of expansion valve? (CO2, K2) 2
- (2.3) Which refrigerant is used in vortex tube refrigeration system? (CO3, K2) 2
- (2.4) State the factors that determine human comfort. (CO4, K2) 2
- (2.5) What are the selection criteria for a condenser? (CO5, K2) 2

SECTION-B

30

Answer any one of the following:-

- (3.1) A machine working on a Carnot cycle operates between 305K and 260K. Determine the C.O.P. when it is operand as: (i). a refrigerating machine; (ii). a heat pump; and (iii). a heat engine. (CO1, K3) 6
- (3.2) Draw the block diagram and T-S diagram of boot strap with evaporative air refrigeration system. (CO1, K2) 6

Answer any one of the following:-

- (3.3) Explain the effect of i) sub cooling of liquid and ii) superheat of vapor on the system performance. (CO2, K2) 6
- (3.4) With a neat sketch, explain the working principle of vapour compression refrigeration system. (CO2, K3) 6

Answer any one of the following:-

- (3.5) What are the functions of analyzer and Rectifier in VAR system. (CO3, K2) 6
- (3.6) What is an absorption refrigeration system? How does it differ from vapour compression system? (CO3, K2) 6

Answer any one of the following:-

- (3.7) The atmospheric conditions of air are 35°C dry bulb temperature, 60% relative humidity and 1.01325 bar pressure. If 0.005 kg of moisture per kg of dry air is removed, the temperature becomes 25°C. Determine the final relative humidity and dew point temperature. (CO4, K3) 6
- (3.8) Prove that the partial pressure of water vapour in the atmospheric air remains constant as long as the specific humidity remains constant. (CO4, K3) 6

Answer any one of the following:-

- (3.9) What are the important issues to be considered in the design of refrigeration systems? Explain in brief. (CO5, K2) 6
- (3.10) What are the major causes of food spoilage? Explain in brief. (CO5, K2) 6

SECTION-C

50

4. Answer any one of the following:-

- (4.1) Explain, with a neat sketch, the working principle of simple evaporative type of air refrigeration system. Draw T-S diagram for the system. (CO1, K3) 10
- (4.2) A dense air machine operates on reversed Brayton cycle and is required for a capacity of 10 TR. The cooler pressure is 4.2 bar and the refrigerator pressure is 1.4 bar. The air is cooled in the cooler at a temperature of 50°C and the temperature of air at inlet to compressor is -20°C. Determine for the ideal cycle: 1. C.O.P.; 2. mass of air circulated per minute; 3. theoretical piston displacement of compressor; 4. theoretical piston displacement of expander; and 5. net power per tonne of refrigeration. Show the cycle on p-v and T-s planes. (CO1, K3) 10

5. Answer any one of the following:-

- (5.1) A VCR works between the pressures limits of 60 and 25 bars respectively. The working fluid is just dry at the end of the compression and there is no under cooling of liquid before the expansion valve. Determine (i) COP of the cycle, (ii) Capacity of the refrigerant if the fluid flow is at rate of 5 kg/min. (CO2, K3) 10

- (5.2) Explain a three-stage compression with multiple expansion valves and flash intercooler. (CO2, K2) 10
6. Answer any one of the following:-
- (6.1) Explain working of Li-Br vapour absorption refrigeration system with neat sketch. (CO3, K2) 10
- (6.2) Draw a neat labelled sketch of a Practical Vapour Absorption refrigeration cycle and explain its working in brief. (CO3, K2) 10
7. Answer any one of the following:-
- (7.1) The air at 35°C dry bulb temperature and 25°C wet bulb temperature is passed through a cooling coil at the rate of 280 m³/min. The air leaves the cooling coil at 26.5°C dry bulb temperature and 50% relative humidity. Find; 1. Capacity of the cooling coil in tonnes of refrigeration; 2. Wet bulb temperature of the leaving air; 3. Water vapour removed per minute; and 4. Sensible heat factor. (CO4, K3) 10
- (7.2) The amount of air supplied to an air conditioned hall is 300 m³/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. (CO4, K3) 10
8. Answer any one of the following:-
- (8.1) What is the automatic expansion valve? Explain its working principle with neat sketch. (CO5, K3) 10
- (8.2) Explain with neat sketch of Centrifugal compressor. (CO5, K2) 10