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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 and 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) The coefficient of performance (COP) of a refrigerator working as a heat pump is given by: (CO1, K1) 1
- (a) $(COP)_{\text{heat pump}} = (COP)_{\text{refrigerator}} + 2$
 - (b) $(COP)_{\text{heat pump}} = (COP)_{\text{refrigerator}} + 1$
 - (c) $(COP)_{\text{heat pump}} = (COP)_{\text{refrigerator}} - 1$
 - (d) $(COP)_{\text{heat pump}} = (COP)_{\text{refrigerator}}$
- (1.2) One ton refrigeration is equivalent to: (CO1, K1) 1
- (a) 3.5 kW
 - (b) 1.5 kW
 - (c) 2.5 kW
 - (d) 5.5 kW
- (1.3) The correct sequence of the given components of a vapour compression refrigerator is:(CO2,K1) 1
- (a) Evaporator, compressor, condenser and throttle valve
 - (b) Condenser, throttle valve, evaporator and compressor
 - (c) Compressor, condenser, throttle valve and evaporator
 - (d) Throttle valve, evaporator, compressor and condenser
- (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) Solar energy can be directly used in (CO3,K1) 1
- (a) Vapour compression refrigeration system
- (b) Vapour absorption refrigeration system
- (c) Air refrigeration system
- (d) Jet refrigeration system
- (1.6) Waste heat can be effectively used in which one of the following refrigeration systems? (CO3,K1) 1
- (a) Vapour compression cycle
- (b) Vapour absorption cycle
- (c) Air refrigeration cycle
- (d) Vortex refrigeration system
- (1.7) The wet bulb depression is zero, when relative humidity is equal to (CO4,K1) 1
- (a) 1
- (b) 0.6
- (c) 0.5
- (d) 0.1
- (1.8) On a Psychrometric chart, what does a vertical downward line represent? (CO4, K1) 1
- (a) Adiabatic saturation
- (b) Sensible cooling
- (c) Dehumidification
- (d) Humidification
- (1.9) The refrigerant supplied to a compressor must be (CO5,K1) 1
- (a) superheated vapour refrigerant
- (b) dry saturated liquid refrigerant
- (c) a mixture of liquid and vapour refrigerant
- (d) none of the above
- (1.10) The natural convection air-cooled condensers are used in (CO5,K1) 1
- (a) domestic refrigerators
- (b) water coolers
- (c) room air conditioners
- (d) all of these

2. Attempt all parts:-

- (2.1) Define Unit of refrigeration and C.O.P.(CO1,K2) 2
- (2.2) Differentiate refrigeration from cooling.(CO2,K2) 2
- (2.3) In Amonia-water system list the absorbent and refrigerant. (CO3,K2) 2
- (2.4) What do you understand by the term 'psychrometry'?(CO4,K2) 2
- (2.5) Which material is commonly used for making ducts in the air conditioning systems? (CO5, K2) 2

SECTION-B

30

Answer any one of the following:-

- (3.1) Differentiate between heat engine, refrigerator and heat pump with help of neat sketch. (CO1, K2) 6
- (3.2) Draw the block diagram and T-S diagram of simple air refrigeration system. (CO1, K2) 6

Answer any one of the following:-

- (3.3) The temperature limits of an ammonia refrigerating system are 25°C and -10°C . If the gas is dry at the end of compression, calculate the coefficient of performance of the cycle assuming no undercooling of the liquid ammonia. Use refrigeration chart. (CO2, K3) 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, K3) 6
- (3.6) Explain the working of Electrolux Refrigerator with neat sketch, and also explain the significance of Hydrogen used in system. (CO3, K3) 6

Answer any one of the following:-

- (3.7) Atmospheric air at 0.965 bar enters the adiabatic saturator, wet bulb temperature is 20°C and dry bulb temperature is 31°C during adiabatic saturation process. Determine : 1. humidity ratio of the entering air; 2. vapour pressure and relative humidity at 31°C , and 3. dew point temperature. (CO4, K4) 6
- (3.8) Explain 'comfort chart' and show on it the 'comfort zone'. (CO4, K4) 6

Answer any one of the following:-

- (3.9) Explain the applications of refrigeration for food preservation. (CO5, K3) 6
- (3.10) Explain with neat sketch of desert water cooler. (CO5, K3) 6

SECTION-C 50

4. Answer any one of the following:-

- (4.1) Explain the working of a simple air cycle cooling system used for aircrafts. (CO1, K4) 10
- (4.2) A refrigerating system working on Bell-Coleman cycle receives air from cold chamber at -50°C and compresses it from 1 bar to 4.5 bar. The compressed air is then cooled to a temperature of 37°C before it is expanded in the expander. Calculate the C.O.P. of the system when compression and expansion are (i) isentropic ; and (ii) follow the law $PV^{1.25} = \text{constant}$. (CO1, K4) 10

5. Answer any one of the following:-

- (5.1) An ice plant working on ammonia as refrigerant works between overall pressure limits of 2.5 bar and 15 bar. It is fitted with expansion valve with vapour extraction at 5 bar and 10 bar. The load on the plant is 10 TR. Find the circulation of the refrigerant through the condenser and the power required to drive the three compressors. Use p-h chart. (CO2, K4) 10
- (5.2) Sketch the T-S and p-h diagrams for the vapour compression cycles when the vapour after compression is: (CO2, K4) 10
- i. Dry saturated

- ii. Wet
- iii. Super heated and

6. Answer any one of the following:-

(6.1) Draw a neat diagram of three-fluid system of refrigeration (electrolux refrigeration system) and explain its working. (CO3, K3) 10

(6.2) Derive the expression for COP of VARS system.(CO3,K3) 10

7. Answer any one of the following:-

(7.1) 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,K4) 10

(7.2) Draw a neat labelled diagram of a air conditioning system. Explain its important components. (CO4, K2) 10

8. Answer any one of the following:-

(8.1) Write short notes on : (a) Room air conditioner; (b) Refrigerated trucks; and (c) Marine air-conditioning. (CO5, K2) 10

(8.2) Explain in detail about the methods of food preservations.(CO5,K2) 10