C. U. SHAH UNIVERSITY
Summer Examination-2022

Subject Name: Refrigeration and Air Conditioning

Subject Code: 4TE07RAC1   **Branch: B.Tech (Mechanical)**

Semester: 7   **Date: 26/04/2022**   **Time: 02:30 To 05:30**   **Marks: 70**

Instructions:
  (1) Use of Programmable calculator & any other electronic instrument is prohibited.
  (2) Instructions written on main answer book are strictly to be obeyed.
  (3) Draw neat diagrams and figures (if necessary) at right places.
  (4) Assume suitable data if needed.

Q-1   **Attempt the following questions:**   **(14)**

1) One ton of the refrigeration is   **(01)**
(a) the standard unit used in refrigeration problems
(b) the cooling effect produced by melting of 1 ton of ice
(c) the refrigeration effect to freeze 1 ton of water at 0°C into ice at 0°C in 24 hours
(d) the refrigeration effect to produce 1 ton of ice at NTP conditions

2) The coefficient of performance is the ratio of   **(01)**
(a) refrigerant effect to the heat of compression
(b) refrigerant effect to the work done by the compressor
(c) refrigerant effect to the enthalpy increase in compressor
(d) all of the above

3) The sequence of components in the vapour compression refrigeration system is   **(01)**
(a) compressor, condenser, expansion device, evaporator
(b) compressor, condenser, expansion device, evaporator
(c) expansion devise, compressor, condenser, evaporator
(d) compressor, evaporator, condenser, expansion device

4) How is the refrigerant used in the Air refrigeration cycle?   **(01)**
(a) In the compressor (b) In the condenser
(c) Directly in contact (d) Not used at all

5) Which of the following is the key difference between a simple VAR and Electrolux refrigerator? **(01)**
(a) Working mechanism (b) Generator (c) Absorber (d) Liquid pump

6) Efficiency of the Refrigerator is _____ to the C.O.P of the refrigerator.   **(01)**
(a) independent (b) directly proportional
(c) inversely proportional (d) equal

7) Which of the following is the common application of Air standard refrigeration system? **(01)**

(a) Cold storage(b) Car air conditioning system
(c) Domestic refrigerators(d) Aircraft air conditioning

8) What is Air Conditioning? **(01)**
(a) Air Conditioning is the process of adding heat and increasing the humidity
(b) Air Conditioning is the process of removing heat and controlling the humidity of air in a closed space
(c) Air conditioning is the process of controlling air moisture in an open area by adding heat
(d) None of the mentioned

9) Which of the following process is used in winter air conditioning? **(01)**
(a) Cooling and Dehumidification (b) Heating and Humidification
(c) Dehumidification (d) Humidification

10) If the Coefficient of performance of a heat pump is 5, then what is the value of the Coefficient of performance of the refrigerator operating under the same conditions? **(01)**
(a) 0.2 (b) 3 (c) 4 (d) 6

11) Which of the following represents sensible cooling on the psychrometric chart? **(01)**
(a) Inclined line (b) Curve (c) Horizontal line (d) Vertical line

12) What is the value of optimum effective temperature in winter? **(01)**
(a) 17 (b) 18 (c) 19 (d) 20

13) What is represented by inclined straight lines but non-uniformly spaced on the psychrometric chart? **(01)**
(a) Specific humidity (b) Relative humidity (c) WBT (d) DPT

14) What is the mixture of a number of gases? **(01)**
(a) Moist air (b) Dry air (c) Fresh air (d) Saturated air

Attempt any four questions from Q-2 to Q-8

Q-2   **Attempt all questions** **(14)**
A State important applications of refrigeration system. Explain construction and working of an Ice plant. **(07)**
B Explain in brief important Properties required for a good refrigerant. **(07)**

Q-3   **Attempt all questions** **(14)**
A Sketch bootstrap air cycle refrigeration cycle and derive an expression for its COP. **(07)**
B An air refrigeration open system operating between 100 KPa and 1 MPa is required to produce a cooling effect of 2000 kJ/min. Temperature of the air leaving the cold chamber is $-5°C$ and at leaving the cooler is 300C. Neglect losses and clearance in the compressor and expander. Determine : **(07)**
(i) Mass of air circulated per min,
(ii) Compressor work, expander work, cycle work ,
(iii) COP and power in kW required.

Q-4   **Attempt all questions** **(14)**
A Explain standard vapour compression refrigeration cycle with T-S and P-H diagram. What is the effect of sub-cooling on the performance of vapour compression refrigeration system? **(07)**
B A refrigeration machine is required to produce ice at 0^0 C from water at 20^0 C. The machine has a condenser temperature of 25^0C while **(07)**

evaporator temperature is -5⁰C. The relative efficiency of the machine is 50% and 6 kg of Freon-12 is circulated through the system per minute. The refrigerant enters in the compressor with dryness fraction of 0.6. Calculate the amount of ice produced in 24 hrs. Take latent heat of ice 335 Kj/kg.

Temp.(^{0}C)	Liquid Heat (Kj/kg)	Latent Heat (Kj/kg)	Entropy of liquid (Kj/kg-K)
25	59.7	138	0.2232
-5	31.4	154	0.1251

Q-5		**Attempt all questions**	**(14)**
	A	Explain with neat sketch the Cascade refrigeration system.	**(07)**
	B	With a diagram explain Li-BR Vapour absorption refrigeration system and write its application.	**(07)**
Q-6		**Attempt all questions**	**(14)**
	A	Explain construction, working, advantages and disadvantages of Thermostatic Expansion valve with neat sketch.	**(07)**
	B	Explain the following terms briefly: (1) Refrigerating effect (2) Psychrometry (3) Comfort Air conditioning (4) Dew point temperature (5) Wet bulb temperature (6) Cooling and Dehumidification (7) Relative humidity	**(07)**
Q-7		**Attempt all questions**	**(14)**
	A	Write short note on load calculation for automobiles	**(03)**
	B	Explain flywheel effect of building material.	**(04)**
	C	A circular duct of 40 cm is selected to carry air in an air conditioned space at a velocity of 440 m/min to keep the noise level at desired level. If this duct is replaced by a rectangular duct of aspect ratio of 1.5, find out the size of rectangular duct for equal friction method when (a) the velocity of air in two ducts is same, (b) the discharge rate of air in two ducts is same.	**(07)**
Q-8		**Attempt all questions**	**(14)**
	A	Explain velocity reduction method with advantages and disadvantages.	**(03)**
	B	Define Effective Temperature. List out factors governing human comfort.	**(04)**
	C	Classify air conditioning systems. Explain Central air conditioning system with a neat sketch.	**(07)**