Enrollment No: _____   Exam Seat No: _____

C. U. SHAH UNIVERSITY
Winter Examination-2021

Subject Name: Refrigeration and Air conditioning

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

Semester: 7   **Date: 16/12/2021**   **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) The vapour compression refrigerator employs the following cycle.
(A) Rankine   (B) Carnot   (C) Reversed Rankine   (D) Reversed Carnot

2) The condition of refrigerant after passing through the condenser in a vapour compression system is
(A) Saturated liquid   (B) Wet vapour
(C) Dry saturated vapour   (D) Superheated vapour

3) The fluids used in Electrolux refrigerator are
(A) Water   (B) hydrogen   (C) Ammonia   (D) All of these

4) The refrigerant widely used in domestic refrigerators is
(A) Ammonia   (B) Carbon dioxide   (C) Sulphur dioxide   (D) R-12

5) The wet bulb depression is zero when relative humidity is
(A) Zero   (B) 0.5   (C) 0.75   (D) 1.0

6) Heat Rejected by the refrigerant during vapour compression refrigeration cycle in
(A) Condenser   (B) Evaporator   (C) Compressor   (D) Throttle Valve

7) The relative coefficient of performance is equal to
(A) (Theoretical C.O.P.)/ (Actual C.O.P.)
(B) (Actual C.O.P.) / (Theoretical C.O.P.)
(C) (Actual C.O.P.) $\times$ (Theoretical C.O.P.)
(D) None of these

8) The capacity of a domestic refrigerator is in the range of
(A) 0.1 to 0.3 TR   (B) 1 to 3 TR   (C) 3 to 5 TR   (D) 5 to 7 TR

9) The C.O.P. of a refrigerator working on a reversed Carnot cycle is (where T_1 = Lowest absolute temperature, and T_2 = Highest absolute temperature)
(A) $T_1 / (T_2 - T_1)$ (B) $(T_2 - T_1)/T_1$ (C) $(T_1 - T_2)/T_1$ (D) $T_2/ (T_2 - T_1)$

10) In a flooded evaporator refrigerator, an accumulator at suction of compressor is used to
(A) Collect liquid refrigerant and prevent it from going to compressor
(B) Detect liquid in vapour
(C) Superheat the vapour
(D) Collect vapours

11) Which of the following refrigerant has the lowest freezing point?
(A) R-11   (B) R-12   (C) R-22   (D) Ammonia

12) The capillary tube is not used in large capacity refrigeration systems because
(A) Cost is too high   (B) Capacity control is not possible
(C) It is made of copper   (D) Required pressure drop cannot be achieved

13) In a vapour compression system, the condition of refrigerant is dry saturated vapour
(A) Before entering the compressor   (B) After leaving the compressor
(C) Before entering the condenser   (D) After leaving the condenser

14) The horizontal and non-uniformly spaced lines on a psychrometric chart indicates
(A) Dry bulb temperature   (B) Wet bulb temperature
(C) Dew point temperature   (D) Specific humidity

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

Q-2   **Attempt all questions**

(a) Discuss Revered Carnot cycle with the help of P-V and T-S diagram?   **(07)**

(b) The atmospheric air at pressure *1 bar* and temperature *-5 °C* is drawn in the cylinder of   **(07)**
the compressor of a Bell-Coleman refrigerating machine. It is compressed
isentropically to a pressure of *5 bar*. In the cooler, the compressed air is cooled to *15
°C*, pressure remaining the same. It is then expanded to a pressure of *1 bar* in an
expansion cylinder from where it is passed to the cold chamber. Find 1) the work done
per kg of air and 2) C.O.P of the plant. For air assume law of expansion $pv^{1.2} = C$; law
for compression $pv^{1.4}=C$ and specific heat of air at constant pressure = *1 KJ/kg K*.

Q-3   **Attempt all questions**

(a) Draw and Explain domestic Electrolux refrigeration system.   **(07)**

(b) Explain in brief with a neat sketch a hermetically sealed compressor.   **(07)**

Q-4   **Attempt all questions**

(a) Write short note on capillary tube.   **(05)**

(b) Define refrigerant? What are the desirable properties of an ideal refrigerant?   **(05)**

(c) Explain heat engine and refrigerator. Also derive the equation of COP.   **(04)**

Q-5   **Attempt all questions**

(a) Explain vapour compression system with p-h and t-s diagram.   **(07)**

(b) Calculate the power needed to compress *20 kg/min* of *R-12* from saturated vapour at   **(07)**
1.4 bar to a condensing pressure of *10 bar* by two stage compression with inter-cooling
by liquid refrigerant at *4 bar*. Assume saturated liquid to leave the condenser and dry
saturated vapours to leave the evaporator.

Q-6   **Attempt all questions**

(a) Draw a labeled sketch and explain working of window air conditioning system.   **(07)**

(b) What do you understand by the term "psychrometry"? Explain each and every term   **(07)**

related to psychrometric chart.

Q-7   **Attempt all questions**
  (a)   Explain the thermal exchange mechanism of human body with environment.   **(06)**
  (b)   A VCRS works between the pressure limits of *60 bar* and *25 bar*. The working fluid is   **(08)**
           just dry at the end of compression and there is no undercooling of the liquid before the
           expansion valve. Determine 1) COP of cycle 2) capacity of the refrigerator if the fluid
           flow is at the rate of *5 kg/min.*
           Data:

Pressure (bar)	Temp(K)	Enthalpy(KJ/kg)		Entropy (KJ/kg K)	
		Liquid	**Vapour**	**Liquid**	**Vapour**
60	295	151.96	293.29	0.554	1.0332
25	261	56.32	322.58	0.226	1.2464

Q-8   **Attempt all questions**
  (a)   What are different methods used for design of the ducts and explain advantages of each   **(07)**
           over other.
  (b)   List the water cooled condenser and explain any one.   **(07)**