

00127

**Diploma in Electrical and Mechanical
Engineering**

Term-End Examination

June, 2010

BME-043 : RAC/UTILIZATION

Time : 2 hours

Maximum Marks : 70

Note : All questions are compulsory. Use of calculator is allowed. Psychometric chart is provided.

1. Choose the correct answer : **14x1=14**

(a) For a refrigerating machine, 'Energy Ratio' for cooling is :

(i) $\frac{Q_K}{Q_K - Q_O}$ (ii) $\frac{Q_O}{Q_K - Q_O}$

(iii) $\frac{Q_K - Q_O}{Q_O}$ (iv) $\frac{Q_K - Q_O}{Q_K}$

(b) 1 TR is equivalent to :

(i) 50.4 K cal/min (ii) 211 kJ/min.

(iii) 3.5167 kW (iv) All of the above

- (c) Water is designated by :
- (i) R - 717
 - (ii) R - 718
 - (iii) R - 722
 - (iv) R - 744
- (d) Freezing point of Refrigerant should be :
- (i) as high as possible
 - (ii) as low as possible
 - (iii) equal to one
 - (iv) none of the above
- (e) Refrigerant should be stored in :
- (i) High pressure vessel
 - (ii) Small pressure vessel
 - (iii) Atmospheric pressure vessel
 - (iv) None of the above
- (f) Which relation is **incorrect**
- (i) Fourier Law - Heat conduction
 - (ii) Newton's Law - convection
 - (iii) Stefan - Boltzman Law - Radiation
 - (iv) None of the above
- (g) The cooling medium in Evaporative condenser is :
- (i) Air
 - (ii) Water
 - (iii) Water and Air
 - (iv) None of the above

- (h) Evaporators for cold storage and low temperature applications necessarily have the temperatures.
- (i) equal to 0°C
 - (ii) lower than 0°C
 - (iii) higher than 0°C
 - (iv) 5°C
- (i) In domestic refrigerators, which insulating material is used :
- (i) Polystyrene (ii) Polyurethane
 - (iii) Phenotherm (iv) Glass wool
- (j) If 'T', 'r' and 'a' represent 'transmissivity', 'reflectivity' and 'absorptivity' then :
- (i) $T+r+a=1$ (ii) $T+r+a=0$
 - (iii) $T+r=a$ (iv) $T=r+a$
- (k) In cross flow Heat Exchanger, the hot and cold fluid flows.
- (i) parallel to each other
 - (ii) right angle to each other
 - (iii) opposite to each other
 - (iv) all of the above

(l) For a rectangular fin, the fin efficiency η_f is given by :

(i) $\frac{\tan h ml}{ml}$

(ii) $\frac{\sin h ml}{ml}$

(iii) $\frac{\cos h ml}{ml}$

(iv) $\frac{\sin h ml + \cos h ml}{ml}$

(m) If E_b is emmissive power and T is the absolute temperature, then as per Stefan - Boltzman law which one is correct ?

(i) $E_b \propto T$ (ii) $E_b \propto T^2$

(iii) $E_b \propto \delta T^3$ (iv) $E_b \propto T^4$

(n) In centrifugal fans, the air flows through the impeller :

(i) axially

(ii) radially

(iii) sometime axially and sometime radially

(iv) none of the above

2. Answer *any two* of the following :
- (a) (i) What is ton of refrigeration ? 2
 - (ii) Define a refrigerant. Can water be used as a refrigerant ? 2
 - (iii) What is the coefficient of performance of refrigeration machine and heat pump. 3
 - (b) (i) Discuss any five desirable thermodynamic characteristics of a fluid to be used as a refrigerant. 5
 - (ii) State Fourier Law of heat conduction. 2
 - (c) Derive an expression for specific humidity and show that it is a function of vapour pressure and barometric pressure of air. 7
3. Answer *any two* of the following :
- (a) (i) How heat exchangers are classified ? 2
 - (ii) Determine the effectiveness of heat exchangers by NTU method. 5
 - (b) Explain different processes involved in vapour compression refrigeration and indicate them on T - S and P - h diagram. 5+2
 - (c) What is logarithmic mean area ? Derive an expression for Heat flow through cylinder and show that it is a function of log mean area and temperature distribution. 2+5

4. Answer *any two* of the following :
- (a) 30 m³ of air at 15°C DBT and 13°C WBT are mixed with 12 m³ of air at 25°C DBT and 18°C WBT. Assuming the barometric pressure of one standard atmosphere, determine the DBT and WBT of the resulting mixture. 7
- (b) In P - h diagram for R - 12, it is found that $h_1 = 185.4$ kJ/kg, $h_2 = 208.0$ kJ/kg, $h_3 = h_4 = 74.6$ kJ/kg, $v_1 = 0.065$ m³/kg. Using these data, calculate : 7
- (i) refrigerant mass flow rate
 - (ii) theoretical horse power of compressor per ton of refrigeration
 - (iii) heat rejected to the condenser in kW
 - (iv) actual COP and Carnot COP.
- (c) 320 mm thick reactor wall is made up of an inner layer of fire brick (thermal conductivity of 0.84 W/m.k) covered with a layer of insulation (thermal conductivity of 0.16 W/m.k.) The reactor operates at the temperature of 1325°C and the ambient temperature is 25°C. Calculate : 7
- (i) the thickness of fire brick and insulation, which give minimum heat loss
 - (ii) the heat loss presuming that insulation material has a maximum temperature of 1200°C.

5. Answer *any two* of the following :

- (a) Explain the importance of air filters in air conditioning. Discuss the different type of filters used. 7
- (b) What are fan laws ? Draw the fan performance curve. 7
- (c) Write short notes on **any two** of the following : 7
 - (i) selection of Insulation material.
 - (ii) Evaporative cooling.
 - (iii) Type of fans.
 - (iv) selection of condenser.