

B.E. DEGREE EXAMINATIONS: APRIL / MAY 2011

Sixth Semester

MECHATRONICS ENGINEERING

U07MH604: Thermodynamics and Heat Transfer

(Use of approved steam table, refrigeration table and HMT data book are permitted)

Time: Three hours

Maximum Marks: 100

Answer all Questions:-

PART A (10 x 1 = 10 Marks)

1. An isolated system has
 - a. mass transfer
 - b. heat transfer
 - c. mass and heat transfer
 - d. no mass and heat transfer
2. Heat Transfer is a Function.
 - a. point
 - b. path
 - c. mass
 - d. parametric
3. In Otto Cycle, the efficiency while increasing compression ratio.
 - a. increases
 - b. decreases
 - c. not affected
 - d. irrelevant data.
4. Ports are used in stroke engines.
 - a. two
 - b. four
 - c. six
 - d. compression
5. In a fire tube boiler, water is circulated
 - a. outside the tube.
 - b. inside the tube
 - c. in boiler drum
 - d. economizer
6. CoP of a Heat Pump is equal to
 - a. $1 + \text{CoP of a Refrigerator}$
 - b. $1 - \text{CoP of a Refrigerator}$
 - c. $2 * \text{CoP of a Refrigerator}$
 - d. $1.5 * \text{CoP of a Refrigerator}$
7. In a steam carrying pipe line available in thermal power plant, the heat loss to be.....
 - a. minimum
 - b. maximum
 - c. 0 %
 - d. 100 %
8. Fins are used to
 - a. increase heat transfer
 - b. decrease heat transfer
 - c. arrest heat transfer
 - d. generate heat
9. In a thermo flask, heat loss is carried out through heat transfer
 - a. conduction
 - b. convection
 - c. radiation
 - d. a and b
10. To have higher heat transfer through conduction, the thermal conductivity to be.....
 - a. minimum
 - b. maximum
 - c. 0
 - d. none of the above

PART B (10 x 2 = 20 Marks)

11. State First Law of Thermodynamics for a cycle.

12. State some reason for irreversibility.
13. Why intercooler is used in multi stage air compressors?
14. What is the use of valve timing diagram?
15. Define Degree of Superheat.
16. What for water level indicator is used in boilers?
17. Calculate the area required to have 400 W of Heat Transfer (Q) through conduction, if Thermal Conductivity (k) = 10 W/mK and Temperature Difference (ΔT) = 20 K. Define Fin Efficiency.
18. How convective heat transfer is increased by forced convection method?
19. What is Emissivity?

PART C (5 x 14 = 70 Marks)

21. a) (i) State and explain Kelvin-Planck and Clausius statements. [7]
- (ii) Explain different equilibriums are available with example. [7]

(OR)

- b) (i) State and prove the Carnot theorem [7]
- (ii) Show that the efficiency of a Carnot cycle is the maximum possible efficiency. [7]

22. a) In an air compressor air flows steadily at the rate of 0.5 kg/s. At entry to the compressor air has a pressure of 105 kPa and specific volume of 0.86 m³/kg and at exit of the compressor those corresponding values are 705 kPa and 0.16m³/kg. Neglect kinetic and potential energy change. The internal energy of air leaving the compressor is 95 kJ/kg greater than that of air entering. The cooling water in the compressor absorbs 60 kJ/s of heat from the air. Find power required to drive the compressor.

(OR)

- b) An engine working on Otto cycle has a volume of 0.5 m³, pressure 1 bar and temperature 27°C at the commencement of compression stroke. At the end of compression stroke, the pressure is 10 bar. Heat added during the constant volume process is 200 kJ. Determine:
 - (i) Percentage of clearance volume
 - (ii) Air standard efficiency
 - (iii) Mean effective pressure

23. a) (i) How Dryness Fraction of Steam is calculated for a particular state point? [5]
- (ii) Why ODP value is considered while selecting a refrigerant? [4]
- (iii) Define CoP of a refrigeration system. [5]

(OR)

- b) (i) Differentiate Water tube and fire tube boilers. [5]
(ii) Explain the working principle of a simple vapour compression refrigeration system. [9]

24. a) Derive the general differential equation for heat conduction in Cartesian coordinates and deduce the equation for steady state heat conduction, Poisson and Laplace equation form.

(OR)

- b) (i) Water at 50°C flows in a 1.5 cm diameter and 3 m long tube with a velocity of 1 m/s. The tube wall is maintained at a constant temperature of 90°C. Calculate the heat transfer coefficient and the total amount of heat transfer if the exit temperature is 64°C. [10]
(ii) State the difference between forced and free convection. [4]

25. a) (i) What are the factors affecting the convective heat transfer? [4]
(ii) Explain Stephan Boltzmann's law applied to radiation heat transfer. What is meant by absorptivity, reflectivity and transmissivity? [10]

(OR)

- b) (i) Explain different modes of heat transfer with the formulae used for calculate the heat transfer. [10]
(ii) State the difference between forced and free convection. [4]
