KUMARAGURU
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Register Number: ………………..

B.E DEGREE EXAMINATIONS: MAY 2015

(Regulation 2009)

Sixth Semester

MECHATRONICS ENGINEERING

MCT116 : Thermodynamics and Heat Transfer

(Use of approved steam tables and charts are permitted)

(Use of approved heat and mass transfer data book is permitted)

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Work done in a constant volume process is

   a) Maximum   b) Positive

   c) Zero   d) Negative

2. Second law of thermodynamics defines

   a) Heat   b) Work

   c) Enthalpy   d) Entropy

3. The air standard efficiency of Otto cycle is given by

   a) $1-(1/r^{r-1})$ b) $1+(1/r^{r+1})$

   c) $1/r^{r-1}$ d) $1/r^{r+1}$

4. Compression ratio of diesel engine may have a range of

   a) 8 to 10   b) 16 to 20

   c) 10 to 15   d) 4 to 10

5. The thermal conductivity is expressed as

   a) W/mK   b) W/m^2K

   c) W/hmK   d) W/h^2m^2K

6. The radial heat transfer rate through hollow cylinder increases as the ratio of outer radius to inner radius

   a) Increases   b) Decreases

   c) Constant   d) Zero

7. The Reynolds number is given by

   a) VL/µ
   b) hL/K
   c) VL/γ
   d) h/v.cp

8. The quantity of heat radiation depends on

   a) Area of the body
   b) Shape of the body
   c) Temperature of the body
   d) Both a) and b)

9. A lump of sugar dropped in a cup of tea will dissolve by

   a) Convection
   b) Diffusion
   c) Radiation
   d) Conduction

10. Ficks law of diffusion is given by

   a) $Na = -D_{ab}$ x dc_a/dx
   b) $Na = D_{ab}$ x dc_a/dx
   c) $Na = -D_{ab} + dc_a/dx$
   d) $Na = -D_{ab} - dc_a/dx$

PART B (10 x 2 = 20 Marks)

11. Distinguish between open system and closed system.

12. State kelvin plank statement of second law of thermodynamics.

13. Draw the p-v diagram of diesel cycle and label the process.

14. Compare two stroke and four stroke engines.

15. List out the various modes of heat transfer.

16. State Fourier law of heat conduction.

17. Summarize the various types of convections.

18. Define the terms black body and grey body.

19. What is meant by molecular diffusion?

20. Summarize the values of prandl number Schmidt number for the Renolds analogy.

PART C (5 x 14 = 70 Marks)

21. a) A fluid system contained in a piston and cylinder machine passes through a complete cycle of four processes. The sum of all heat transferred during a cycle is -340 KJ. The system completes 200 cycles/min. Complete the following table showing the method for each item and compute the net rate of work output in KW.

Process	Q(KJ/min)	W(KJ/min)	E (KJ/min)
1 – 2	0	4340	-
2 – 3	42000	0	-

| 3 – 4 | - 4200 | - | -73200 |
| 4 –1 | - | - | - |

(OR)

b) A turbine operating under steady flow condition, receives 4500 kg/hour of steam. The steam enters the turbine at a velocity of 2800 m/min, an elevation of 5.5m and a specific enthalpy of 2800 kJ/kg. It leaves the turbine at a velocity of 5600 m/min, an elevation of 1.5m and a specific enthalpy of 2300 kJ/kg. Heat losses from the turbine to the surroundings are 16000 kJ/hr. Determine the power output of the turbine.

22. a) An engine operates on the air standard diesel cycle. The compression ratio is 18. The pressure and temperature at the start of compression process are 100KPa and 300K. The heat added is 1800KJ/Kg of air. Determine the maximum pressure and temperature in the cycle, the thermal efficiency and net work done.

(OR)

b) (i) Describe the working of four stoke cycle petrol engine with a neat sketch. (10)

(ii) Summarize the functions of lubrication systems. (4)

23. a) Derive the general differential equation of heat conduction in Cartesian co-ordinates.

(OR)

b) A furnace wall is made up of three layers of thickness 250mm, 100mm, and 150mm with thermal conductivities of 1.65, K, 9.2 W/m°C respectively. The inside is exposed to gases at 1250 C with a convection co-efficient of 25 W/m^{2o}C and the inside surface isat 1100°C, the outside surface is exposed air at 25°C with convection co-efficient of 12 W/m^{2o}C. Determine (i) the unknown thermal conductivity 'K' (ii) The overall heat transfer co-efficient (iii) All surface temperatures.

24. a) A steam pipe of 184 mm outer diameter and 168mm inner diameter is covered with two layers of insulation. The thickness of first is 40mm and that of second layer is 62mm. The thermal conductivities of pipe and insulating material are 100, 0.35 and 0.045 W/m°C respectively. The inner surface temperature is

380°C and outer surface temperature of insulating material is 42°C. Determine the quantity of heat loss per meter length of pipe. If the surrounding temperature is 27°C, what is the outer surface heat transfer co-efficient.

(OR)

b) Calculate the following for an industrial furnace in the form of a black body and emitting radiation of 2500 °C.

(i)   Monochromatic emission power of 1.2μm length.

(ii)   Maximum emissive power.

(iii)   Total emissive power.

25.   a) CO_2 and air experience equimolar counter diffusion in a circular tube whose length and diameter are 1m and 50 mm respectively. The system is at a total pressure of 1 atmosphere at a temperature of 25 °C. The ends of the tube are connected to large chambers in which the species concentrations are maintained at fixed values. The partial pressure of CO_2 at one end is 190 mm of Hg while at the other end is 95 mm of Hg. Estimate the mass transfer rate of CO_2 and air through the tube.

(OR)

b) Define the expression for steady equimolar counter diffusion.

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