CBCS SCHEME

USN | | | | | | | | | |

15MT72

Seventh Semester B.E. Degree Examination, June/July 2019
Thermal Engineering

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Heat transfer data hand book is permitted.

Module-1

1 a. Define the following:
i) Open system
ii) Closed system
iii) Intensive property
iv) Extensive property
v) Thermodynamic state point
vi) Thermodynamic process. **(06 Marks)**

b. State the Zeroth law of thermodynamics. Explain thermodynamic equilibrium. **(05 Marks)**

c. Explain Quasistatic process with a neat sketch. **(05 Marks)**

OR

2 a. State and explain thermodynamic definition of work. **(04 Marks)**

b. Derive an expression for displacement work of polytropic process with P-V diagram. **(06 Marks)**

c. A spherical balloon has an initial diameter of 25c-m and contains air at 1.2 bar. Because of heating the diameter of the balloon increases to 30cm and daring heating process the pressure is found to be proportional to the diameter. Calculate the work done during the process. **(06 Marks)**

Module-2

3 a. Show that energy is a property of the system. **(04 Marks)**

b. Derive an expression for Steady Flow Energy Equation (SFEE) with suitable assumptions. **(08 Marks)**

c. Showing the control volume approximately modify the SFEE for the following cases:
i) Steam turbine with negligible potential energy if the process is adiabatic.
ii) Boiler with negligible kinetic energy and potential energy. **(04 Marks)**

OR

4 a. State the Kelvin plank and Claussius statement and explain its equivalence of the two statements. **(08 Marks)**

b. Explain PMMI and PMMII kind. **(04 Marks)**

c. A COP of a heat pump is 5 and power required to drive it is 35kW, find the a heat transfer from and to working fluid, heat from heat pump is used to heat the water circulating the radiator of the building. Find mass flow rate of water if its temperature rise by 20°C. **(04 Marks)**

Module-3

5 a. Derive an expression for air standard efficiency of otto cycle with P.V. diagram and T-S diagram. **(08 Marks)**

b. Compare otto, diesel and dual cycle. When:
   i) Operating under same compression ratio
   ii) At the same maximum temperature. **(05 Marks)**

c. Define the following:
   i) Compression Ratio (R_c)
   ii) Mean effective pressure (P_m)
   iii) Air standard efficiency (η_{air}). **(03 Marks)**

OR

6 a. Derive an expression for laws governing conduction and convection. **(06 Marks)**

b. Define the following:
   i) Conduction ii) Convection iii) Thermal conductivity iv) Heat transfer co-efficient. **(04 Marks)**

c. The convective heat transfer co-efficient $h_c = 2.512\ (\Delta T)^{1/4}\ W/m^2K$. A hot plate of $A = 0.2m^2$ at 59°C loses heat to a room at temperature 20°C. Find the fraction of heat loss by natural convection, when heat is transferred from plate steadily at the rate of 100W. **(06 Marks)**

Module-4

7 a. Derive an expression for general three dimensional conduction equations in Cartesian coordinate. **(08 Marks)**

b. A large composite wall is built up of following material 10cm Marbel having thermal conductivity 1.33 W/m°K, 8c-m brick having thermal conductivity 0.696 W/m°K and 2c-m insulating material having thermal conductivity 0.0696 W/m°K. The inside and out side heat transfer co-efficient are 58 $W/m^{2\circ}K$ and 11.6 $W/m^{2\circ}K$ and temperature are inside 200°C and outside 20°C respectively, calculate: i) Overall heat transfer coefficient ii) Heat flux iii) Temperature drop across layer. **(08 Marks)**

OR

8 a. Using Buckingham's π theorem method, for natural convection show that Nu = f (Gr, Pr). **(10 Marks)**

b. Explain the following:
   i) Natural convection
   ii) Local heat transfer co-efficient
   iii) Grasshoff number
   iv) Drag force
   v) Nusselt number
   vi) Drag-co-efficient. **(06 Marks)**

Module-5

9 a. Air at 25°C and atmospheric pressure is flowing over a flute plate at a velocity of 4m/sec. If the plate is 20cm wide and 65°C calculate the following quantities at a distance of 40cm from the leading Edge,
   i) Thermal boundary layer thickness
   ii) Local shear stress
   iii) Local heat transfer-co-efficient
   iv) Total drag force and also heat transfer. **(12 Marks)**

b. Explain the physical significance of the following:
   i) Reynolds number
   ii) Staton number
   iii) Prandtl number
   iv) Nusselt number. **(04 Marks)**

OR

10 a. Explain :
   i) Stefan Boltzman law
   ii) Kirchoff law
   iii) Plank's law
   iv) Wein's displacement law
   v) Radiation shield. **(10 Marks)**

b. The filament of a 75W light bulb may be consider a black body radiating in to black enclosure at 70°C. The filament diameter is 0.10mm and length is 50mm considering the radiation, determine the filament temperature. **(06 Marks)**

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