CBCS SCHEME

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17MT72

Seventh Semester B.E. Degree Examination, July/August 2021
Thermal Engineering

Time: 3 hrs. Max. Marks: 100

Note: *1. Answer any FIVE full questions.*
2. Use of heat transfer data book and thermodynamics data book are permitted.

1 a. Describe :
i) System and control volumes
ii) State and equilibrium
iii) Process and cycles. **(12 Marks)**

b. Explain thermodynamic equilibrium. **(08 Marks)**

2 a. Describe :
i) Thermodynamic definition of work
ii) Displacement work
iii) Path function and Point function. **(12 Marks)**

b. Compute the work done by 1kg of a fluid system as it expands slowly behind a piston from an initial pressure of 6×10^5Pa and initial volume of $0.06m^3$ to a final volume of $0.18m^3$ in the following process.
i) Pressure remains constant and
ii) $Pv^{1.3}$ = constant. **(08 Marks)**

3 a. Define first law of thermodynamics. Show that energy is a property of the system. **(12 Marks)**

b. In a steady flow apparatus, 135kJ of work is done by each kg of fluid. The specific volume of the fluid, pressure and velocity at the inlet are 0.37 m^3/kg, 600KPa and 16m/s. The inlet is 32m above the floor, and the discharge pipe is at floor level. The discharge conditions are 0.62 m^3/kg, 100KPa, and 270m/s. The total heat loss between the inlet and discharge is 9kJ/kg of fluid. In flowing through this apparatus, does the specific internal energy increases or decrease, and by how much. **(08 Marks)**

4 a. Explain :
i) Heat engines
ii) Perpetual Motion Machines (PMM). **(06 Marks)**

b. Explain Carnot cycle with suitable diagram. **(07 Marks)**

c. Two Carnot engines work in series between the source and sink temperature of 550K and 350K respectively. If both engines develop equal power determine the intermediate temperature? **(07 Marks)**

5 a. Describe diesel cycle with suitable diagram. **(10 Marks)**

b. An engine working on the otto cycle is supplied with air at 0.1MPa, 35°C. The compression ratio is 8. Heat supplied is 2100 kJ/kg. Calculate the maximum pressure and temperature of the cycle. **(10 Marks)**

6 a. Explain basic laws governing modes of heat transfer. **(10 Marks)**
b. Describe boundary conditions of 1st, 2nd and 3rd kind? **(10 Marks)**

7 a. Derive general 3 – D heat conduction equation in Cartesian co-ordinate. **(12 Marks)**
b. The thermal contact conductance at the interface of two 1cm thick aluminium plates is measured to be 11,000 $w/m^2°C$. Determine the thickness of the aluminium plate whose thermal resistance is equal to the thermal resistance of the interface between the plates. The thermal conductivity of aluminum at room temperature is K = 237 w/m°C. **(08 Marks)**

8 Derive $N_u = B\ G_r^a\ P_r^b$ by dimensional analysis of free convection heat transfer. [Notations of equation with their usual meanings]. **(20 Marks)**

9 Explain physical significance of following non-dimensional members.
a. Reynold numbers
b. Prandtl number
c. Nusselt number
d. Stanton number. **(20 Marks)**

10 Explain following laws of radiation heat transfer :
a. Stefen-Boltzman law
b. Kirchoff's law
c. Plank's law
d. Wein's displacement law. **(20 Marks)**

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