B. CIVIL ENGINEERING (EVENING) 1st YEAR 1st SEMESTER SUPPLEMENTARY EXAMINATION, 2017

Thermodynamics and Heat Power

Time:-Three Hours Full Marks:-100

Answer any five questions

All parts of the same question must be answered together

Data, consistent with the problem may be assumed if necessary

1. Answer the following questions (***any four***):

a) What do you mean by thermodynamic property of a system?

b) Define the term 'Thermodynamic equilibrium'.

c) Define the terms: Heat, Work.

d) State and explain the Zeroth law of thermodynamics.

e) What is air standard cycle?

20

2 a) Derive an expression of cycle efficiency for the Diesel cycle with relevant parameters. 8

b) An engine working on the Otto cycle has an air standard cycle efficiency of 56% and rejects 544 kJ/kg of air. The pressure and temperature of air at the beginning of compression are 0.1 MPa and 60^0C respectively. Compute (a) the compression ratio of the engine, (b) the work done per kg of air, (c) the pressure and temperature at the end of compression, and (d) the maximum pressure of the cycle.

12

3 a) Find out an expression for the work done in an isothermal process (*pV=constant*). 6

b) A fluid is confined in a cylinder by a spring loaded, frictionless piston so that the pressure in the fluid is a linear function of the volume ($P = a + bV$). The internal energy of the fluid is given by the following equation $U = 34 + 3.15pV$, where U is in kJ, p in kPa, and V in m^3. If the fluid changes from an initial state of 170 kPa, 0.03 m^3 to a final state of 400 kPa, 0.06 m^3, with no work other than done on the piston, find the direction and magnitude of the work and heat transfer. 14

4 a) What is PMM1? Why is it impossible?

b) 1.5 kg of air in a piston-cylinder arrangement at 60^0C, 1100 kPa is expanded in a reversible isobaric process to 150^0C. Find the work done, change in internal energy and heat transfer during this process. Also plot the above process on *P-V*, *P-T* planes. Assume for air R= 0.287 KJ/Kg K and C_v= 0.718 KJ/Kg K.

5

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5 a) The enthalpy and the velocity of the fluid passing at the inlet to a certain nozzle are 3000 kJ/kg and 60 m/s respectively. At the discharge end, the enthalpy is 2762 kJ/kg. The nozzle is horizontal and there is negligible heat loss from it. (i) Find the velocity at exit from the nozzle. (ii) If the inlet area is 0.1 m^2 and the specific volume at inlet is 0.187m^3/kg, find the mass flow rate. (iii) If the specific volume at the nozzle exit is 0.498m^3/kg, find the exit area of the nozzle.

b) Write a short note on 'Energy reservoir'. 12

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6. a) What is the function of a fusible plug? 3
   b) Classify boiler. 5
   c) Discuss with neat sketch the working principle of a fire tube boiler. 12

7. Write short notes on the following (***any four***):
   a) PMM1, b) Safety valve, c) Heat pump, d) Economiser, e) Enthalpy, f) Heat engine. 20