Student Exam No. _____

GANPAT UNIVERSITY

B. Tech. Semester : III (Mechatronics) Engineering

CBCS Regular Examination November – December-2014

Subject: 2MC306 Thermal Engineering

Time: 2 Hours **Total Marks: 50**

Instruction: *1. Don't write anything on the question paper.*
2. Use of non programmable scientific calculator is permitted.
3. Also use heat and mass Transfer Data Book.

Section - 1

Que. – 1 **(a)** Give the thermodynamic concept of work. Are work and heat point function or path function ? Explain. 4

(b) A cyclic heat engine operates between a source temperature of 800 °C and a sink temperature of 30 °C. What is the least rate of heat rejection per KW net output of the engine.? 4

OR

Que. – 1 **(a)** A blower handles 1 kg/s of air at 20°C and consumes a power of 15 kW. The inlet and outlet velocities of air are 100 m/s and 150 m/s respectively. Find the exit air temperature assuming adiabatic conditions. Take c_p of air is 1.005 kJ/kg-K. 4

(b) What is the Heat Pump? How does it differ from a Refrigerator? Show the COP of a heat pump is greater than COP of a refrigerator by unity. 4

Que. – 2 **(a)** What are the limitation of first law of thermodynamics? State the second law as stated by kelvin – Plank and Clausius also prove their equivalence? 4

(b) Define following terms: 3
(i) System (ii) Boundary (c) Surroundings

OR

Que. – 2 **(a)** Derive the stady flow energy equation for following. 4
(i) Condencer (ii) compressor (iii) Turbine (iv) Nozzle

(b) Define enthalpy. Compare it with internal energy. 3

Que. – 3 **(a)** With the help of P-V and T-S diagrams, show that for the same maximum pressure and heat input and compare diesel, dual and Otto cycle. 5

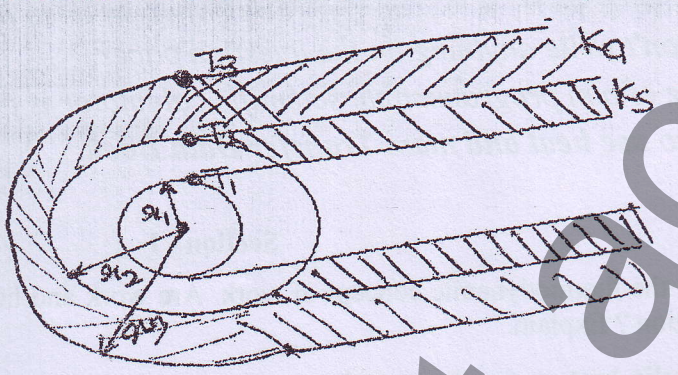
(b) Draw the following cycles on P-v and T-s diagram 5
(a) Carnot cycle (b) Otto
(c) Diesel (d) Dual cycle
(e) Ericsson cycle

P.T.O.

Section - II

Que. – 4 **(a)** Calculate the rate of heat transfer per unit area through a copper plate 45 mm thick, whose one face is maintained at 350 ^{0}C and the other face at 50 ^{0}C . Take thermal conductivity of copper as 370 W/m^{0}C. 4

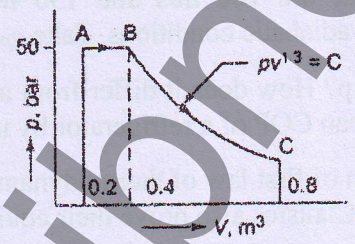
(b) A stainless steel tube K_s = 19watt/mk, 2 cm internal dia and 5cm outer dia insulated with 3cm thick asbestos K_a = 0.2 W/mk, If the temperature difference between inner most and outer most surface is 600 ^{0}C and the heat transfer rate per unit length. 4



OR

Que. – 4 **(a)** What is Fourier's Law? And the steady state radial conduction H.T. through a hollow cylinder, Derive Equation and also write assumptions 4

(b) Determine the total work done by a gas system following an expansion process as shown in Figure 4



Que. – 5 **(a)** A hot fluid at 200 °C enters heat exchanger at a mass flow rate of 10^4 kg/h. Its specific heat is 2000 J/kgK. It is to be cooled by cooled by another fluid entering at 25 °C with a mass flow rate 2500 kg/h and specific heat 400 J/kgK .The overall heat transfer coefficient based on outside area of 20 m^2 is 250 W/m^{2}K. Find the exit temperature of the hot fluid when the fluids are in parallel flow. 7

OR

Que. – 5 **(a)** The flow rates of hot and cold water streams running through a parallel flow heat exchanger are 0.2 kg/s and 0.5 kg/s respectively. The inlet temperatures on the hot and cold sides are 75°C and 20°C respectively. The exit temperature of hot water is 45°C. If the individual heat transfer coefficients on both sides are 650 W/m^{2}C, calculate the area of the heat exchanger. 7

Que. – 6 **(a)** Derive an expression for logarithmic mean temperature difference (LMTD) in case of (i)parallel flow, and (ii) Counter-flow heat exchangers. 6

(b) Explain the briefly zeroth law of thermodynamics. 2

(c) What is the difference between intensive and extensive properties ? Explain with examples. 2

END OF PAPER