Exam No: _____

GANPAT UNIVERSITY
B. TECH SEM-III (Mechatronics)
REGULAR EXAMINATION– NOV-DEC 2016
2MC302 Thermal Engineering

TIME: 3 HRS **TOTAL MARKS:**60

Instructions: (1) This Question paper has two sections.
(2) Attempt each section in separate answer book.
(2) Figures on right indicate marks.
(3) Be precise and to the point in answering the descriptive questions.

SECTION: I

Q.1 (a) Derive the entropy change (Δs) for open, closed and isolated system. (5)

(b) Define the PMM-1 and PMM-2. (5)

OR

Q.1 (a) Define the following term (any five): Re, Pr, Nu, St, βi, Gr, Pe (5)

(b) Derive the equation for heat transfer through hollow cylinder. (5)

Q.2 (a) Describe the VCR system with neat sketch and draw the p-v, T-s and p-h diagram. (7)

(b) Derive the COP relation between Heat pump and Refrigeration. (3)

OR

Q.2 (a) The humidity ratio of atmospheric air at 28 °C dry bulb temperature and 760 mm of mercury is 0.016 kg/kg of dry air. Determine: Partial pressure of water vapour, relative humidity, dew point temperature, specific enthalpy and vapour density. (5)

(b) Define the terms: Dew point temperature, Wet bulb temperature, Dry bulb temperature, Relative humidity and Absolute humidity. (5)

Q.3 (a) Derive LMTD equation for the parallel flow type heat exchanger: (5)

$$\theta_m = \frac{\theta_2 - \theta_1}{\ln(\frac{\theta_2}{\theta_1})}$$

(b) Derive the Overall heat transfer co-efficient considering fouling or scaling for hollow cylinder. (5)

SECTION: II

Q.4 (a) The interior of the refrigerator having inside dimension of 0.5 m * 0.5 m base area and 1m height, is to be maintained at 6 °C. The walls of refrigerator are constructed of two mild steel sheets 3mm thick (k=46.5W/m °C) with 50 mm of glass wool insulation (k= 0.046 W/m °C) between them. If the average heat transfer co-efficient at outer and inner surfaces are 11.6 W/m^2 °C and 14.5 W/m^2 °C respectively. Calculate, (5)

(i) The rate at which heat must be removed from the interior to maintain at specified temperature in kitchen at 25 °C, and

(ii) The temperature on the outer surface of the metal sheet.

(b) An aluminum pipe carries steam at 110 °C. The pipe (k=185 W/m °C) has an inner diameter of 100 mm and outer diameter of 120 mm. The pipe is located in the room where the ambient air temperature is 30 °C and the convective heat transfer co-efficient between the pipe and the air is 15 W/m^2 °C. Determine the heat transfer rate per unit length of pipe. (5)

To reduces the heat loss from the pipe, it is covered with the 50 mm thick layer of insulation (k= 0.20 W/m °C). Determine the heat transfer rate per unit length from the insulated pipe. Assume that the convective heat resistance of the steam is negligible.

OR

Q.4 (a) Describe in detail Clausius Inequality. (5)

(b) Find the change in the entropy of steam generated at 400 °C from 5 kg of water at 27 °C and atmospheric pressure. Take specific heat water to be 4.2 kJ/kg K, heat of vaporization at 100 °C as 2260 kJ/kg and specific heat for the steam is given by: (5)

$C_p = R\,(3.5+1.2\,T+0.14\,T^2)$ J/kgK

Q.5 (a) Define and describe the Kirchhoff's law for the radiation. (5)

(b) Describe the temperature distribution profile for the evaporation and condenser type heat exchanger. (5)

OR

Q.5 (a) Write the Electrolux refrigerator with neat sketch. (5)

(b) Describe the various mode of Heat transfer. (5)

Q.6 (a) Prove that the critical radius of insulation for sphere is 2k/h. (5)

(b) In counter flow double pipe heat exchanger, water is heated from 25 °C to 65 °C by an oil with specific heat of 1.45 kJ/kg K. And mass flow rate is 0.9 kg/s. The oil is cooled from 230 °C to 160 °C. If the overall heat transfer co-efficient is 420 W/m^2 °C. Calculate, (5)

(i) The rate of heat transfer,

(ii) The mass flow rate of water,

(iii) The surface area of the heat exchanger.

----------END OF PAPER----------