10

Exam No:

Ganpat University

B.Tech. Sem. III (Mechatronics) Examination (CBCS-Regular) Nov- Dec 2012

Subject: 2MC306 Thermal Engineering

Time: 2 Hour **Total Mark: 50**

Instruction:

(1) Attempt all question.
(2) Right figure indicates full marks.
(3) Assume required data if necessary.
(4) Allow Steam Table

Section-I

Que.1.

(a) What do you understand by the term phase as applied to a system? Differentiate between homogeneous and heterogeneous systems **4**

(b) In what respects are the heat and work interactions (i) Similar, and (ii) dissimilar? **4**

OR

Que.1. **(a)** Define an isochoric, isobaric and isothermal process. How it is represented graphically on P-v diagram. **4**

(b) What is the essence of first law of thermodynamics? Write down expressions for the first law applied to a cycle and process **4**

Que.2.

(a) A reversible heat engine operates within the higher and lower temperature limits of 1500 K and 500 K respectively. The entire output from this engine is utilized to operate a heat pump. The pump works on reversed Carnot cycle, extracts heat from a reservoir at 400 K and delivers it to the reservoir at 500 K. If 100 KJ/s of net heat is supplied to the reservoir at 500 K, calculate the heat supplied to the engine by the reservoir at 1500K. **5**

(b) Show that COP of a heat pump is greater than COP of a refrigerator by unity. **3**

OR

Que.2.

(a) 3 kg of air at 150 kPa pressure and 360 K temperature is compressed polytropically to pressure 750 kPa according to the law $PV^{1.2}$ = constant. Subsequently the air is cooled to initial temperature at constant pressure. This is followed by expansion at constant temperature till the original pressure of 150 kPa is reached. Sketch the cycle on p-v and T-s plots and determine the work done, heat transfer and entropy change for each process. **5**

(b) What does the principle of entropy increase, specify? **3**

Que.3. **Attempt following question**

(a) Define the terms available energy and unavailable energy. **3**

(b) State the Kelvin –Plank and Clausius statements of the second law of thermodynamics. **3**

(c) Derive the SFEE for (i) Compressor (ii) Combustion Chamber **3**

Section-II

Que.4. Attempt following questions

(a) Derive expression for the air standard efficiency of Brayton cycle. 4

(b) Give the comparison of Otto, Diesel and Dual 4
   (i) Same compression ratio and heat input
   (ii) Same maximum pressure and heat input

Que.5.

(a) Derive an expression for heat loss through a composite wall of layers with convective heat transfer 4

(b) A furnace wall is made up of three layers of thickness 250 mm, 100 mm, and 150 mm with thermal conductivities of 1.65, k and 9.2 W/m ^{0}C respectively. The inside is exposed to gases at 125^{0}C with a convection coefficient of 25 W/ m^2 ^{0}C and the inside surface is at 1100^{0}C, the outside surface is exposed air at 25^{0}C with convection coefficient of 12 W/m^2 ^{0}C. determine: 5
   (i) The unknown thermal conductivity.
   (ii) The overall heat transfer coefficient
   (iii)All surface temperature.

OR

Que.5.

(a) Derive an expression for the logarithmic mean temperature difference in a parallel flow heat exchanger. 4

(b) Steam enters a counter flow heat exchanger, dry saturated at 10 bar and leaves at 35^{0}C. The mass flow of steam is 800 kg/min. the gas enters the heat exchanger at 650^{0}C and mass flow rate is 1350 kg/min. If the tube is 30 mm diameter and 3 m long. Determine the number of tubes required. Neglect the resistance offered by metallic tubes. Use the following data: 5
For steam t_{sat} = 180^{0}C (at 10 bar), C_{psteam} =2.71 kJ/kg ^{0}C, h_s = 600 W/m^2 ^{0}C
For gas C_g =1 kJ/kg 0C, h_g = 250 W/m^2 ^{0}C

Que.6.

(a) Derive the expressions for fin efficiency and effectiveness of infinitely long rectangular fin 4

(b) Define the following number 4
   (i) Nusselt number (ii) Grashof Number

OR

Que.6.

(a) Give the difference between Forced and Free convection heat transfer 4

(b) Explain Stefan-Boltzmann Law for radiation heat transfer. 4

Best Luck

End of Paper