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Question Paper Code : 97113

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Third Semester

Mechanical Engineering

ME 6301 — ENGINEERING THERMODYNAMICS

(Common to Automobile Engineering and Mechanical and Automation Engineering)

(Regulation 2013)

Time : Three hours Maximum : 100 marks

Instruction:

1. Answer ALL questions.
2. Symbols used should be explained at least once in each solution.
3. Sketches should be drawn neatly.
4. Answers without units and with wrong units will carry less marks.
5. Use of standard thermodynamic tables, Mollier diagram and refrigerant property tables are permitted.

PART A — ($10 \times 2 = 20$ marks)

1. Define thermodynamic equilibrium.
2. Enlist the similarities between work and heat.
3. An inventor claims to have developed an engine which absorbs 100 kW of heat from a reservoir at 1000 K produces 60 kW of work and rejects heat to a reservoir at 500 K. Will you advise investment in its development?
4. A turbine gets a supply of 5 kg/s of steam at 7 bar, 250°C and discharges it at 1 bar. Calculate the availability.
5. Draw the p-T diagram for water and label all salient points.
6. State the advantages of using super heated steam in turbines.
7. What is known as equation of state and when it can be used for engineering calculations?
8. What are known as thermodynamic gradients?
9. Define molar mass.
10. Define sensible heat factor.

PART B — (5 × 16 = 80 marks)

11. (a) Three grams of nitrogen gas at 6 atm and 160°C in a frictionless piston cylinder device is expanded adiabatically to double its initial volume, then compressed at constant pressure to its initial volume and then compressed again at constant volume to its initial state. Calculate the net work done on the gas. Draw the P–V diagram for the processes. (16)

Or

(b) 90 kJ of heat is supplied to a system at a constant volume. The system rejects 95 kJ of heat at constant pressure and 18 kJ of work is done on it. The system is brought to original state by adiabatic process. Determine

(i) The adiabatic work (8)

(ii) The values of internal energy at all states if initial value is 105 kJ. (8)

12. (a) Two heat engines operating in series are giving out equal amount of work. The total work is 50 kJ/cycle. If the reservoirs are at 1000K and 250K, find the intermediate temperature and the efficiency of each engine. Also, find the heat extracted from the source. (16)

Or

(b) 5 kg of air at 550 K and 4 bar is enclosed in a closed vessel.

(i) Determine the availability of the system if the surrounding pressure and temperature are 1 bar and 290 K. (8)

(ii) If the air is cooled at constant pressure to the atmospheric temperature, determine the availability and effectiveness. (8)

13. (a) (i) State the conditions under which the equation of state will hold good for a gas. (4)

(ii) State the main reasons for the deviation of behavior of real gases from ideal gases. (4)

(iii) Explain irreversibility with respect to flow and non flow processes. (4)

(iv) Explain the effectiveness of a system. (4)

Or

(b) Derive Maxwell relations. (16)

14. (a) Explain steam formation with relevant sketch and lable all salient points and explain every point in detail. (16)

Or

(b) In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2 bar. Determine

(i) The pump work (4)

(ii) The turbine work (3)

(iii) The rankine efficiency (3)

(iv) The condenser heat flow (3)

(v) The dryness at the end of expansion. Assume flow rate of 9.5 kg/s. (3)

15. (a) A mixture of hydrogen (H_2) and Oxygen (O_2) is to be made so that the ratio of H_2 to O_2 is 2: 1 by volume. If the pressure and temperature are 1 bar and 25°C respectively, Calculate:

(i) The mass of O_2 required (8)

(ii) The volume of the container. (8)

Or

(b) 120 m^3 of air per minute at 35°C DBT and 50% relative humidity is cooled to 20°C DBT by passing through a cooling coil. Determine the following

(i) Relative humidity of out coming air and its wet bulb temperature (6)

(ii) Capacity of cooling coil in tones of refrigeration (5)

(iii) Amount of water vapour removed per hour. (5)