B.E. CHEMICAL ENGINEERING SECOND YEAR FIRST SEMESTER
SUPPLEMENTARY EXAM 2018

ENGINEERING THERMODYNAMICS

Time: 3 Hours | Full Marks: 100

Attempt any ***five*** questions
Steam and other tables and charts may be used
Assume any data, if required

1. (a) Discuss (i) System, (ii) Quasistatic process, (iii) Work (12)

   (b) A cylindrical gas tank 1 m long, inside diameter of 20 cm, is evacuated and then filled with air at 30°C. To what pressure should it be charged if there should be 1.5 kg of air? (08)

2. (a) State the first law of thermodynamics for a system undergoing a cycle. Also state the first law of thermodynamics for a system undergoing a process. What is an isolated system? Show that the energy of an isolated system remains constant. (10)

   (b) A domestic refrigerator is loaded with food and the door closed. During a certain period the machine consumes1 kWh of energy and the internal energy of the system drops by 5000 kJ. Find the net heat transferred from the system. (10)

3. (a) Write the Kelvin-Planck statement and Clausius statement of the second law of thermodynamics. Hence prove that the violation of the Kelvin-Planck statement leads to the violation of the Clausius statement. (10)

   (b) An inventor claims to have developed a refrigeration unit which maintains the refrigerated space at –10°C while operating in a room where the temperature is 25°C, and which has a COP of 8.5. How do you evaluate his claim? How would you evaluate his claim of a COP of 7.5? (10)

4. (a) Write down the steady state steady flow energy equation for a turbine and a boiler with all assumptions. (10)

   (b) Steam enters a turbine at 3 Mpa, 400°C, expands in a reversible adiabatic process and exhausts at 10 kPa. Changes in kinetic and potential energies between the inlet and exit of the turbine are small. The power output of the turbine is 800 kW. What is the mass flow rate of steam through the turbine? (10)

5. (a) Define (i) Environment, (ii) Dead state. (iii) Useful work, (iv) Exergy and (v) immediate surroundings. (10)

   (b) A heat engine receives heat from a source at 1200 K at a rate of 500 kJ/s and rejects the waste heat to a medium at 300 K. The power output of the engine is 180 kW. Determine the reversible power and the irreversibility rate for this process. (10)

6. (a) Plot an Air Standard Diesel cycle on *PV* and *TS* planes. Derive an expression for the efficiency of Diesel cycle in terms of appropriate dimensionless parameters. (12)

   (b) Using the thermodynamic property differential equations, derive the Maxwell relations. (8)

7. Write short notes on any ***four*** of the following: (5x4=20)

   (a) Entropy generation
   (b) PMM I
   (c) Rankine cycle
   (d) Heat Pump
   (e) Ideal gas temperature

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