BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

Term-End Examination

June, 2008

BME-019 : ENGINEERING THERMODYNAMICS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any **five** questions. Use of calculator is allowed.*

1. (a) Explain briefly the Clausius' statement. 7

(b) A Bourdon gauge of a steam generator shows a pressure of 800 KPa. The barometer reads 875 mm Hg. What is the absolute pressure in KPa of the steam in the steam generator ? Take the density of the mercury to be 13600 kg/m^3. 7

2. (a) A closed system undergoes a thermodynamic cycle ABCDA. The heat transfer per minute during processes AB, BC and DA are –600 kJ, 10200 kJ and –1300 kJ respectively. The work transfers per second during processes AB, BC, CD and DA are –10300 kJ, zero, 17500 kJ and –1500 kJ respectively. Find the rate of heat transfer during the process CD and net rate of work done in kW. *10*

(b) During a working stroke, an engine rejects 300 kJ/kg of heat of the working substance. The internal energy of the working substance also decreases by 420 kJ/kg. Determine the work done by the engine. *4*

3. (a) Consider three hypothetical heat engines A, B and C are operating between 900 K and 400 K. When each engine involves itself with a heat interaction of 1500 kJ with the high temperature reservoir, it is claimed that while A develops a work of 500 kJ, B and C develop 600 kJ and 700 kJ. Use the Carnot statement and identify the engines A, B and C as reversible, irreversible or impossible. Justify your answer. *10*

(b) The efficiency of Carnot engine rejecting 1200 kJ/min to a heat sink at 20° C is 33%. Determine the temperature of heat source and the power of the engine. *4*

4. (a) In a certain reversible process the rate of heat transfer to the system per unit temperature rise is constant and is given by $\frac{dQ}{dT}$ = 2·4 kJ/degree. Find the increase in entropy of the system as its temperature increases from 250 K to 400 K. 7

(b) Describe working of Carnot cycle, with the aid of P – V and T – S diagrams. Also deduce the formula for Carnot cycle efficiency. 7

5. (a) Explain the various roles of energy manager. 6

(b) Briefly describe the working of Ideal reheat Rankine cycle. Also explain the advantages of reheat Rankine cycle. 8

6. (a) Describe the working of vapour absorption refrigeration system with a neat sketch. 7

(b) Explain the difference between Carnot cycle and Rankine cycle used in steam power plants. 7

7. (a) A reciprocating air compressor operates between 150 KPa and 600 KPa with a polytropic exponent of 1·3. How much clearance would have to be provided in the ideal case, to make the volumetric efficiency 40 percent ? 7

(b) A gas is to be compressed from 40 KPa to 600 KPa. It is known that cooling corresponding to a polytropic exponent of 1·25 is practical and the clearance of the available compressor is 3%. Compare the volumetric efficiencies to be anticipated for

(i) single-stage compression, and

(ii) two-stage compression with equal pressure ratios in the stages. 7