B. Tech Degree IV Semester Examination, April 2008

ME 403 THERMAL ENGINEERING II

(1999 Scheme)

Time : 3 Hours Maximum Marks : 100

(The use of steam table and refrigeration tables are permitted)

I. (a) How does Rankine cycle differ from a Carnot cycle? (8)

(b) A steam turbine working on Rankine cycle is supplied with dry saturated steam at 25 bar and the exhaust takes place at 0.2 bar. For the steam flow rate of 10 Kg/s, determine :

(i) Quality of steam at end of expansion (ii) Turbine shaft work

(iii) Power required to drive the compressor (iv) Rankine efficiency

(v) Heat flow in the condenser. (12)

OR

II. (a) Obtain the relation for critical pressure for isentropic flow through nozzles. (10)

(b) Dry saturated steam expands isentropically through a nozzle from 5 bar to a back pressure of 0.2 bar. The mass flow rate is 120 Kg/min. Neglecting the initial velocity of steam, determine the exit and throat diameters of the nozzle. (10)

III. (a) Explain the throttle or qualitative governing of steam turbines. (10)

(b) In the impulse stage the blade angles is to be determined. The nozzle angle is 12°. The steam speed is 400 m/s. Assume optimum blade speed and find the blade inlet angle. If the steam leaves the blades axially at exit, find the blade outlet angle. Also find the blade efficiency. (10)

OR

IV. (a) With neat sketches explain a simple Brayton cycle. (10)

(b) A Brayton cycle operates with air entering the compressor at 1 bar and 25°C. The pressure ratio across the compressor is 3:1, and the maximum temperature in the cycle is 650°C. Determine the compressor work, turbine work, thermal efficiency of the cycle. (10)

V. (a) Explain with diagram a Bootstrap system of aircraft refrigeration. (10)

(b) An air refrigeration open system between 1 MPa and 100 kPa is required to produce a cooling effect of 2000 kJ/min. The temperature of air leaving the cold chamber is –5° C and leaving the cooler is 30° C. Neglecting losses and clearance in the compressor and expander, determine –

(i) Mass of air circulated per hour (ii) Compressor and expander work

(iii) COP (iv) Power required to drive the machine (10)

OR

VI. (a) Describe with neat diagrams a simple vapour compression refrigeration cycle. (10)

(b) A standard vapour compression cycle is operating using F – 12 as the refrigerant between a condenser pressure of 10 bar and an evaporator pressure of 1.5 bar. The evaporator absorbs 75 kJ/min of energy as heat and the vapour is dry saturated at exit from the compressor. Determine (i) refrigerant flow rate (ii) power consumed (iii) COP. The relevant properties of F – 12 are given below: (10)

Pressure bar	Saturation temperature ° C	Enthalpy of liquid kJ/Kg	Enthalpy of vapour kJ/Kg	Entropy of liquid kJ/Kg-K	Entropy of vapour kJ/Kg-K
10	41.7	76.8	203.65		0.682
1.5	-20.1	17.82	178.84	0.073	0.709

VII. (a) Define and explain the terms in relation to psychrometry :
(i) Dry bulb, wet bulb and dew point temperatures
(ii) Relative humidity and specific humidity. (10)

(b) The temperature in a room is 30°C and the relative humidity is 30%. Determine - (i) the partial pressure of water vapour and the dew point (ii) the density of each component (iii) the specific humidity (iv) degree of saturation. Barometer reads 760 mm Hg. (10)

OR

VIII. (a) Explain winter air conditioning system. (10)

(b) One stream of air enters a mixing chamber at 20°C, 1.01325 bar and 40% RH at the rate of 40 Kg/s. Another stream enters at 10°C, 1.01325 bar and 80%, at the rate 20 Kg/s. Determine (i) the specific humidity (ii) the relative humidity (iii) the temperature of air leaving the mixing chamber. Assume adiabatic mixing process. (10)

IX. (a) Explain the different systems and components that constitute a thermal power plant. (10)

(b) Determine the quantity of air required per kg of coal burnt in a boiler fitted with 32 m high stack. Draught produced is 18.5 mm of water when the temperature of the flue gases in the chimney is 370° C and that of the boiler house is 30°C. Calculate also the draught produced in terms of column of gas in metres. (10)

OR

X. (a) Explain a pressurized water reactor with neat diagrams. (10)

(b) Explain general layout of a hydroelectric power plant. (10)

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