This question paper contains 4 printed pages.

3271 *Your Roll No.* .....

B. Tech. (M) / III J

Paper— THERMAL ENGINEERING – II

(EME–304)

Time : 3 hours *Maximum Marks* : 70

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt three questions from Part A and two questions from Part B. Assume missing data suitably, if any. Use of Steam tables, Refrigeration tables and Air conditioning tables is permitted.

PART A

1. (*a*) Compare centrifugal and axial flow compressors. 7

   (*b*) Explain the phenomenon of surging and choking in a compressor. 7

2. (*a*) Prove that the optimum pressure ratio is square root of maximum pressure ratio in a simple gas turbine cycle. 7

   (*b*) In a gas turbine plant, working on the Brayton cycle with a regenerator of 74% effectiveness, the air at the inlet to the compressor is at 0·1 MPa, 30°C, the pressure ratio is 6, and the maximum

P. T. O.

cycle temperature is 905°C. If the turbine and compressor have each an efficiency of 79%, find the percentage increase in the cycle efficiency due to regeneration. 7

3. (*a*) Briefly explain the desirable properties of refrigerants. 6

(*b*) A 5 ton ammonia vapour compression refrigerator works between 40°C and −10°C. Assuming a standard cycle, determine the COP of the system and the power required for the unit.

If the evaporator temperature is −20°C, what will be the percentage change in COP and the power requirement? 8

4. Describe the working of the following with the help of figure:

(*i*) Steam jet refrigeration 5

(*ii*) Vortex tube refrigeration 4

(*iii*) Simple Electrolux refrigerator system. 5

PART B

5. (*a*) Derive the COP expression of regenerative air refrigeration cycle. 6

(*b*) In an air refrigerating machine the compressor takes in air at 1 bar and 10°C. After compression to 5·5 bar, the air is cooled to 30°C before expanding it back to 1 bar in a turbine. Assuming ideal conditions, determine the COP.

In an actual plant using the above machine the air flow rate is 1700 kg/hr. The actual air temperature at the entry and exit of the cold chamber are −65°C and 7°C respectively. If the total power input to the device is 65 kW, find the relative COP. 8

6. (*a*) Derive the COP expression of vapour absorption refrigeration cycle. 4

(*b*) Mention the advantages of VAR over VCR. 4

(*c*) In an absorption type refrigerator, the heat is supplied to NH_3 generator by condensing steam at 2 bar and 90% dry. The temperature to be maintained in the refrigerator is −5°C. The temperature of the atmosphere is 30°C. Find the maximum COP possible.

If the refrigeration load is 20 tonnes and actual COP is 70% of maximum COP, find the weight of steam required per hour. 6

7. (*a*) Sketch the flow diagram of a typical system used for year-round air conditioning. Briefly explain the working. 6

(*b*) An air conditioning system is designed for industrial process for hot and wet summer conditions.

Outdoor conditions 30 DBT and 75% RH

Required conditions 22 DBT and 70% RH

Amount of free air circulated is 200 m^3/min

Coil dew-point temperature is 14°C.

P. T. O.

The required condition is achieved first by cooling and dehumidifying and then by heating. Find the following:

(*i*) The cooling capacity of the cooling coil and its by-pass factor.

(*ii*) Heating capacity of the heating coil in kW and surface temperature of the heating coil if the by-pass factor is 0·2. 8

8. (*a*) Explain the following psychrometric properties:

(*i*) Specific humidity

(*ii*) Relative humidity

(*iii*) Dew point temperature

(*iv*) Wet bulb temperature

(*v*) Degree of saturation. 5

(*b*) Describe the different systems used for distribution of air conditioning. 4

(*c*) Explain different temperature control elements. 5