B.E. DEGREE EXAMINATIONS, November 2011

MECHANICAL ENGINEERING

Fifth Semester

ME 9302 THERMAL ENGINEERING II

Time : 3 Hours **Max. Marks : 100**

(Use of Steam Tables, Mollier Chart and Refrigeration Tables is permitted)

Answer ALL Questions

PART – A 10x2=20 Marks

1. What are the advantages of reheating and regeneration in steam power cycle?
2. Distinguish between boiler mountings and accessories.
3. What do you mean by nozzle choking?
4. Define the metastable flow of steam in a nozzle.
5. Define blade velocity coefficient in an impulse turbine.
6. Explain the principle of operation of a reaction turbine.
7. Define one ton of refrigeration.
8. What are the various thermodynamic cycles employed in producing refrigeration?
9. What is cogeneration?
10. Give some applications where waste heat recovery is possible from Energy intensive industries.

PART – B 5x16=80 Marks

11. Dry saturated steam at a pressure of 11 bar enters a steam nozzle and leaves at a pressure of 2 bar. If the flow is adiabatic and frictionless, determine: (i) the exit velocity of steam (ii) ratio of cross-section at exit and that at throat. Assume the index of adiabatic expansion to be 1.135 **(16)**

12.a) 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. Consider the flow rate is 9.5 kg/s. Determine (i) The pump work (ii) The turbine work (iii) The Rankine efficiency (iv) The condenser heat flow (v) The dryness at the end of expansion. **(16)**

(OR)

b) How are boilers classified? Explain the unique features of the high pressure boilers.

13. a) In an impulse turbine (with a single row wheel) the mean diameter of the blade is 1.05 m and the speed is 3000 r.p.m. The nozzle angle is 18° the ratio of blade speed to steam speed is 0.42 and the ratio of the relative velocity at outlet from the blades to that at inlet is 0.84. The outlet angle of the blade is to be made 3° less than the inlet

angle. The steam flow is 10 kg/s. Draw the velocity diagrams for the blades and determine the following.

(i) Tangential thrust on the blades
(ii) Axial thrust on the blades
(iii) Resultant thrust on the blades
(iv) Power developed in the blades
(v) Blading efficiency **(16)**

(OR)

b) A stage of a turbine with Parson's blading delivers dry saturated steam at 2.7 bar from the fixed blades at 90m/s. The mean blade height is 40 mm and the moving blade exit angle is 20°. The axial velocity of steam is ¾ of the blade velocity at the mean radius. Steam is supplied to the stage at the rate of 9000 kg/hr. The effect of the blade tip thickness on the annulus area can be neglected. Calculate: (i) the wheel speed in r.p.m. (ii) the diagram power (iii) the diagram efficiency **(16)**

14.a) A refrigeration system of 10.5 tonnes capacity at an evaporator temperature of -12° C and a condenser temperature of 27° C is needed in a food storage locker. The refrigerant ammonia is sub-cooled by 6° C before entering the expansion valve. The vapour is 0.95 dry as it leaves the evaporator coil. The compression in the compressor is of adiabatic type. Using p-h chart find: (i)condition of vapour at outlet of the compressor (ii) condition of vapour at entrance to evaporator (iii) C.O.P and (iv) power required, in kW. Neglect valve throttling and clearance effect

(OR)

b)i)Explain the function of various parts of a simple vapour compression system. **(10)**

ii)What are various factors to be considered in the load estimation for the air-conditioning? **(6)**

15.a)(i)Explain the need for cogeneration and waste heat recovery with respect to II Law of thermodynamics. **(8)**

(ii) With suitable circuit, explain the function wise differences between topping and bottoming cycle. **(8)**

(OR)

b) A textile factory requires 10t/h of steam for process heating at 3 bar saturated and 1000 kW of power, for which a back pressure turbine of 70% internal efficiency is used. Find the steam condition required at inlet of the turbine. **(16)**