13/11/13

Roll No. | | | | | | | | | | |

B.E / B.Tech (Full-Time) DEGREE END SEMESTER EXAMINATIONS, NOV / DEC 2013

MECHANICAL ENGINEERING

Fifth Semester

ME 382 / ME 9302 THERMAL ENGINEERING II

(Regulation 2004 / 2008)

Use of Steam tables / Mollier chart / Refrigeration tables/ Psychrometric chart permitted

Time: 3 Hours | Answer ALL Questions | Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. What is meta stable flow?
2. What are the effects of super saturation in a steam nozzle?
3. Define equivalent evaporation.
4. State the function of an economiser.
5. Define degree of reaction.
6. What are the different methods of governing steam turbines?
7. List the merits of cogeneration.
8. What is a back pressure turbine?
9. What is the function of a throttling valve?
10. Define bypass factor of a cooling/heating coil.

Part – B (5 x 16 = 80 marks)

11. i) Derive the expression for maximum velocity and maximum discharge at throat. (8)
ii) Steam at a pressure of 15 bar with 50° C of superheat is allowed to expand through a convergent-divergent nozzle. The exit pressure is 1 bar. If the nozzle is required to supply 2 kg/s. of steam to a turbine, then calculate (a) The velocities at throat and exit. (b) Areas at throat and exit. Assume 10% frictional loss in divergent part only and percentage taken as % of total heat drop across the nozzle. (8)

12. a)i) With a neat schematic explain working of a Lamont boiler. Also mention its merits and demerits. (10)

ii) A boiler generates steam at the rate of 6 T/h at a pressure of 8 bar & 0.98 dry. The feed water is supplied at 40°C. If the boiler efficiency is 80%, calculate the coal consumption rate, whose calorific value is 31 MJ/kg. Also calculate the evaporation rate and equivalent evaporation.

(OR)

b)i) An ideal regenerative Rankine cycle operates with the steam entering the turbine at 30 bar and 500°C, and exhausted at 0.1 bar. A single stage feed water is used, which operates at 5 bar. Calculate the thermal efficiency and steam rate of the

cycle. Also find the increase in efficiency, mean temperature of heat addition with respect to an ideal Rankine cycle without regeneration. Represent the cycle on a T-s diagram. (10)

ii) Compare fire tube and water tube boilers.(Atleast six points) (6)

13. a)i) Derive the expression of maximum blade efficiency in a single stage impulse turbine. (8)

ii) In a Parson turbine running at 1500 rpm the available enthalpy drop for an expansion is 65 kJ/kg. If the mean diameter of the rotor is 100 cm, find the number of rows of moving blades required, assume stage efficiency as 80%, blade outlet angle as 20° C and speed ratio as 0.7. (8)

(OR)

b) Steam enters the blade row of an impulse turbine with a velocity of 600 m/s at an angle of 25° to the plane of rotation of blades. The mean blade speed is 200 m/s. The blade angle at the exit is 30°. The blade friction loss is 10 %. Determine (a) The blade angle at inlet (b) The work done per kg of steam (c)The diagram efficiency (d) The axial thrust on turbine rotor. (16)

14. a) What do you understand by cogeneration? Explain the concept of cogeneration with a schematic, and also the two types of cogeneration systems. (3+8+5)

(OR)

b) A certain process plant requires heat from process steam at 110°C at the rate of 4 MJ/s and electric power at the rate of 1000 kW from generator terminals. Both the heat and power requirements are met by a back pressure turbine of internal efficiency 85% and brake efficiency 90%.The turbine exhausts steam at 110°C dry saturated. The latent heat released during condensation is utilised in the process heater. Determine the pressure and temperature of steam at inlet to the turbine, assuming 95% generator efficiency. (16)

15. a) A refrigeration system of 10.5 tonnes capacity at an evaporator temperature of -10°C and a condenser temperature of 30°C is needed for a food storage locker. The refrigerant ammonia is sub cooled by 5°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. Find (a) Condition of vapour at the outlet of the compressor (b) Condition of vapour at the entrance of the evaporator (c) COP and (d) The power required. Neglect valve throttling and clearance effect. (Use refrigerant tables / p-h chart.) (16)

(OR)

b)i) Explain with a neat sketch the Air - Conditioning suitable for Chennai during summer weather condition. (8)

ii) Saturated air at 21°C is passed through a drier so that the final relative humidity is 20%. The air is then passed through a cooler until its final temperature is 21°C without a change in specific humidity. Find a) The temperature of air after drying process b) The heat rejected in cooling process c)The dew point temperature at the end of drying process. (8)