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B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2014

MECHANICAL ENGINEERING

V Semester - Arrear Examinations

ME 382 / ME 9302 THERMAL ENGINEERING – II

(Regulation 2004/2008)

Time: 3 Hours Answer ALL Questions Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. List the sources of moisture in boiler flue gas
2. Why water tube boilers are used for power generation as compared to fire tube?
3. List any 2 effects of super saturation in a nozzle
4. Does friction improve dryness fraction of steam? Justify with a suitable h-s plot
5. Mention any 4 advantages of steam turbines over steam engines
6. Gist on the role of governors in steam turbines
7. Give an example for topping CHP cycle and bottoming CHP cycle
8. Brief the working principle of heat pipe
9. Differentiate 1 ton and 1 tonne of refrigeration
10. Present any 2 demerits of air refrigeration system

Part – B (5 x 16 = 80 marks)

11. Consider a coal-fired steam power plant that produces 300 MW of electric power. The power plant operates on a simple ideal Rankine cycle with turbine inlet conditions of 50 bar and 450°C and a condenser pressure of 0.25 bar. The coal used has a heating value of 29,300 kJ/kg. Assuming that 75 percent of this energy is transferred to the steam in the boiler and that the electric generator has an efficiency of 96 percent, determine:
    (i) the overall plant efficiency
    (ii) the required rate of coal supply

12. a) Prove that the discharge through the nozzle will be maximum when its critical pressure ratio is :

$$\left(\frac{n}{n+1}\right)^{\frac{n}{n-1}}$$

(OR)

(OR)

b) Steam enters a nozzle at 400°C and 8 bar with a velocity of 10 m/s and leaves at 300°C and 2 bar while losing heat at a rate of 25 kW. For an inlet area of 800 cm^2, determine the velocity and the volume flow rate of the steam at the nozzle exit.

13. a) (i) Compare : Impulse and Impulse–Reaction turbine.

(ii) Derive the expression for maximum blade efficiency of a single stage impulse turbine.

(OR)

b) In a reaction turbine, the fixed and moving blades are of same shape but reversed in direction. The angles of the receiving tips are 35° and of the discharging tips 20°. Find the power developed per pair of blades for a steam consumption of 2.5 kg/s, when the blade speed is 50 m/s. If the heat drop per pair is 10.04 kJ/kg, find the efficiency of the pair.

14. a) With suitable T-S plots, compare the working, merits and demerits of the following cogeneration system variants:
back pressure cogeneration system and extraction cum condensing cogeneration system

(OR)

b) In a cogeneration plant, the power load is 5.6 MW and the heating load is 1.163 MW. Steam is generated at 40 bar and 500°C and is expanded isentropically through a turbine to a condenser at 0.06 bar. The heating load is supplied by extracting steam from the turbine at 2 bar, which is condensed in the process heater to saturated liquid at 2 bar and then pumped back to boiler. Compute, by neglecting pump work, the following

(i) The steam generation capacity of the boiler in t/h

(ii) The heat input to the boiler in kW

(iii) The fuel burning rate of the boiler in t/h if a coal of calorific value 25 MJ/kg is burned and the boiler efficiency is 88%

(iv) The rate of flow of cooling water in the condenser if the temperature rise of water is 6°C.

15. a) With relevant T-S and P-H sketches, explain the influence of following parameters on COP of a VCRS

(i) Condenser temperature (ii) Evaporation temperature

(iii) Super-heating of refrigerant (iv) Sub-cooling of refrigerant

(OR)

(OR)

b) An auditorium of 100 seating capacity is conditioned for the given specifications.

Outdoor conditions	-	35°C and 65% R.H.
Required air inlet conditions	-	25°C and 60% R.H.
The quantity of air supplied	-	0.5 m^3/min/person.

The required condition is achieved first by cooling and dehumidifying and then by heating. Determine

(a) The capacity of cooling coil in tons of Refrigeration,

(b) Capacity of heating coil in kW

(c) By-pass factor of the heating coil if the surface temperature of the coil is 22°C.