

End Semester Examinations - 2015-16 Even Semester - May 2016

14ME2015 Thermal Engineering I

Set B

Time : 3 hrs
Total Marks: 100

1. The following observations were made on a boiler plant during one hour test: Steam pressure = 20 bar ; steam temperature = 260 °C ; Steam generated = 37,500 kg; Temperature of water entering the economizer = 15 °C ; Temperature of water leaving the economizer = 90 °C ; Fuel used = 4400 kg ; Energy consumption of fuel = 30,000 kJ/kg. Calculate (a) the equivalent evaporation per kg of fuel (b) the thermal efficiency of the plant and (c) the percentage heat energy of the fuel energy utilized by the economizer.

OR

2. a) The following observations were made in a boiler trail: Coal used 250kg of calorific value 29800 kJ/kg, water evaporated 2000kg, steam pressure 11.5 bar, dryness fraction of steam 0.95 and feed water temperature 34 °C. Calculate equivalent evaporation ' from and at 100 °C' per kg of coal and the efficiency of the boiler. (14M).
- b) What are the differentiating features between a fire tube and water tube boiler? (6M)

3. Derive an expression for the exit velocity of steam and discharge of steam through the nozzle.

OR

4. A convergent divergent nozzle is required to discharge 2 kg of steam per second. The nozzle is supplied with steam at 7 bar and 180°C and discharge takes place against a back pressure of 1 bar. The expansion upto throat is isentropic and the frictional resistance between the throat and exit is equivalent to 63kJ/kg of steam. Taking approach velocity of 75 m/s and throat pressure of 4 bar, estimate: 1) Suitable areas for the throat and exit. 2) overall efficiency of the nozzle based on enthalpy drop between the actual inlet pressure and temperature and the exit pressure.
5. In an impulse turbine (with a single row wheel) the mean diameter of the blades is 1.05m 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 relative velocity at the 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 diagram for the blades and derive 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.

OR

6. Describe in detail various compoundings of steam turbine?
7. A single stage single acting air compressor delivers 0.6 kg of air per minute at 6 bar. The temperature and pressure at the end of suction stroke are 30°C and 1 bar. The bore and stroke of the compressor are 100 mm and 150 mm respectively. The clearance is 3% of the swept volume. Assuming the index of compression and expansion to be 1.3 Find: i) Volumetric efficiency of the compressor ii) Power required if the mechanical efficiency is 85% and iii) Speed of the compressor (r.p.m)

OR

8. a) What is multistage compression? State its advantages? (5M)
- b) Derive the expression for work done by a single stage air compressor without clearance volume (15M)
9. a) Describe briefly about Vapour absorption refrigeration system? (10M)
- b) A vapour compression refrigeration system works between the pressure limits of 60 bar and 25 bar. The working fluid is just dry at the end of compression and there is no under cooling of the liquid before the expansion valve. Determine: 1. C.O.P of the cycle. 2) Capacity of the refrigerator if the fluid flow is at the rate of 5 kg/min.

Pressure, bar	Saturation temperature, K	Enthalpy, kJ/kg		Entropy, kJ/kg K	
		liquid	vapour	liquid	vapour

60	295	61.9	208.1	0.197	0.703
25	261	-18.4	234.5	-0.075	0.896

Wishing you All the Best
