PMM/KS/15/7081/7133

Faculty of Engineering & Technology

Sixth Semester B.E. (Mechanical Engg.)/P.E. (C.B.S.)

Examination

ENERGY CONVERSION—I

Time : Three Hours] [Maximum Marks : 80

1. (a) Explain the construction and working of a velox boiler with the help of a neat sketch. 6

(b) Discuss in brief with their function :

(i) Fusible plug

(ii) Air preheater

(iii) Feed check valve

(iv) Economiser. 8

OR

2. (a) Explain with the neat sketch a steam boiler for locomotive, clearly explaining the draught system used. 8

(b) Define a steam generating unit. What are the advantages of high pressure boilers ? 6

3. (a) Explain the function of boiler draught. What are the various types of draught used in boiler ? 3

(b) In a certain boiler installation, a chimney of 42.5 m height produces a natural draught equivalent to 33.25 m column of hot gases. The mass flow rate of gases per kg of coal is 20 kg. If the temperature of boiler house is 33°C.

Calculate :

(i) Temperature of furnace gases leaving the chimney.

(ii) Extra heat being carried away by the gases by artificial draught. The gas can be reduced as low as 120°C. The unit is inforced due to condensation of gases below this temperature. The mean specific heat of flue gases = 1.005 kJ/kg K.

(iii) Calculate efficiency of chimney.

(iv) The percentage of heat of fuel being spent extra on the production of chimney draught.

(v) Temperature of chimney gases and the corresponding draught for the condition of Maximum discharge through the chimney. Take calorific value of fuel 31350 kJ/kg. 10

OR

4. (a) A boiler generates 5000 kg/hr of steam at 18 bar. The steam temperature being 325°C. The feed water temperature is 49.4°C. The efficiency of boiler is 80% when using oil of calorific value 44500 kJ/kg. The steam generated is supplied to a turbine developing 500 KW and exhausting at 1.8 bar. The dryness fraction of exhaust steam

being 0.98. Calculate the oil burned per hour and turbine efficiency. Also find the energy available in the exhaust steam above 49.4°C. 8

(b) Derive an expression for draught produced in terms of height of chimney, ambient and flue gas temperatures. 5

5. Write short notes on (any **THREE**) :—

(i) Ash handling system

(ii) Coal handling system

(iii) Bubbling fluidized bed boilers

(iv) Circulating fluidized bed boilers. 13

OR

6. (a) Explain the working principle of cogeneration system. And write its application. 7

(b) What do you mean by topping and bottoming cycle ? Explain. 6

7. (a) Explain the supersaturated flow through nozzle. 4

(b) Steam at a pressure of 15 bar and a dryness fraction of 0.97 is discharged through a convergent divergent nozzle to a back pressure of 0.2 bar. The steam consumption is 9 kg/kW-hr. If the power developed is 220 KW. Determine :

(i) Throat pressure

(ii) Number of nozzles required, if each nozzle has throat of rectangular cross-section of 4 mm × 8 mm.

(iii) The cross-sectional area of the exit rectangle if 12% of the overall isentropic enthalpy drop reheats steam by friction in divergent portion. 10

OR

8. (a) Why the compounding of steam turbine is necessary ? Explain velocity compounding. 4

(b) Steam at a pressure of 20 bar, 250°C expands in a convergent divergent nozzle upto the exit pressure of 2 bar. Assuming a nozzle coefficient of 0.94 for supersaturated flow up to the throat and nozzle efficiency as 90%.

Find :

(i) Velocity at throat

(ii) Mass flow rate, if the throat diameter is 1 cm.

(iii) Velocity and diameter of the nozzle at the exit. 10

9. (a) Explain various losses in steam turbine. 4

(b) Steam is supplied to a turbine at 30 bar 350°C. The turbine exhaust pressure is 0.08 bar. The main condensate is heated regeneratively in two stages by steam bled from the turbine at 5 bar and 1 bar respectively. Calculate mass of steam bled off at each pressure per kg of steam entering the turbine and theoretical thermal efficiency of the cycle. 9

OR

10. (a) In a reaction turbine the blade tips are inclined at 35° and 20° in the direction of motion. The guide blades are of the same shape as the moving blades, but reversed in direction. At a certain place in the turbine, the drum diameter is 1 meter and the blades are 10 cm high. At this place steam has a pressure of 1.75 bar and dryness 0.935. If speed of the turbine is 250 rpm and the steam passes through the blades without shock find the mass of steam flow and power developed in the ring of moving blades. 9

(b) Show that for an impulse turbine maximum efficiency is given by $(1+KC)\frac{\cos^2\alpha}{2}$, where K is coefficient of velocity and C is constant. 4

11. (a) Give the need and importance of condenser in steam power plant. 3

(b) The steam turbine discharges 5000 kg of steam per hour at 40°C and 0.85 dry. The air leakage into the condenser operating in conjunction with a steam turbine is estimated as 15 kg/hr. The temperature at the suction air pump is 32°C and temperature of condensate is 35°C.

Determine :

(i) The vacuum gauge reading

(ii) Capacity of air pump

(iii) Loss of condensate in kg/hr

(iv) The quantity of working water if rise in temperature of cooling water is limited to 10°C. 10

OR

12. (a) Write a note making a comparative study of a dry cooling tower and net cooling tower, giving sketches where necessary. 5

(b) The following observations were taken during test on condenser :

(I) Barometric reading = 760 mm of Hg

(II) Condenser vacuum = 705 mm of Hg

(III) Mean temperature of condensate = 35°C

(IV) Condensate collected = 2000 kg/hr

(V) Quantity of cooling water circulated = 60000 kg/hr

(VI) Rise in temperature of cooling water = 16°C

(VII) Hot well temperature = 28°C

Determine :

(i) Vacuum efficiency

(ii) Condenser efficiency

(iii) Quality of steam entering the condenser.

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