B.E. Sixth Semester (Mechanical Engineering / Power Engineering) (C.B.S.)

Energy Conversion - I

P. Pages : 3 **KNT/KW/16/7395/7421**

Time : Three Hours * 0 1 2 4 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.
12. Use of steam, tables, Mollier chart is permitted.

1. a) Differentiate between fire tube boiler and water tube boiler. **6**

b) Explain the construction and working of lamont boiler. **7**

OR

2. a) Enlist the various boiler mountings and accessories. Explain with neat sketch water level indicator. **6**

b) Clarify steam boilers and state the unique features of high pressure boilers. **7**

3. a) Define draught and its types. **6**

b) Find the draught produced in mm of water by a chimney 40 m high and discharging 20 kg of flue gases per kg of fuel burned in the combustion chamber. The temperature of the flue gases and ambient air are 270º C and 23º C respectively. Assuming the diameter of the chimney as 1.5 m and 30% of the theoretical draught is lost in friction. find the mass of the flue gases passing through the chimney per minute. **7**

OR

4. a) Define equivalent evaporation and boiler efficiency. **4**

b) The following readings are taken during the test on a boiler for one hour. **9**
Steam generated : 5400 kg
Coal burnt : 700 kg
C.V. of coal : 31500 kJ/kg
Dryness fraction of steam entering the super heater = 0.92
Rated pressure of the boiler = 11.5 bar Temperature of steam leaving the superheater =250º C, Temperature of hot well = 45º C, Determine (a) Equivalent evaporation per kg of fuel without and with superheater (b) thermal efficiency of the boiler without and with superheater (c) Amount of heat supplied by the superheater per hour.

5. a) Explain with neat sketches various regimes of fluidization in a fluidized bed boiler. **7**

b) Write short note on (a) coal- handling (b) Ash handling. **7**

OR

6. a) Explain working principle and applications of cogeneration systems. **7**

b) Explain with neat sketches, Topping cycle and bottoming cycle used in cogeneration systems. **7**

7. a) Dry saturated steam at a pressure of 11 bar enters a convergent divergent nozzle and leaves at a pressure of 2 bar. If the flow is adiabatic and frictionless, determine. **6**

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.

b) Steam at a pressure of 15 bar and dryness fraction 0.97 is discharged through a convergent divergent nozzle to a back pressure of 0-2 bar. The mars flow rate is 9 kg/ kwh. If the power developed is 220 kw, determine. **7**

i) Throat pressure.
ii) Number of nozzles required if each nozzle has a throat of rectangular cross-section of 4 mm x 8 mm.
iii) If 12% of the overall isentropic enthalpy drop reheats by friction the steam in divergent portion find the cross section of exit rectangle.

OR

8. a) In an installation 5.2 kg/s of steam at 30 bar and 350º C is supplied to group of six nozzles in a wheel diameter maintained at 4 bar. Determine. **9**

i) The dimensions of nozzles of rectangular cross sectional area with aspect ratio 3:1 The expansion may be considered metastable and friction is neglected.
ii) Degree of under cooling and supersaturation.
iii) Loss in available heat drop due to irreversibility
iv) Increase in entropy.

b) Write short note on compounding of steam turbines. **4**

9. The following data refers to a compound impulse turbine having two rows of moving blades and one row of fixed blade in between them velocity of steam leaving the **13**
Nozzle = 600 m/s.
Nozzle angle = 20º,
Blade speed = 125 m/s.
First moving blade outlet angle = 20º
First fixed blade outlet angle = 25º
Second moving blade outlet angle = 30º.
Friction loss in each stage = 10% of relative velocity. Find
a) Diagram efficiency.
b) Power developed if the steam flow rate is 300 kg/s

OR

10. a) In a reaction turbine, the blade tips are inclined at 35 º and 20º 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 m and blades are 10 cm high At this place, the steam has a pressure of 1.75 bar and 0.935 dry If the speed of the turbine is 2500 r.p.m and the steam passes through the blades without shock, find the mass of steam flow and power developed in the ring of the moving blades. **8**

b) Define the term 'degree of reaction' as applied to a steam turbine. show that for parson's reaction turbine the degree of reaction is 50%. **5**

11. a) In a surface condenser a section of the tubes near to the air pump suction is screened off so that the air is cooled to a temperature below that of the condensate, separate extraction pumps being provided to deal with air and condensate respectively. 5448 kg of steam are condensed per hour and the air leakage is 4.54 kg/h. The temperature of exhaust steam is 21.1º C. Assuming a constant vacuum throught the condenser, find: **9**

i) The mass of steam condensed per hour in the air cooler.
ii) The volume of air in m^3/h to be dealt with by the air pump.

b) State the sources of air in condenser and explain the construction and working of a surface condenser. **5**

OR

12 a) During a trial on a steam condenser, the following observations were recorded. **9**
Condenser vacuum = 680 mm of Hg
Barometer reading = 764 mm of Hg
Mean condensate temperature = 36.2º C
Hot well temperature = 30º C
Condensate formed per hour = 1780 kg
Cooling water inlet temperature = 20º C
Cooling water outlet temperature = 32º C
Quantity of cooling water = 1250 kg/min
Determine:

i) Condenser vacuum corrected to standard barometer.
ii) Vacuum efficiency.
iii) Under cooling of condensate.
iv) Condenser efficiency.

b) Write short note. **5**

i) Evaporative condenser.
ii) Natural draught cooling tower.

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