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

Energy conversion - I

P. Pages : 3 **NIR/KW/18/3479/3505**

Time : Three Hours * 1 2 9 2 * 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 table and Mollier diagram are permitted.

1. a) State the features of high pressure boiler. Explain the construction and working of Benson boiler with neat sketch. **7**

b) Classify fuel used for steam generators and state the necessity of water treatment in a steam generating unit. **6**

OR

2. a) What is mounting and accessories of a boiler plant? Enlist them. State the function of fusible plug. **7**

b) Define "a steam generation unit". Explain construction and working of Babcock and Wilcox boiler with neat sketch. **6**

3. a) Define boiler draught and show that condition for maximum discharge through chimney is given by: **7**

$$\frac{T_g}{T_a} = 2\left[\frac{m_a + 1}{m_a}\right]$$

b) Calculate the height of chimney and mass of gas flowing through it when draught produced is 19 mm of water. Temperature of gas is 290ºC and air temperature is 20ºC. The flue gas produced 23 kg/kg of fuel burnt. The diameter of chimney is 1.8 meters. Neglect the losses. **6**

OR

4. a) The following observation were made on boiler plant during 1 hour test: **7**

Steam pressure - 20 bar
Steam temperature - 260ºC
Steam generated - 37,500 kg
Fuel used - 4,400 kg
Calorific value of coal - 30, 000 kJ/kg
Temperature of water entering economizer = 15ºC
Temperature of water leaving economizer = 90ºC
specific heat of steam = 2.1 kJ/kg K
Calculate:

1) Equivalent Evaporation
2) Efficiency of Boiler including Economizer.
3) Percentage of fuel energy utilized by economizer.

b) Defined Evaporation capacity, Equivalent Evaporation and Boiler efficiency. **6**

5. Write short notes on **any three.** **14**

1) Bubbling fluidized bed boiler.
2) Circulating fluidized bed boiler.
3) Coal Handling System.
4) Ash Handling System.

OR

6. a) Explain Topping cycle and Bottoming cycle with neat sketch. **7**

b) Explain cogeneration principle with its type. **7**

7. A steam at a pressure of 14 bar and 275ºC is to be expanded to a back pressure of 1 bar through convergent divergent nozzle. Determine the throat and exit diameter if the steam flow rate is 500kg/hr. Take frictional loss is 12% in the divergent part only. What is the condition of steam at throat and exit of nozzle? **13**

OR

8. a) Explain with the help of neat sketch. Working of single stage impulse turbine. Sketch pressure velocity variation along the axis of the turbine. **5**

b) What is governing of steam turbine? What are its types? Explain any one of them. **5**

c) Explain the various losses in steam turbine. **3**

9. a) Define the term "Degree of Reaction" as applied to reaction turbine. Show that for a Parson's reaction turbine, the degree of reaction is 50%. **6**

b) In thermal power plant steam is supplied at a pressure of 30 bar and temperature 300ºC to turbine and expanded to 5 bar. The steam is then reheated to 300ºC at constant pressure and then expanded to low pressure turbine to 0.5 bar. Find the efficiency of cycle with and without reheating. **7**

OR

10. a) In a De laval impulse turbine steam issues from nozzle with velocity of 1200 m/s. The Nozzle angle is 20º. The mean blade velocity is 400 m/s. Inlet and outlet angles of blades are equal. The mass of steam flowing through the turbine per hour is 1000 kg. **6**
Calculate:
1) Blade angle
2) Tangential force on blade
3) Relative velocity of steam entering the blade.
4) Power developed.
5) Blade efficiency
Take blade velocity coefficient = 0.8

b) In a 3 stage steam turbine steam enters at 35 bar and 400ºC and exhausts at 0.05 bar, 0.9 dry. If the work developed per stage is equal, determine: **7**
i) Condition of steam at entry to each stage
ii) The stage efficiencies
iii) Re heat factor.

11. a) A surface condenser is designed to handle 10,000 kg of steam per hour. The steam enters at 0.08 bar and 0.9 dryness and the condensate Leaves at the corresponding saturation temperature. The pressure is constant throughout the condenser. Estimate the cooling water flow rate per hour, if cooling water temperature rise is limited to 10ºC. Take C_P of water 4.184 kJ/kg K. **7**

b) Explain Evaporative condenser. **4**

c) Explain the Dalton's Law of partial pressure. **3**

OR

12. a) The following observations were recorded during a test on steam condenser: **10**

Barometer reading	=	765 mm of Hg
Condenser Vacuum	=	710 mm of Hg
Mean condenser temperature	=	35ºC
Condensate temperature	=	28ºC
Condensate collected per hour	=	2 tonnes
Quantity of cooling water per hour	=	60 tonnes
Inlet temperature of cooling water	=	10ºC
Outlet temperature of cooling water	=	25ºC

Find:

i) Vacuum corrected to standard barometer reading.
ii) Vacuum efficiency of condenser.
iii) Under cooling of condensate
iv) Condenser efficiency.
v) Quantity of steam entering the condenser.

b) Write short notes on cooling Towers. **4**

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