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

Energy Conversion - I

P. Pages : 3 **NKT/KS/17/7395/7421**

Time : Three Hours * 0 5 6 0 * 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. Diagrams and chemical equations should be given whenever necessary.
11. Illustrate your answers whenever necessary with the help of neat sketches.
12. Use of non programmable calculator is permitted.
13. Steam tables mollier chart is permitted.

1. a) Draw the layout of thermal power plant. Explain function of important component. **6**

b) What are the characteristics of a good boiler? Explain the construction and working of Benson boiler. **7**

OR

2. a) What are the factors affecting the selection of a boiler. Also differentiate between a water tube boiler and a fix tube boiler. **7**

b) Discuss in brief with their function. **6**

i) Fusible plug.

ii) Blow off cock.

iii) Feed check valve.

3. a) Derive an expression for maximum discharge through a chimney. **6**

b) A 40-m high chimney is discharging flue gases at 350°C, when the ambient temperature is 30°C. The quantity of air supplied is 18 kg per kg of fuel burnt. Determine **8**
i) draught produced in mm of water.
ii) Equivalent draught in meters of hot-gas column.
iii) Efficiency of the chimney if maximum temperature of artificial draught is 150°C, the mean specific heat of flue gases is 1-005 KJ/kg k
iv) The temperature of chimney gases for maximum discharge in a given time and what would be the corresponding draught in mm of water produced.

OR

4. a) State the advantage of artificial draught over natural draught. **3**

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b) The following data were recoded during a boiler trial : **11**

Boiler room temperature	=	25°C
Temperature of feed water	=	55°C
Mass of steam	=	14000 kg/hr
Steam pressure	=	128 N/cm^2
Steam temperature	=	250°C
Coal consumption	=	1600 kg/hr
CV of coal	=	35000 KJ/kg

Analysis of flue gas by volume
CO_2 = 9.4%, O_2 = 1.1%, N_2 = 79.5%
percentage composition of coal by mass
C = 85.2%, H_2 = 4.8% Ash = 10%
Moisture = 1.8%
Temperature of flue gases leaving the boiler = 310°C
Partial pressure of Steam = 0.08 bar
Specific heat of air & dry flue gases = 1.02 kJ/kg k
Draw the heat balance sheet on percentage basis.

5. a) Explain the principle of operation of FBC boiler. Enumerate the advantage of FBC boiler. **6**

b) Explain how cogeneration is advantages over conventional power plant? What is meant by combined cycle cogeneration. **7**

OR

6. Write a short notes **any three.** **13**

a) Coal handling system

b) Ash handling system.

c) Bottoming cycle.

d) Bubbling bed fluidised boiler.

7. a) Derive an expression for critical pressure ratio through an isentropic nozzle. **5**

b) A steam turbine develops 190 kw with a consumption of 18 kg/kwh. The pressure and temperature of steam entering the nozzle are 11.8 bar and 220°C respectively. The steam leaves the nozzles at 1.18 bar. The diameter of nozzle at the throat is 8 mm. find the number of nozzles. **8**
If 8% enthalpy drop is lost due to friction in diverging part of the nozzle, determine the diameter at the exit of the nozzle and exit velocity of leaving steam.

OR

8. a) Describe the various method of compounding in an impulse turbine with help of neat sketches. **6**

b) Write a brief note **any two.** **7**

i) Nozzle control governing.
ii) Different between impulse and reaction turbine.
iii) Velocity diagram of impulse turbine.

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9. a) A single stage impulse turbine is supplied with steam at 4 bar and 160°C and it is exhausted at a condenser pressure of 0.15 bar at the rate of 60 kg/min. The steam expands in a nozzle with an efficiency of 90%. The blade speed is 250 m/s and the nozzles are inclined at 20° to the plane of the wheel. The blade angle at the exit of the moving blade is 30°. Neglecting friction losses in the moving blade, determine. **7**

i) Steam jet velocity.
ii) Power developed.
iii) Blade efficiency and
iv) Stage efficiency.

b) Derive an expression for optimum stage efficiency of a reaction turbine. **6**

OR

10. a) Explain the various efficiencies involved in the steam turbine. **2**

b) The following particulars relate to a two -row velocity compounded impulse wheel. Steam velocity at nozzle outlet = 650 m/s **11**
Mean blade velocity = 125 m/s
The nozzle outlet angle = 16°
Outlet angle of first row of moving blades = 18°
Outlet angle of fixed guide blades = 22°
Outlet angle of second moving blades = 36°
Steam flow rate = 2.5 kg/s
The ratio of relative velocity at the outlet to that at the inlet is 0.84 for all blades determine.

i) Axial thrust on blades.
ii) The power developed and
iii) The efficiency of the wheel.

11. a) Why does an ejector type jet condenser not require a water extraction pump? Explain. **5**

b) During a trial on a condenser, the following reading were recorded: **9**
Barometric reading = 766 mm of Hg
Actual vacuum recorded by gauge=716 mm of Hg
Temperature of exhaust steam = 35°C
Temperature of hot well = 29°C
Inlet temperature of cooling water = 15°C
Outlet temperature of cooling water = 24°C
Calculate

i) Corrected vacuum to standard barometric reading of 760 mm of mercury.
ii) Vacuum efficiency
iii) Under cooling of condensate
iv) Condenser efficiency

12. a) Explain the working of a natural draft cross flow cooling tower with a diagram. **5**

b) 3000 kg of net steam with a dryness fraction of 0.95 is condensed per hours in a barometric condenser. The minimum height of the tail race above the hot well is 8.5m. The barometric pressure is 760 mm of Hg. The cooling water enters the condenser at 25°C and the mixture of condensate and cooling water exit temperature is 50°C. Determine **9**

i) Vacuum in the condenser in mm of Hg.
ii) Absolute pressure in the condenser in kpa.
iii) Mass of cooling water required without under cooling.

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