

Total No. of printed pages = 5

ME 131603

Roll No. of candidate

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2016

**B. Tech 6th Semester End-Term Examination**

**POWER PLANT ENGINEERING**

Full Marks-100 Pass Marks-35 Time-Three hours

The figures in the margin indicate full marks  
for the questions.

Answer any *five* questions.

1. (a) What are the advantages of reheating the steam in high pressure steam plants ? What are the different methods used for reheating? Draw a schematic diagram of a simple reheat cycle. 2+3+5=10
  
- (b) In a regenerative cycle, the steam pressure at turbine inlet is 30 bar and exhaust is at 0.04 bar. The steam is initially saturated. Enough steam is bled off at the optimum pressure to heat the feed water. Determine the cycle efficiency. Neglect pump work. 10

[Turn over

2. (a) What are the sources of heat loss in boiler plant ?
- (b) The following data were taken during boiler test for 1 hr. Steam generated = 5000 kg, coal burnt = 700 kg, quality of steam = 0.92, boiler pressure = 1.2 MPa, feed water temperature = 45°C. Find equivalent evaporation.
- (c) A 30m high chimney discharges flue gases at 357°C, when outside temperature is 27°C. If a natural draught equivalent to 17.44 mm of water column is produced and the boiler uses 1360 kg of coal per hour, calculate
- air supplied per kg of coal burnt
  - draught in terms of column of hot gases
  - flow rate of hot gas through the chimney
  - diameter of chimney base if velocity of gas is given by  $H_1 = K C^2/2$ , where  $K = 1.627$ ,  $C$  is velocity,  $H_1 =$  draught in terms of column of hot gases.
3. (a) Define ultimate analysis and proximate analysis. Explain how sampling of coal is done in a boiler trial.

- (b) Draw the schematic diagram of a Benson boiler and discuss its merits and demerits. 5+5=10
- (c) What is the purpose of air pre-heater ? What are the functions of superheater ? Why economiser is essentially used irrespective of fuel used in boiler ? 3+4+3=10
- (d) Draw a neat line diagram of in-plant coal handling and indicate the names of equipments used at different stages. 5
- (e) What are the different ash handling systems ? 5
- (a) Define terms—critical pressure ratio, choked flow, critical discharge. 2+2+2=6
- (b) Steam is expanded in a set of nozzles from 10 bar, 300°C to 2 bar. Are the nozzles convergent or divergent ? Neglecting the initial velocity, find the minimum area of the nozzles to flow 1 kg/sec of steam. Assume isentropic expansion. 5
- (c) Why are steam turbines compounded ? What are the different methods of compounding ? 4+5=9

6. (a) In an impulse turbine (with single row wheel) the mean diameter of the blades is 1.05m and speed is 3000 rpm and nozzle angle is  $18^\circ$ . The ratio of blade speed to steam speed is 0.42 and the ratio of the relative velocity at outlet from the blade to that at inlet is 0.84. The outlet angle of the blade is to be made  $3^\circ$  less than the inlet angle. The steam flow is 10 kg/sec. Draw the velocity diagram and calculate —

(i) the tangential thrust on blades,

(ii) axial thrust on blades,

(iii) power developed,

(iv) blade efficiency.  $3+3+2+2=10$

(b) What are various losses taking place in steam turbine? Differentiate between throttle governing and nozzle governing.  $5+5=10$

7. (a) What are the principles of Fluidised Bed Combustion (FBC) system? What are the types of fluidised bed combustion systems? What are its advantages?  $3+5+2=10$

(b) What different load curves are considered in designing a power plant? What is the effect of its nature on the working of power plant?  $5+5=10$

Write short notes on any four of the following :

$4 \times 5 = 20$

(a) Binary vapour cycle

(b) Boiler efficiency

(c) Super critical boiler

(d) Parson's turbine

(e) Condenser

(f) Nuclear power plants

(g) Degree of reaction.