

BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR, HOW-3
B.E. (ME) Part-IV 8th Semester Examinations, 2013

Power Plant Engineering (ME-802)

Branch: Mech. Engg.

Paper Code: ME-802

Time: 3 hrs.

Full Marks: 70

Attempt THREE questions from each half. All questions carry equal marks. Use of property tables and charts allowed.

FIRST HALF

1. (a) Mention the sources of heat loss in a conventional coal-fired steam power plant and give the expressions of gross and net heat rates of a plant.

(b) A coal-fired steam power plant has a turbine generator rated at 1000 MW gross. The plant requires 9% of its power output for its own internal operations. Daily coal consumption is 9800 tonnes and the coal CV is 26 MJ/kg. The steam generator efficiency is 86%. Calculate the net plant heat rate and net cycle heat rate and the overall efficiency.
2. (a) Describe, with neat sketches, the different methods of liquid-vapor separation employed in boiler drums.

(b) What are the drawbacks of single-element drum level control? Explain, how they are overcome by resorting to three-element control. Draw the control schematic diagram.
3. (a) State the working principles of Recuperative type and Regenerative type air pre-heaters.

(b) For a tubular air preheater, following data apply:
Flue gas inlet and exit temperatures: 450° C and 160° C, Gas flow rate: 1250 kg/s
Air temperature at AH inlet: 35° C, Air flow rate: 1167 kg/s
Overall heat transfer coefficient: 0.03 kW/m²-K Tube ID/OD: 60/65 mm
If there are 69,650 tubes in all, calculate the air exit temperature and estimate the length of each tube in the air heater. Assume C_p for gas and air to be 1.1kJ/kg-K and 1.005kJ/kg-K respectively.
4. (a) Define 'Approach', 'Range' and 'Cooling efficiency' for a wet cooling tower. With a representative diagram, explain the temperature profiles for the cooling water and the air in a counter-flow induced draft wet cooling tower.

(b) What is a Deaerator and where is it usually located in a steam power plant? Briefly explain how deaerator level is controlled in tandem with the hot well level, by using a surge tank in the feed circuit.
5. Write short notes on any two:
 - (a) Pneumatic ash handling system
 - (b) Cross-limited combustion control
 - (c) Integrated Gasification Combined Cycle
 - (d) Car emission from coal-fired units

"2nd half"

- 6 a) What is a dam? Describe with a neat sketch the use of solid gravity dams used in hydel plants.
- b) It is proposed to utilize the energy of the monsoon stream by constructing a dam across it. The stream discharge during the monsoon season of four months is $20\text{m}^3/\text{s}$ and for the remaining year, it should be taken as $2.5\text{m}^3/\text{s}$. Determine the following:
- The minimum capacity of the reservoir required on the upstream side of the dam.
 - If the head loss in the pipe is 3% of the actual head and overall efficiency of generation is 90%, find the output of the generating station. Take the mean level of water in the reservoir above the tail race level to be 80 m. Take monsoon period from 1st June to 30th September and the year of 365 days.
7. a) Describe with a neat sketch the working of a Boiling Water Reactor (BWR) with its advantages and limitations.
- b) The following data relates to a steam power station of 120 MW capacity which takes 100 MW peak demand at 80% load factor:
- Annual cost towards interest and plant depreciation: Rs 100/kW installed
- Operation costs: Rs 1200×10^3 per year
- Maintenance costs: Rs 200×10^3 per year (fixed)
- Rs 400×10^3 per year (Variable)
- Miscellaneous costs (Variable): Rs 100×10^3 per year
- Cost of coal used: Rs 32/ton
- C.V of fuel used: 26880 kJ/kg
- Overall efficiency of the plant: 20%
- Determine the following: i) Cost of coal per year ii) Overall cost of generation in Paise per kwh.
8. a) Describe with a neat sketch the general arrangement and working of a compressed air storage plant.
- b) What are the main challenges before the development of gas turbine combustion chamber? Explain with a neat sketch working of a combustion chamber with downstream injection and swirl holder for gas turbines.
9. Write short notes on following:
- a) Mini and Micro hydel plants b) Spillways and their utility c) Plant use factor d) Doherty tariff
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