B.E. (M.E) 8th Semester Final Examination 2012

Power Plant Engineering (ME-802)

i) Question 1 is compulsory *for each half* and attempt any three from *the rest of* each half.

ii) Use of steam table/ Mollier diagram/ graph paper is permitted.

iii) Assume suitable data if necessary.

Time 3 hrs   Full Marks: 70

IST HALF

1. Write true or false for the following:

   a) Pump storage plant is used as a base load plant.

   b) CANDU reactors use natural uranium as fuel.

   c) Breeder reactors use thermal neutrons.

   d) Higher plant load factor indicates better performance.

   e) High diversity factor is desirable.   [5]

2. a) Describe in brief the function of following with respect to storage type hydel power plants:
   i) Trash rack ii) Forebay iii) Spillway iv) Draft tube v) Dam

   b) The average monthly run-off data of two rivers A and B for twelve months is tabulated as given below:

Month	J	F	M	A	M	J	J	A	S	O	N	D
River A	40	30	30	20	20	160	180	180	100	80	50	50
River B	50	50	60	80	100	100	90	90	70	60	60	60

The run-off is given in millions of cu-m per month. The head available for river A is 80m and for river B is 82 m. Using the above data, find the following:

   a) Which river is more suitable for storage type hydroelectric power plant? Assume that the overall efficiency of generation is same for both the sites.

   b) If a run-off river power plant is to be established, then select the proper river for the same. The minimum quantity of water available for 85% of the total year for run-off river plant.

   c) The ratio of run-off of river A and river B as well as ratio of power if constant run off from both rivers is required for 60% of the year.

   d) At what percentage of time, the run-off rate of both sites is same?   [10]

3. a) Describe the different methods of determining the tariff for electrical energy.

   b) A factory wants 99 kW load at 30% load factor. The following two alternatives are available to the factory owner:

i) Developing a captive plant with the following data:

Capital cost   Rs 500 x 10^3

Cost of fuel   Rs 80/ton

Fuel consumption   0.3 kg/kWh generated

Cost of maintenance   0.25 p/kWh generated

Cost of lubricating oil, water   0.30 p/kWh

Wages Rs 18000/year

Interest and depreciation: 10% per year

ii) Taking from Public supply at the rate of Rs 80/kW of maximum demand per year and 3p/kWh.

Which option will be more economical to the factory owner?   [10]

4. a) Describe with a neat sketch the working of a Pressurized Water Reactor with its advantages and limitation.

b) A thermal power plant consists of two 60 MW units each running for 8000 hours and one 30 MW unit running for 2000 hours per year. The energy produced by the plant is 876 x 10^6 kWh per year. Determine the plant load factor and plant use factor. Consider that the maximum demand is equal to plant capacity.   [10]

5. 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.   [10]

6. Write short notes on the following:

a) Advantages of Boiling Water Reactor b) Plant Use Factor c) Fast Breeder reactor   [10]

Attempt the first question and any three from the rest. Use of property tables/diagrams permitted

1. Answer in a short sentence each:

   (a) What is 'net plant heat rate' for a thermal power plant?

   (b) What is the main function of a deaerator?

   (c) When is an Air Separation Unit (ASU) needed in an IGCC plant?

   (d) What is CEP and where is it located in a steam power plant?

   (e) Why spray attemperator is not employed after final stage of superheating?   [1 x 5]

2. (a) State the different methods of steam temperature control and elaborate any one of them.

   (b) State the energy balance equation for a spray attemperator. A boiler generates steam at 150 bar and at a rate of 670 t/hr. A spray attemperator is put between secondary and final stages of superheater. The inlet temperature to the final stage must be limited to 500°C. If the steam temperature at the secondary exit shoots up to 520°C, estimate the spray water requirement assuming that the spray water is supplied at 210°C.   [5 + 5]

3. (a) What is circulation ratio (CR) for a natural circulation boiler? How does it influence the density of the two-phase flow in the water walls? Define void fraction in a two-phase flow.

   (b) In a natural circulation boiler, the operating pressure is 150 bar and the furnace walls are 20 m high. The circulation ratio is 10. Estimate the top dryness fraction (TDF) and the driving pressure of natural circulation.   [6 + 4]

4. (a) What are 'swelling' and 'shrinkage' effects in a steam drum? Why does a single-element drum level control fail to address the 'swelling' and 'shrinkage' situations?

   (b) With a neat control schematic, explain the standard deaerator level control system.   [5 + 5]

5. (a) Define TTD for closed-type feed water heaters. On a temp-length (T-L) plot show the temperature profiles of the heating steam and the feed water for a 3-zone FW Heater.

(b) Define 'approach' for a wet cooling tower. At what ambient conditions, a natural draft wet cooling tower will perform well? What are the advantages of artificial draft systems for wet cooling tower?

[4 + 6]

6. Write short notes (any two)

   (a) Sliding pressure mode of turbine control

   (b) Pneumatic ash handling system

   (c) Controlling particulate emission by using ESP

[5 + 5]