FEDERAL UNIVERSITY OF TECHNOLOGY OWERRI
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY
DEPARTMENT OF ELECTRICAL/ELECTRONIC ENGINEERING
2012/2013 HARMATTAN SEMESTER EXAMINATION MARCH 2013
PSE 409: ELECTRICAL POWER PLANT TECHNOLOGY TIME ALLOWED: 3 HOURS
INSTRUCTION: Answer any five questions

Q1a. Draw a typical diagram of a steam plant. Explain the main features of the diagram.

b. The thermal station has the following data;

Maximum demand = 20, 000kW; Load factor = 40%; Boiler efficiency = 85%; Turbine efficiency = 90%; Coal consumption = 0.9kg/kWh; cost of 1 tonne of coal = N300. Determine (i) thermal efficiency and (ii) Coal bill per annum.

Q2. Draw a neat schematic diagram of a hydro-electric plant and explain the functions of various components. It has been estimated that a minimum run off of approximately 94m^3/second will be available at a hydraulic project with a head of 39m. Determine (a) firm capacity (b) yearly gross output. Assume the efficiency of the plant to be 80%.

Q3. The fuel-cost functions for three thermal plants in Naira/h are given by

$$C_1 = 350 + 7.20P_1 + 0.0040P_1^2;\ C_2 = 500 + 7.30P_2 + 0.0025P_2^2;\ C_3 = 600 + 6.74P_3 + 0.0030P_3^2:$$

where P_1, P_2 and P_3 are all in MW. Neglecting line losses and generator limits, show which generator (s) is/are best suitable for supplying real power of 450MW.

Q4 a). What is a spinning reserve? Explain with a reason which of the power plants is/are suitable for spinning reserve.

b) What are the factors to be considered before building a gas turbine?

c) Using a suitable diagram, explain how electricity is generated in a gas turbine plant. Can gas turbine plant be used as Co-generation?

Q5(a) The world is developing towards achieving a ratio of energy demand coming to equilibrium. Discuss four major ways Nigeria can meet up with this challenge as a fast growing economy.

(b) Elaborate on three fundamental ways the energy of the sun can be harnessed abundantly. Hence what are the roles of an inverter system in a solar generating plant?

(c) How does the lunar system relate to Tidal energy in terms of natural phenomenon?

Q6(a) With the aid of a well labelled diagram discuss the operation of thermoelectric power generator.

(b) Distinguish between thermionic converter and thermoelectric power generator mode of operation.

(c) Use the basic fuel cell diagram to explain the functionality of a fuel cell plant. Hence enumerate the various advantages of fuel cell over the conventional power plants.

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2009/2010 HARMATTAN SEMESTER EXAMINATION

PSE 409:ELECTRICAL POWER PLANT ENGINEERING. **TIME ALLOWED: 3HOURS**

INSTRUCTIONS: ATTEMPT FIVE QUESTIONS ONLY.

Question 1

Explain in details the main factors governing the sitting of major hydropower stations in Nigeria.

Calculate the average power in KW that can be generated in a hydro-electric project from the following data:

Catchment area = 5×10^9 m^2

Mean head, H = 30m

Annual rainfall, F = 1.25m

Yield factor, K=80%

Overall efficiency, $\eta_{overall}$=70%

If the load factor is 40%, what is the rating of generators installed?

Question 2

Discuss the main reasons for the low efficiency of steam generating power plant in Nigeria.

The relation between water evaporated (WKg), coal consumption (CKg) and KWh generated per 8-hour shift for a steam generating station is as follows:

W = 13500 + 7.5KWh ..... (I)

C = 5000 + 2.9KWh ..... (II)

(i) To what limiting value does the water evaporating per kg of coal consumed approach as the station output increases?

(ii) How much coal per hour would be required to keep the station running on no load?

Question 3

Briefly discuss on the main components of a diesel power station with a schematic diagram.

Question 4

Sketch an atomic reactor used to generate electrical energy and explain the functions of each of the components.

Enumerate on the various factors hindering the development of nuclear power plants in Nigeria.

What is the power output of a $_{92}U^{235}$ reactor if it takes 30 days to use up 2Kg of fuel given that energy released per fission is 200MeV and Avogadro's number = 6.023×10^{26} per kilo mole?

Question 5

(i) What is Solar energy? Write in brief, Electrical Generation from Solar energy.

(ii)What are the salient features of solar energy power plants?

(iii) With the aid of a diagram, explain the working principle of a thermionic converter.

Question 6

Nigeria is blessed with abundant water and gas resources which she is using to harness her energy resources but the growing energy demand has over grown the existing or conventional source of these energy resources. Hence discuss with good diagrams, four alternative energy generations and its technology apart from solar energy generation and thermionic converter.