

FEDERAL UNIVERSITY OF TECHNOLOGY OWERRI  
SCHOOL OF ELECTRICAL SYSTEMS ENGINEERING AND TECHNOLOGY  
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

2019/2020 HARMATTAN SEMESTER EXAMINATION  
PSE 409: ELECTRICAL POWER PLANT ENGINEERING: 3 Units

Instruction: Answer Four Questions, Two from Each Section

Time Allowed: 2.5 hours: Date: 20/2/2021

**SECTION A**

A1(a) Briefly explain five energy resources available in Nigeria, state nature of plant and city where each is deployed. (15marks)

A1(b) Briefly discuss two renewable energy resources that are practically deployable in FUTO. (10marks)

A2(a) Present one-line schematic design of EEE FUTO solar farm project. (10marks)

A2 (b) Justify the deployment of four major components in the EEE FUTO solar farm. (8marks)

A2 (c) State and explain the need for one key component that if included will improve the EEE solar farm efficiency. (7marks)

A3 (a) Using appropriate one-line diagrams, explain the three major types of power plant layouts you studied in this course. (9marks).

A3(b) Design an appropriate distribution system configuration with four Cummins generators, each rated 0.415kV, 1500A that will be used to supplying power to the new Federal University of Technology Owerri power plant with five feeder breakers rated 1200A each on a secondary of 11/0.415kV, 60Hz and 5000A bus. (10marks)

A3(c) State and briefly explain which of the plant layouts in A3(a) will you recommend to FUTO if the Management decides to have a special choice of running its generators during peak energy consumption times with higher cost and run of utility supply during off-peak times with less energy cost? (6marks)

**SECTION B**

B1 (a(i)) Sketch a typical layout of a steam power plant. (5marks)

B1 (a(ii)) Explain in details the operation of the station. (5marks)

B1 (b) A steam power plant spends  $\text{N}30 \times 10^5$  per annum for coal used in the station. The coal has a calorific value of 5000kcal/kg, and costs N300 per ton. If the station has thermal efficiency of 33% and electrical efficiency of 90%, find the average load on the station. (15marks)

B2(a) Using block diagram representation, explain fossil fueled plant energy conversion plant. (13marks)

B2(b) A steam power station has an overall efficiency of 20% and 0.6kg of coal is burnt per kwh of electric energy generated. Calculate the calorific value of the fuel. (12marks)

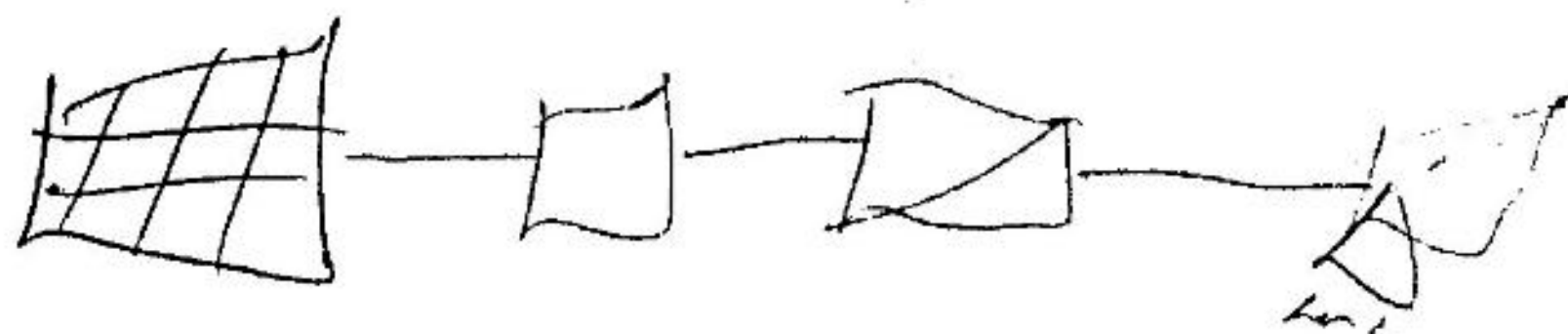
B3(a) List four technical factors that determine the siting of Hydro-electric power plants. (4marks)

B3(b) A factory is located near a water fall where usable head for power generation is 25m. The factory requires continuous of 400kW throughout the year. The river flow in a year is (a)  $10\text{m}^3/\text{sec}$  for four months (b)  $6\text{m}^3/\text{sec}$  for two months (c)  $1.5\text{m}^3/\text{sec}$  for six months.

(i) If the site is developed as a run-of-river type of plant without storage, determine the standby capacity to be provided in each case. Assume that the overall efficiency of the plant is 80% for all cases. (16marks)

(ii) If a reservoir is arranged upstream, will any standby unit be necessary? (7marks)

(iii) What will be the excess power available? (3marks)



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HARMATTAN SEMESTER TEST EXAMINATION FOR 2019/2020  
PSE 409: ELECTRICAL POWER PLANT TECHNOLOGY SESSION

Instructions: Answer all questions.

Time: Allowed 1hr 15 minutes

Q1.(a)(i) Apart from solar, state two renewable energy resources that are <sup>deployable</sup> ~~deployed~~ in FUTO  
(2marks)

Q1b(ii) State three reasons for preference of solar in FUTO (3marks)

Q1b (i) State and justify the utilization of six major components in EEE FUTO solar farm project  
(3marks).

Q1b(ii) State and explain two modern devices that may be introduced in EEE solar farm to  
improve its efficiency (2marks)

Q1c. Using all components identified, present a one line schematic design of EEE solar farm  
project from energy harnessing to full utilization (5marks)

Q2(a) With the aid of block diagram representation, explain the energy conversion processes  
involved in fossil-fueled power plant (10 marks)

Q2(b). List three technical factors that determine the siting of fossil-fueled power plant  
(3 marks)

Q2(c) Name five (5) advantages and two (2) disadvantages of a steam power plant (7 marks)

