



(University of Choice)

**MASINDE MULIRO UNIVERSITY OF  
SCIENCE AND TECHNOLOGY  
(MMUST)**

**MAIN CAMPUS**

**UNIVERSITY EXAMINATIONS  
2021/2022 ACADEMIC YEAR**

**FIFTH YEAR SPECIAL/SUPPLEMENTARY EXAMINATIONS  
FOR THE DEGREE  
OF  
BACHELOR OF SCIENCE IN ELECTRICAL AND  
COMMUNICATIONS ENGINEERING**

**COURSE CODE: ECE 417**

**COURSE TITLE: POWER SYSTEMS III**

**DATE: OCTOBER 7<sup>th</sup>, 2022**

**TIME: 03.00 - 05.00 PM**

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**INSTRUCTIONS TO CANDIDATES**

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.  
QUESTION ONE CARRIES 30 MARKS AND ALL OTHERS 20 MARKS EACH.

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over. 



**Question One****30 Marks**

- a) Name and briefly explain the role of any six key players in the Kenyan energy sector. [6 Marks]
- b)
- (i) What is Power Factor? How does it affect energy bills. [4 Marks]
  - (ii) A factory takes a load of 200 kW at 0.85 p.f. (lagging) for 2,500 hours per annum and buys energy on tariff of Kshs. 150 per kVA plus 6 cts per kWh consumed. If the power factor is improved to 0.9 lagging by means of capacitors costing Kshs. 525 per kVA and having a power loss of 100 W per kVA, calculate the annual saving affected by their use. Allow 8% per annum for interest and depreciation on the capacitors. [6 Marks]
- c) The daily demands of three consumers connected to a power station are as given in Table Q1(d) below.

Table 1: Q1(d)

Time	Consumer 1	Consumer 2	Consumer 3
12 midnight to 8 a.m.	No-load	200 W	No-load
8 a.m. to 2 p.m.	650 W	1000 W	250 W
2 p.m. to 4 p.m.	250 W	No-load	1200 W
4 p.m. to 10 p.m.	700 W	200 W	150 W
10 p.m. to midnight	800 W	No-load	50 W

- (i) Plot the daily load curve and the load duration curve of the station. [6 Marks]
- (ii) Select the size and number of the generating units and outline their operating schedule. You may choose upto four generating units and one reserve generator. [8 Marks]

**Question Two****20 Marks**

- a)
- (i) What is Solar Energy? [2 Marks]
  - (ii) Give the pros and cons of solar power. [6 Marks]
  - (iii) Can a gas turbine be used as peaking power station? Justify. [4 Marks]
- b) It's desired to install a diesel power station to supply power in an urban suburbs with the following setup:
- (i) 1000 houses with average connected load of 1.5 kW in each house. The demand factor and diversity factor being 0.4 and 2.5 respectively.
  - (ii) 10 factories having overall maximum demand of 90 kW.
  - (iii) 7 tubewells of 7 kW each and operating together in the morning.
- The diversity factor among the above three types of consumers is 1.2. What should be the minimum capacity of power station? [8 Marks]

**Question Three****20 Marks**

- a) What is a tariff? [2 Marks]
- b) Briefly explain desirable characteristics of a tariff. [8 Marks]
- c) The maximum demand of a consumer is 25A at 220 V and his total energy consumption is 8760 kWh. If the energy is charged at the rate of 20 cents per unit for 500 hours use of the maximum demand per annum plus 10 cents per unit for additional units. Determine:

- (i) the annual bill
- (ii) the equivalent flat rate.[10 Marks]

**Question Four**

**20 Marks**

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- a) Explain the theory of corona formation. [8 Marks]
- b) Explain any four (4) methods of reducing Corona Effect. [4 Marks]
- c) A certain 3-phase equilateral transmission line has a total corona loss of 53 kW at 106 kV and a loss of 98 kW at 110.9 kV. What is the disruptive critical voltage? What is the corona loss at 113 kV? [8 Marks]

**Question Five**

**20 Marks**

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- a) With a brief explanation, graphically illustrate how you can determine the economic transmission voltage. [8 Marks]
- b) The cost of a 3-phase overhead transmission line is KShs.  $(25000 a + 2500)$  per km where 'a' is the area of x-section of each conductor in  $cm^2$ . The line is supplying a load of 5 MW at 33kV and 0.8 p.f. lagging assumed to be constant throughout the year. If the energy costs 40cents per kWh and interest and depreciation total 10% per annum. Find the most economical size of the conductor. Given that specific resistance of conductor material is  $10^{-6} \Omega \text{ cm}$ . [12 Marks]