STRATHMORE UNIVERSITY

SCHOOL OF COMPUTING AND ENGINEERING SCIENCES

MASTER OF SUSTAINABLE ENERGY TRANSITION

MSSET 8103: POWER SYSTEMS FUNDAMENTALS

DATE: 14th AUGUST 2023 **TIME: 2.5 HOURS**

INSTRUCTIONS

1. This examination contains **FOUR** questions.
2. Attempt **Question ONE (COMPULSORY)** and any other **TWO** questions
3. All workings should be shown clearly.

QUESTION ONE [20 MARKS]

a) A business uses two 3kW fires for an average of 20 hours each per week, and six 150W lights for 30 hours each per week. If the cost of electricity is Ksh 25 per unit, determine the weekly cost of electricity to the business. **[3 marks]**

b) Power system interconnections into regional power pools are becoming very common in the modern world. Discuss the advantages and disadvantages of such interconnections. **[6 marks]**

c) What are the main functions of protection equipment in a power system **[3 marks]**

d) What are the major disadvantages of using high voltage direct current (HVDC) in power system transmission networks? **[4 marks]**

e) With example discus what are power system ancillary services. **[4 marks]**

QUESTION TWO [15 MARKS]

a) Give the deferent types of aluminium conductors used in power systems transmission and distribution lines. **[2 marks]**

b) Define Sag as used in power systems transmission lines and highlight factors that determine the amount of sag. **[4 marks]**

c) A power generating station supplies loads as tabulated below:

Time	0-6	6-8	8-12	12-14	14-18	18-21	21-24
Total kW	50000	40000	70000	50000	60000	80000	50000

(i) Plot the load curve and find the number of units generated by the power station per day.

(ii) Determine the load factor, plant factor, and the utilization factor of the plant if the installed capacity of the plant is 100000 kW **[9 marks]**

QUESTION THREE [15 MARKS]

a) Explain the reasons why underground cables are rarely used for power transmission? **[2 marks]**

b)

i) Briefly explain your understanding of primary and back-up protection in power systems

ii) Why is it important to have overlapping zones in power system protection design? What is the risk of this overlapping? **[5 marks]**

c) Consider a simple power system represented by the equivalent circuit in Figure Q3 (c) below:

i) Find the total impedance, Z_T.

ii) Determine the currents I_1 , I_2 , and I_3.

iii) Calculate the total power provided by the voltage source.

iv) Determine the average powers P_1 , P_2 , and P_3 dissipated by each of the impedances. **[8 marks]**

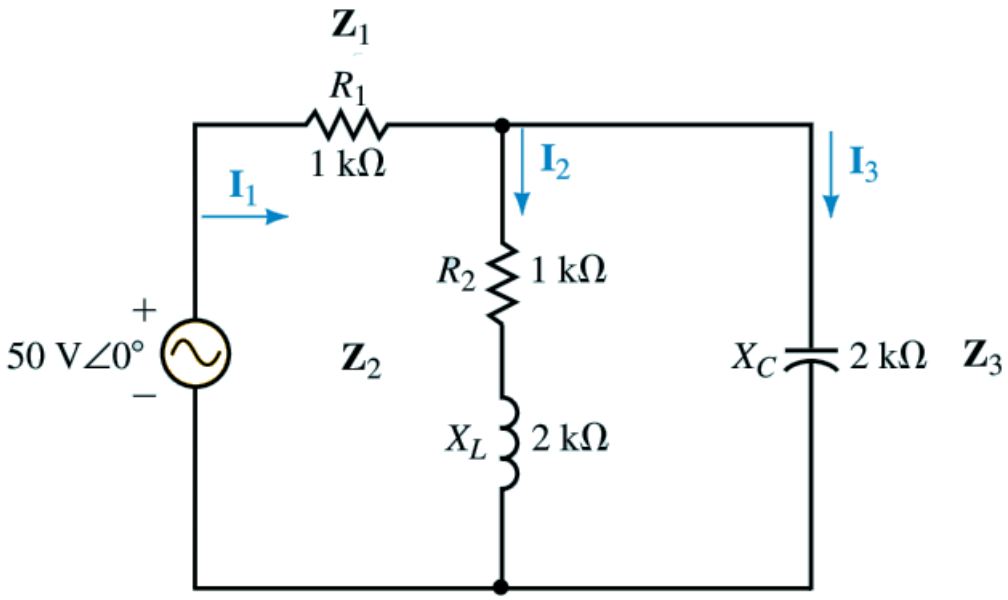

Figure Q3 (c)

QUESTION FOUR [15 MARKS]

a) Explain any SIX reasons why distributed generations could be preferred as opposed to centralised systems in modern power systems **[6 marks]**

b)

i) Give the required features that support structures should possess for appropriate applications in overhead transmission and distributions lines

ii) What are the disadvantages of using wooden poles for this application?

iii) What are the drawbacks of aluminum conductors used for transmission lines? **[9 marks]**