(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2023/2024 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL AND COMMUNICATION ENGINEERING

COURSE CODE: ECE 317

COURSE TITLE: POWER SYSTEMS II

DATE: THURSDAY 07/12/2023 **TIME:** 12: 00 PM – 2:00 PM

INSTRUCTIONS TO CANDIDATES

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

TIME: 2 Hours

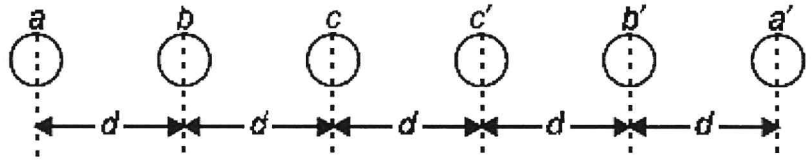
MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION ONE (Compulsory)

a) Explain *two* methods of improving string efficiency of suspension insulators. **[2 Mks]**

b) Determine the inductance per km per phase of a double circuit three-phase line as shown below. The radius of each conductor is **1.5** cm and d=**1.75** m **[5 Mks]**



c) State two main methods of grading underground cables. **[2 Mks]**

d) Explain the following terms in relation to corona effect using appropriate equations.

i. Critical Disruptive Voltage

ii. Visual critical voltage

iii. Power loss due to corona. **[6 Mks]**

e) A 3-phase, 50 Hz, overhead transmission line 160 km long is delivering a load of 100 MVA at 0.8 pf lagging and 132 kV to a balanced load. Resistance per km is 0.16 Ω, inductance per km is 1.2 mH, and capacitance per km per conductor is 0.0082 μF. Use nominal π method to determine:

i. Sending end voltage. **[5Mks]**

ii. Sending end Current. **[3 Mks]**

iii. Sending end power factor. **[2 Mks]**

f) In a 3-phase, 4-wire system, the currents in R, Y, and B lines under abnormal conditions of loading are as under:

$$\overrightarrow{I_R} = 100\angle 30^\circ A \;;\; \overrightarrow{I_Y} = 50\angle 300^\circ A \;;\; \overrightarrow{I_B} = 30\angle 180^\circ A$$

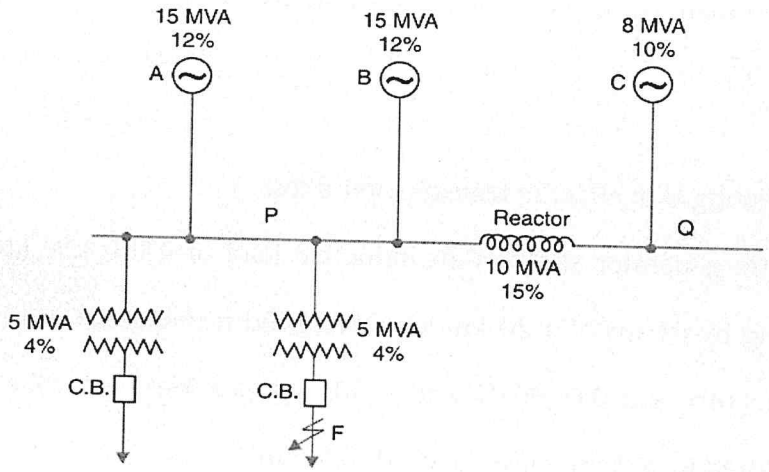
Calculate the positive, negative, and zero sequence currents in the R-line and return current in the neutral wire. **[5 Mks]**

Question Two

a) Define switchgear and state types of switchgear equipment. **[2 Mks]**

b) Explain **two** methods to reduce the Corona discharge effect. **[4 Mks]**

c) Determine the maximum short-circuit MVA with which circuit breakers on the outgoing side of the transformers have to deal. **[6 Mks]**



d) State **four** advantages of suspension insulators. **[2 Mks]**

e) Draw the zero-sequence network for:

i. Star-connected load with no earth connection

ii. Star-connected load with $\mathbf{Z_n}$ from neutral to ground.

iii. Delta-connected load. **[6 Mks]**

Question Three

a) Explain the skin effect phenomena in the power transmission system. **[2 Mks]**

b) A long transmission line delivers a load of 60 MVA at 124 kV, 50 Hz, at 0.8 power factor lagging. The resistance of the line is 25.3 Ω, reactance is 66.5 Ω, and admittance due to charging capacitance is 0.442×10^{-3} mho. Using nominal π, find;

i. A, B, C, D constants

ii. Sending end voltage, current, and power factor

iii. Regulation

iv. Efficiency of the line. **[10 Mks]**

c) State four essential Features of Switchgear. **[2 Mks]**

d) State and explain four main components of Overhead lines. **[6 Mks]**

Question Four

a) State four factors affecting skin effect in transmission lines. **[2 Mks]**

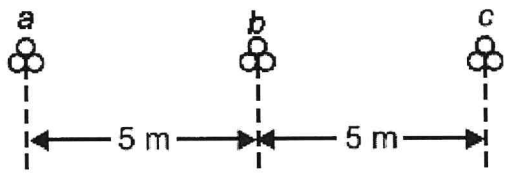
b) A single phase 60 Hz generator supplies an inductive load of 4500 kW at a power factor of 0.80 lagging by means of a 20 km long overhead transmission line. The line resistance and inductance are 0.0195 Ω and 0.60 mH per km. The voltage at the receiving end is required to be kept constant at 10.2kV. Find:

i. The sending end voltage and voltage regulation of the line.

ii. The value of the capacitors to be placed in parallel with the load such that the regulation is reduced to 60% of that obtained in part (a).

iii. Compare the transmission efficiencies in parts (a) and (b). **[12 Mks]**

c) Find out the capacitance per km to neutral of the three-phase line as shown in the figure below. The lines are regularly transposed. The radius of each sub conductor is r=**0.5** cm. **[6 Mks]**



Question Five

a) Name and briefly explain the role of any key four public entities in the Kenyan energy sector.

[4 Mks]

b) A 3-phase, 11 kV, 10 MVA generator has sequence reactances of $\mathbf{X_0}$ =0.05 p.u., $\mathbf{X_1}$=0.15 p.u. and $\mathbf{X_2}$=0.15 p.u. If the generator is on no load, find the ratio of fault currents for the **L-G** fault to that when all the 3-phases are short-circuited. **[8 Mks]**

c) The section bus-bars A and B are linked by a bus-bar reactor rated at 5000 kVA with 10% reactance. On bus bar A, there are two generators each of 10,000 kVA with 10% reactance, and on B two generators each of 8000 kVA with 12 % reactance. Find the steady MVA fed into a dead short circuit between all phases on B with a bus-bar reactor in the circuit.

[8 Mks]