



(University of Choice)

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

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2022/2023 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 SYSTEM II

DATE: 13TH DECEMBER, 2022 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.

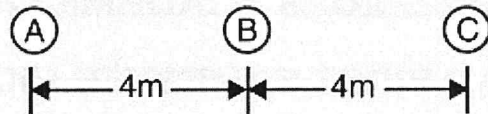
TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

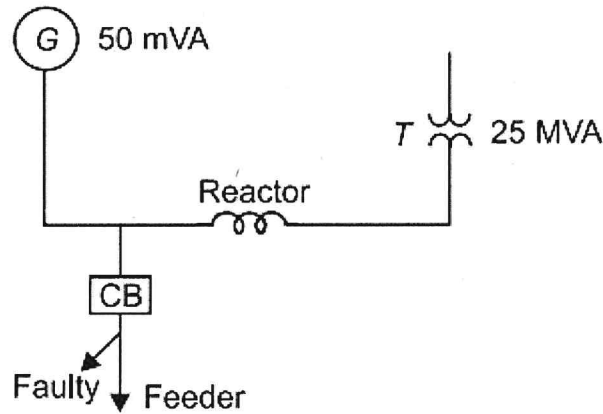
This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION ONE (Compulsory)

- a) Define skin effect and state factors affecting skin effect in Transmission Lines. [2 Mks]
- b) A 3-phase, 50 Hz, 132 kV overhead line has conductors placed in a horizontal plane 4 m apart. Conductor diameter is 2 cm. If the line length is 100 km, calculate the charging current per phase assuming complete transposition. [5 Mks]

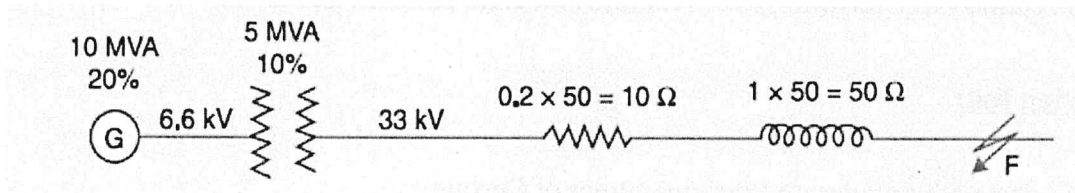


- c) State two main methods of grading of cables. [1 Mks]
- d) Explain critical disruptive voltage in relation to corona effect. [1 Mks]
- e) A 3-phase, 50 Hz, 16 km long overhead line supplies 1000 kW at 11kV, 0.8 p. f lagging. The line resistance is 0.03 Ω per phase per km and line inductance is 0.7 mH per phase per km. Calculate:
- i. Sending end voltage. [5Mks]
 - ii. Voltage regulation. [3 Mks]
 - iii. Efficiency of transmission. [2 Mks]
- f) State **four** desirable properties of insulating material. [2 Mks]
- g) Explain two types faults in power systems. [4 Mks]
- h) A 50 MVA generator with a reactance of 0.10 p. u is connected to a busbar. A 25 MVA transformer with a reactance of 0.05 p. u is also connected through a bus-bar reactor of 0.10 p. u to the same bus-bar. Both these reactance's are based on 25 MVA rating. If a feeder taken out from the bus-bar through a circuit breaker develops a line to ground fault, what should be the rating of circuit breaker. [5 Mks]



Question Two

- a) Define switchgear and state types of switchgear equipment's. [2 Mks]
- b) Explain **two** methods to reduce Corona discharge effect. [4 Mks]
- c) A 10 MVA, 6.6 kV, 3 –phase star-connected alternator having a reactance of 20% is connected through a 5 MVA, 6.6 kV/33 kV transformers of 10% reactance to a transmission line having a resistance and reactance per conductor per kilometer of 0.2 Ω and 1 Ω respectively. 50 kilometers along the line, a short – circuit occurs between the three conductors. Find the current fed to the fault by the alternator. [8 Mks]



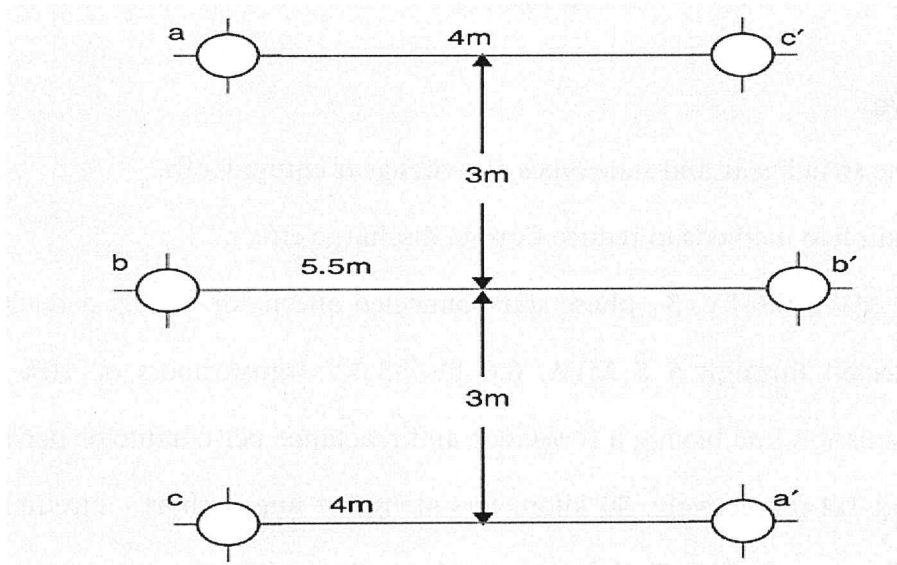
- d) State **four** advantages of suspension insulators. [2 Mks]
- e) Explain Ferranti effect phenomena and its cause. [4 Mks]

Question Three

- a) Explain Corona formation theory in power transmission system. [4 Mks]
- b) Explain three methods of improving string efficiency of suspension insulators. [3 Mks]

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

d) Find the inductance per phase per km of double circuit 3-phase line shown in figure below. The conductors are transposed and are of radius 0.75 cm each. The phase sequence is ABC. [8 Mks]

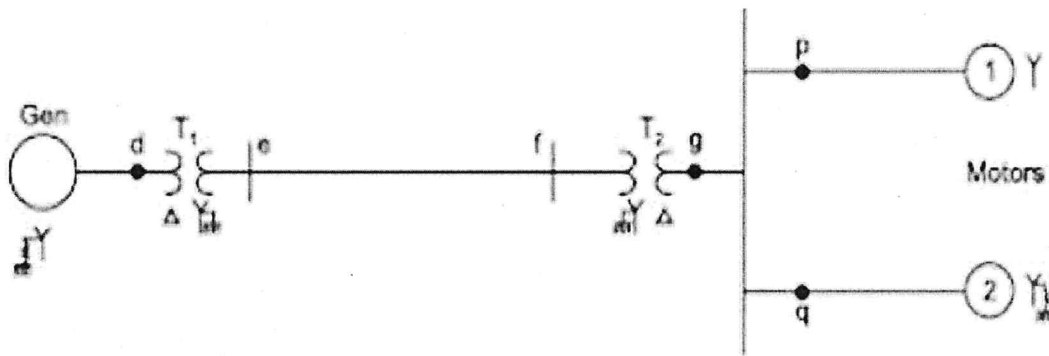


e) Name three advantages of reactors and state possible locations. [3 Mks]

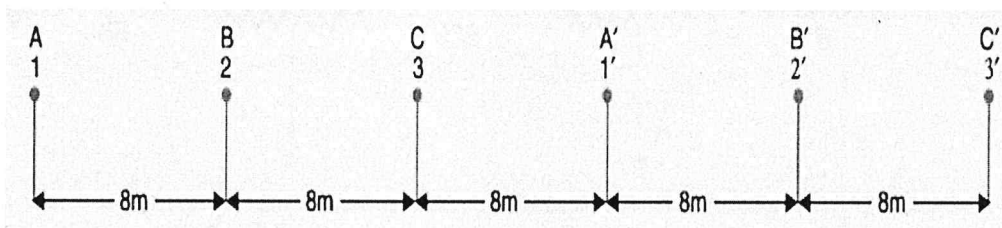
Question Four

a) State advantages and disadvantages of Corona. [2 Mks]

a) A 50MVA, 11KV, synchronous generator has a sub transient reactance of 20%. The generator supplies two motors over a transmission line with transformers at both ends as shown in figure below. The motors have rated inputs of 30 and 15 MVA, both 10KV, with 25% sub transient reactance. The three phase transformers are both rated 60MVA, 10.8/121KV, with leakage reactance of 10% each. Assume zero sequence reactance for the generator and motors of 6% each. Current limiting reactors of 2.5 ohms each are connected in the neutral of the generator and motor number 2. The zero-sequence reactance of the transmission line is 300 ohms. The series reactance of the line is 100 ohms. Draw the positive, negative and zero sequence networks. [12 Mks]

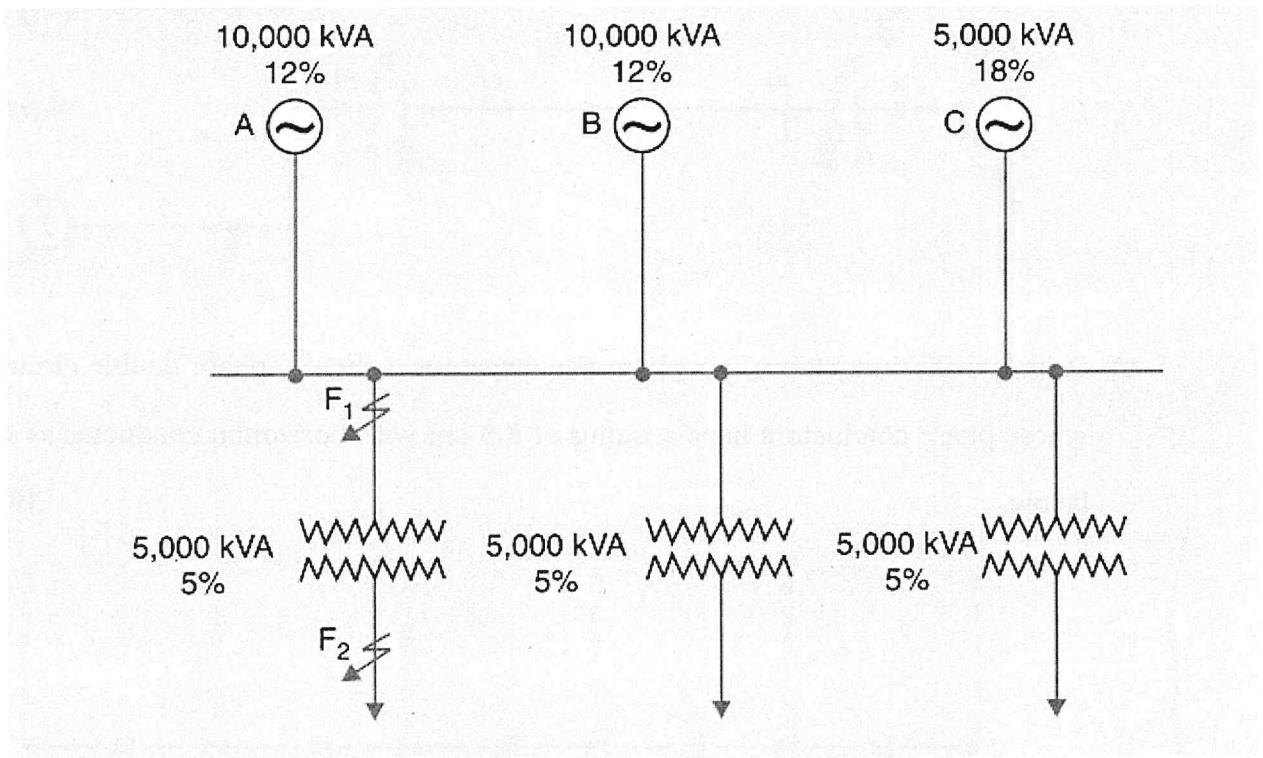


- b) Calculate the inductance per phase per meter for a three - phase double circuit line whose phase conductors have a radius of 5.3 cm with horizontal conductor as shown below. [6 Mks]



Question Five

- a) Name and briefly explain the role of any key four public entities in the Kenyan energy sector. [8 Mks]
- b) Name any two methods of reducing short -circuit current. [2 Mks]
- c) The plant capacity of a 3-phase generating station consists of two 10,000 kVA generators of reactance 12% each and one 5000 kVA generator of reactance 18%. The generators are connected to the station bus-bars from which load is taken through three 5000 kVA step -up transformers each having a reactance of 5%.



Determine the maximum fault MVA which the circuit breakers on;

- i. Low voltage side and
- ii. High voltage side may have to deal with.

[10 Marks]