MACHAKOS UNIVERSITY

University Examinations for 2019/2020Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FIFTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING

EEE 506: HIGH VOLTAGE TECHNOLOGY

DATE: 21/10/2020 **TIME: 8.30-10.30 AM**

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (30 MARKS)

a) With aid of a well labelled diagram of breakdown voltages against time, describe briefly the various breakdown mechanisms in solids. (8 marks)

b) A steady current of 500μA flows through the plane electrode separated by a distance of 0.4cm when a voltage of 12KV is applied. Determine the Townsend's first ionization coefficient if a current of 50 micro amperes flows when the distance of separation is reduced to 0.08 cm and the field is kept constant at the previous value.

(6 marks)

c) An overhead line with inductance and capacitance per kilometer of 1.24 mH and 0.087 μF respectively is connected I series with an underground cable having inductance and capacitance of 0.185mH/km and 0.285 μF /km. calculate the values of transmitted and reflected waves of voltage and current at the junction due to voltage surge of 110KV travelling to the junction:

i. Along the overhead line towards the cable.

ii. Along the cable towards the overhead line. (10 marks)

d) Differentiate between critical disruptive and visual critical voltage. (3 marks)

e) Briefly describe the role of a converter transformer in a converter station. (3 marks)

QUESTION TWO (20 MARKS)

a) From electromechanical breakdown of solids, proof that for any real value of voltage, the reduction in thickness of specimen cannot be more than 60%. (6 marks)

b) Derive the expressions of transmitted and reflected voltages, when a travelling wave reaches the end of:

i. An open circuited transmission line

ii. A short circuited transmission line. (6 marks)

c) A three phase overhead line consists of three conductors transposed and arranged as shown in fig. 1. The conductor diameter is 1.04 centimeter and surface factor of 0.85.the air temperature and pressure are21.1oc and 740mmHg.find visual critical voltage. (6 marks)

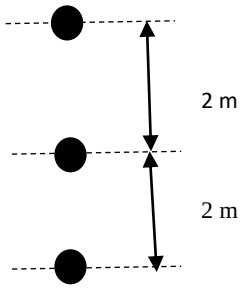

Fig.1

d) Sketch a well labelled homo-polar dc link. (2 marks)

QUESTION THREE (20 MARKS)

a) Discuss various factors which affect the breakdown of gases. (5 marks)

b) Sketch a well labelled diagram of a dielectric material and describe the various parts. (5 marks)

c) A 50-kilometer-long 3-phase, 220 KV, 50 hertz transmission line consists of 1.5 cm radius conductors spaced 2 meters apart in equilateral formation. If the temperature is 40 degrees centigrade and atmospheric pressure is 76 cm, calculate the total corona loss of the line. Take irregularity factor to be 0.9. (7 marks)

d) Differentiate between mono-polar and bipolar dc links. (3 marks)

QUESTION FOUR (20 MARKS)

a) Discuss the effects on high voltage measurements using sphere gap by:

i. Nearby earthed objects

ii. Humidity

iii. Dust particles (6 marks)

b) Calculate the velocity of propagation for waves in an overhead line of capacitance 0.147×10^{-10} F/m and capacitance of 0.75×10^{-6} H/m. (6 marks)

c) Briefly discuss what ground return is and why it is used in high voltage dc transmission. (4 marks)

d) Discuss why dc transmission is superior to ac transmission for very long distances. (4 marks)

QUESTION FIVE (20 MARKS)

a) A generating voltmeter is required to measure voltage between 10KV and 300KV. If the indicating meter reads a minimum current of 1 micro ampere and a maximum of 31 micro ampere, determine the capacitance of the generating voltmeter. Assume that the speed of the driving synchronous motor is 1000 rpm. (6 marks)

b) Describe a surge absorber. (3 marks)

c) Derive the expression of surge impedance and surge velocity. (5 marks)

d) Discuss any three factors that affect corona loss. (6 marks)