



MACHAKOS UNIVERSITY

University Examinations for 2018/2019

**SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

**FIFTH YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR
BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)**

EEE 504: POWER TRANSMISSION AND DISTRIBUTION

DATE:

TIME:

INSTRUCTIONS

Answer Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Describe any THREE types of insulators found in a power system. (6 marks)
- b) In a 33KV overhead line, there are three units in the string of insulators. If the capacitance between each insulator pin and earth is 10% of self-capacitance, find the distribution of voltages between the three insulators and the string efficiency. (10 marks)
- c) An overhead line has a span of 200 meters. The weight of the line conductor is 0.6 kg per meter. Calculate the maximum sag in the line. The maximum allowable tension in the line is 1600kg. (10 marks)
- d) Discuss any TWO ways of voltage regulation and compensation. (4 marks)

QUESTION TWO (20 MARKS)

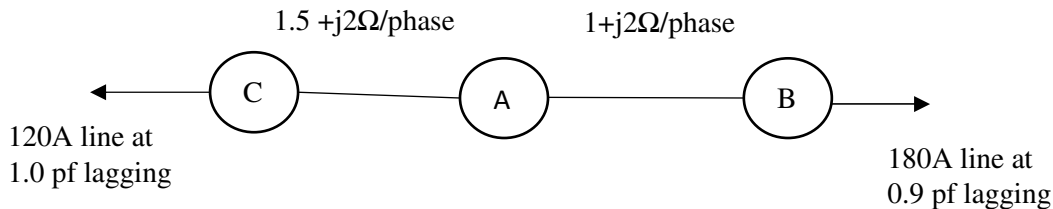
- a) Discuss any TWO tests carried out on a porcelain insulator. (4 marks)
- b) By derivation show that reactive power transferred over a transmission line is directly proportional to $|V_s| - |V_r|$, the voltage drop between the sending and the receiving ends. (10 marks)
- c) A 400 meter long distributor has the following unity power factor loads tapped off the red phase: 100A load at 100 meter from the feeding point, 120A load at 250 meter from the feeding point and 80A load at 400 meter from the feeding point. The resistance of the conductor is 0.25 ohm per km length. Neglecting the voltage drop in the neutral conductor, find the voltage across the load at the far end if the voltage at the feeding point is 200 volts. (6 marks)

QUESTION THREE (20 MARKS)

- a) With aid of a diagram describe how sag and tension varies with variations in temperature. (4 marks)
- b) Discuss THREE advantages of suspension insulators over pin type insulators. (6 marks)
- c) Derive the expression of the most economical cross section area of conductor. (10 marks)

QUESTION FOUR (20 MARKS)

- a) Describe string efficiency. (4 marks)
- b) With aid of a diagram, describe Ferranti effect. (6 marks)
- c) A generating station A, with line voltage of 33KV, supplies TWO sub-stations B and C through three feeders as shown. Calculate:
 - i. The potential difference between B and C.
 - ii. Total power loss in case. (10 marks)



QUESTION FIVE (20 MARKS)

- a) Discuss shortcomings of Kelvin's law of determining the most economical cross section area of a conductor. (5 marks)
- b) Each of the three insulators forming a string has a self-capacitance of C farad. The shunt capacitance of each insulator is 0.25C to earth and 0.15C to line. Calculate the voltage distribution across each insulator as a percentage of line voltage to earth and the string efficiency. (6 marks)
- c) A 400 kilometer 3-phase overhead line has a series impedance of $10 + j100$ ohms per phase and a shunt admittance of $1.12 \times 10^{-3} \angle 90$ siemens per phase. The line delivers 240MW at unity power factor and at 270KV. Find:
 - i. Constants A, B, C and D
 - ii. Sending end voltage
 - iii. Power angle. (9 marks)