



MACHAKOS UNIVERSITY

University Examinations for 2020/2021

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

EEE 504: POWER TRANSMISSION AND DISTRIBUTION

DATE: 17/8/2021

TIME: 2:00 – 4:00 PM

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Question **ONE** is **compulsory**. Attempt any other two questions.

Do not write on the question paper.

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Describe the four main types of load forecasting methods applied in power system planning. (8 marks)
- b) With an aid of diagrams show that, inductance of a three phase overhead transmission line in unsymmetrical spacing is given by:
- $$L_A = 2 \times 10^{-7} \left\{ \ln \left(\frac{\sqrt[3]{d_1 d_2 d_3}}{r} \right) \right\} \quad (10 \text{ marks})$$
- c) With an aid of a flow chart diagram, describe the procedures of transmission line expansion (12 marks)

QUESTION TWO (20 MARKS)

- a) Power from hydroelectric power plant of 9000Mwatts is to be transmitted to a load centre located 500km from the plant. Based on practical line loadability criteria, determine the number of three phase, 60Hz lines required to transmit this power with one line out of service for the following cases:
- (i) 345Kv line with $Z_c = 297 \Omega$
 - (ii) 500kV line with $Z_c = 277\Omega$
 - (iii) 765kV line with $Z_c = 266\Omega$ (8 marks)
- b) A 300km uncompensated line has a sending end voltage of 765kV, receiving end voltage of 0.95 per unit, the phase angle of 35° , $Z' = 97\Omega$, $A = 0.9313\text{p.u.}$, $\theta_A = 0.209^\circ$, $\theta_Z = 87.2^\circ$. Determine:
- (i) The practical line loadability
 - (ii) Full load current at 0.986 p.f leading based on the practical line loadability
 - (iii) Exact receiving end voltage.
 - (iv) Voltage regulation. (12 marks)

QUESTION THREE (20 MARKS)

- a) Determine the theoretical maximum power, in Mw and in p.u of SIL, that a three phase 765kv, 60HZ, 300km, completely transposed line with the following parameters can deliver. $Z = 0.0165 + j 0.3306\Omega/\text{km}$ and $y = j4.674 \times 10^{-6} \text{ S/km}$. (8 marks)
- b) State any four properties possessed by line supports. (4 marks)
- c) An insulator string consists of three units, each having a safe working voltage of 15kv. The ratio of self capacitance to shunt capacitance of each unit is 8:1. Determine:
- (i) The maximum safe working voltage of the string
 - (ii) String efficiency (8 marks)

QUESTION FOUR (20 MARKS)

- a) State any three factors that affect corona (3 marks)
- b) A three phase 220kV, 50Hz transmission line consists of 1.5cm radius conductor spaced 2cm apart in equilateral triangular formation. If the temperature is 40° and atmospheric pressure 76cm, determine the corona loss per km of the line. Take $m_0 = 0.85$. (7 marks)
- c) With an aid of a diagram, show that the generalized constant of a nominal π - medium transmission line obeys the transmission lines rule of $AD - BC = 1$. (10 marks)

QUESTION FIVE (20 MARKS)

- a) A 60 HZ, three phase, 200km transmission line has a $r = 0.1\Omega/\text{km}$, $L = 1.25\text{mH/KM}$ and $C = 0.01\mu\text{F/km}$. The line delivers 30Mwatts at 132kV with 0.8 power lagging. Determine:
- (i) sending end voltage
 - (ii) percentage regulation
 - (iii) Percentage efficiency of the line. (12 marks)
- b) With an aid of a diagram, show that, in a three phase overhead line, the capacitance of a conductor with respect to neutral is given by:

$$C = \frac{2\pi\epsilon_0}{\ln d/r} F/m \quad (8 \text{ marks})$$