



MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF _____

DEPARTMENT OF

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

**FOURTH YEAR SECOND SEMESTER EXAMINATION FOR BACHELOR
OF**

EES432: TRANSMISSION LINES AND ELECTROMAGNETIC WAVES

DURATION: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer Question one and any other two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

- a) Define the following terminologies (5marks)
- Characteristic impedance
 - Lossless line
 - Distortion less line
 - Attenuation
 - Skin depth
- b) State three factors that contribute to attenuation in data cables (3marks)
- c) A telephone line has $R=30\Omega/\text{km}$, $L=100\text{mH}/\text{km}$, $G=0$ and $C=20\text{F}/\text{km}$ at $f=1\text{kHz}$
Calculate (6marks)
- Characteristic impedance
 - The propagation constant
 - Phase velocity
- d) A 50Ω lossless line operates at 600MHz and is terminated by a load of Z_L . If the line is 0.1m long and $Z_{in} = 100 - j20$, Find Z_L and VSWR. Assume $u=0.6C$, solve using a smith chart (5marks)
- e) Proof _____ (5marks)
- f) In free space, $E = 20 \cos(\omega t - 50x) \text{ V/m}$. Find
- J_d
 - _____

SECTION TWO: ANSWER ANY TWO QUESTIONS

QUESTION TWO (20 MARKS)

- a) A certain transmission line 2m long operating at $\omega = 10^6 \text{ rad/s}$ has $\alpha = \frac{8d\beta}{m}$, $\beta = 1 \text{ rad/m}$ and $Z_o = 60 + j40\Omega$. If the line is connected to a source of $1010 \angle 0^\circ \text{ V}$, $Z_g = 40\Omega$, and terminated by a load of $20 + j50\Omega$. Determine
- The input impedance

- ii. The sending end current
 - iii. The current at the middle of the line (10marks)
- b) An airline has a characteristic impedance of 70Ω and $\beta = 3\text{rad/m}$ at 100MHz . Calculate the inductance per metre and the capacitance per metre of the line (6marks)
- c) A lossy transmission line has resistance per unit length $R = \frac{0.05\Omega}{m}$. the line is distortion less and has characteristic impedance of 50Ω . Calculate the attenuation constant of the line. (4marks)

QUESTION THREE (20 MARKS)

- a) A 50Ω transmission line is terminated to a load of $25 + j50$. The length of the transmission line is 3.3λ . By aid of a smith chart find the following (8marks)
- i. Reflection coefficient
 - ii. VSWR
 - iii. Input impedance
 - iv. The input admittance
- b) A distortion less line operating at 500MHz has $z_o = 80\Omega$, $\alpha = 0.04\text{Np/m}$ and $\beta = 1.5\text{rad/m}$ Find R,L,G and C (6marks)
- c) A lossless transmission line is 80cm long and operates at a frequency of 600MHz , the line parameters are $L=0.25\mu\text{H/m}$ and $C=100\text{pF/m}$. Find the characteristic impedance, phase constant, velocity on the line, the input impedance, the VSWR and the reflection coefficient for $Z_l = 100\Omega$ (6marks)

QUESTION FOUR (20 MARKS)

- a) An electric field in free space is given by (10marks)
- $$E = 50 \cos(10^8 t + \beta x) \hat{a}_y \text{ V/m}$$
- i. Find the direction of wave propagation
 - ii. Calculate β and the time it takes to travel a distance _____
 - iii. Sketch the wave at $t=0$, $T/4$ and $T/2$
- b) A load of $100 + j150\Omega$ connected to a 75Ω lossless line find (10marks)

- i) Reflection coefficient
- ii) VSWR
- iii) The load admittance Y_L
- iv) Z_{in} at 0.4_____ from the load
- v) The location of V_{max} and V_{min} with respect to the load if the line is 0.6___long
- vi) Z_{in} at the generator