MACHAKOS UNIVERSITY

University Examinations for 2016/2017

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR DEGREE IN

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING

EEE 313: TRANSMISSION LINES AND WAVEGUIDES

DATE: 14/6/2017 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS

Answer questions One and any other Two Questions. Question One is Compulsory and carries 30 Marks. The remaining questions carry 20marks each.

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Show the Maxwell's equations in differential terms and explain the meaning for each (5 marks)

b) Using Maxwell's equations in vacuum and curl of curl identity $\nabla \times (\nabla \times \mathbf{X}) = \nabla(\nabla \cdot \mathbf{X}) - \nabla^2\mathbf{X}$, derive the wave equations for E and B fields. (5 marks)

c) Describe some common types of transmission lines (5 marks)

d) Discuss the types of waveguides (5 marks)

e) Derive general properties of a transmission line from the distributed line parameters. (5 marks)

f) Discuss dispersion in the transmission lines (5 marks)

QUESTION TWO (20 MARKS)

a) Briefly demonstrate with equations the properties of Uniform Plain Wave in a lossless, isotropic media. (5 marks)

b) Define reflection coefficient at a point z along a transmission line. (5 marks)

c) Discuss parameters of a lossless transmission line (5 marks)

d) Explain how the standing waves occur in a transmission line. (5 marks)

QUESTION THREE (20 MARKS)

a) Describe with illustrations the propagation of waves in a waveguide. (6 marks)

b) Explain three examples of waveguide and their applications (7 marks)

c) Derive the characteristics for distortion less transmission line (7 marks)

QUESTION FOUR (20 MARKS)

a) Define VWSR of a transmission line with respect to reflection coefficient (5 marks)

b) The open-circuit and short-circuit impedances measured at the input terminals of a lossless transmission line of length 1.5 m (which is less than a quarter wavelength) are $-j54.6\ \Omega$ and $j103\ \Omega$, respectively.

i) Find characteristic Impedance Z_0 and constant k of the line. (5 marks)

ii) Without changing the operating frequency, find the input impedance of a short-circuited line that is twice the given length. (5 marks)

iii) How long should the short-circuited line be in order for it to appear as an open circuit at the input terminals? (5 marks)

QUESTION FIVE (20 MARKS)

a) Calculate cutoff frequencies for waveguides as follows: -

i) Metallic circular waveguide of diameter 6 cm (4 marks)

ii) Metallic rectangular waveguide of 6cm x 3cm (4 marks)

b) 100-Ω transmission line is connected to a load consisting of a 50-Ω resistor in series with a 10-pF capacitor. Find the following: -

(i) the reflection coefficient Γ_L at the load for a 100-MHz signal. (6 marks)

(ii) the impedance Z_{in} at the input end of the transmission line if its length is 0.125λ. (6 marks)