MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FIFTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONIC ENGINEERING)

EEE 553: RADIO COMMUNICATIONS ENGINEERING

DATE: TIME:

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

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Explain with illustrations the frequency spectrum used in radio communications and the applications in the various parts of the spectrum. (6 marks)

b) Describe the different propagation methods used in different bands of the radiofrequency spectrum. (4 marks)

c) With illustrations derive the free space loss (FSL) equation as used in communication engineering. (4 marks)

Express FSL in dB given the frequency in MHz and distance in km. (2 marks)

d) Describe with illustrations three essential properties of any three types of antennas (5 marks)

e) Briefly discuss tropospheric scatter radio wave propagation (5 marks)

f) Discuss need and preparing of radio path profile in radio communications engineering (4 marks)

QUESTION TWO (20 MARKS)

a) Briefly explain the medium properties which affect radio wave propagation

(5 marks)

b) A space vehicle 22bn km away from earth has a 3W power transmitter at 8415MHz and an antenna with 48dB gain.

   i)   Calculate effective power transmitted to earth. (5 marks)

   ii) Signal from the space vehicle is received by a large dish antenna with an area of $3,800m^2$. Calculate the power received at the station on earth. (5 marks)

c) Briefly discuss fading and its effects. (5 marks)

QUESTION THREE (20 MARKS)

a) Describe in detail with illustrations refraction and diffraction as they affect radio wave propagation. (6 marks)

b) Discuss the effects of reflections in radio wave propagation and mitigation measures to counter effects of fading arising from reflected radio waves (7 marks)

c) Explain with illustration the meaning and importance Fresnel zone in radio communications engineering (7 marks)

QUESTION FOUR (20 MARKS)

a) Briefly explain the different types of noise experienced in a radio communication systems. (8 marks)

b) Discuss models used to evaluate multiple edge diffraction losses in a radio link

(6 marks)

c) Briefly describe requirements of a radio receiver. (6 marks)

QUESTION FIVE (20 MARKS)

You are required to design a high capacity radio system between two stations A and B 40 km

apart between which there are buildings and trees and line of sight is just possible. Briefly

discuss the following with illustrations and calculations where necessary.

   Assume you will use 2GHz frequency in the system.

   i.   Selection of antenna type (6 marks)

   ii.   Determination of antenna heights (8 marks)

   iii. Determination of Transmit power (6 marks)