



MACHAKOS UNIVERSITY

University Examinations for 2023/2024 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FIFTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

EEE 553 RADIOCOMMUNICATIONS ENGINEERING

DATE:

TIME:

INSTRUCTIONS

Answer questions One and any other Two Questions.

Question One is Compulsory and carries 30 Marks. Other questions carry 20marks each.

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Explain the signal degradation occurring in radiofrequency propagation [6 marks]
- b) Discuss method to estimate diffraction loss from 2 edges along the radio path.
[6 marks]
- c) In a radio link where you expect multipath fading, discuss how you will mitigate this problem in your design of the radio link.
[6 marks]
- d) In the radiofrequency spectrum, explain where you will find the following services giving supporting reasons
 - i. FM radio broadcasting
 - ii. Shortwave Radio broadcasting
 - iii. TV broadcasting
 - iv. Mobile telephone services
 - v. Medium wave radio broadcasting
 - vi. High capacity terrestrial radio links .

[6 marks]

- e) In radio broadcasting, explain the three main systems in use in this country, giving their characteristics, applications, advantages and disadvantages. [6 marks]

QUESTION TWO (20 MARKS)

- a) Explain with illustration the Tropospheric Scattering and its effect in radiowave propagation [5 marks]
- b) A 40km radio link is to operate at 2GHz. Determine the minimum antenna heights assuming a level and unobstructed path. [5 marks]
- c) TV broadcasting has recently become digital in what is known as digital migration. What are the advantages achieved in the digital migration. [5 marks]
- d) Discuss with illustrations the essential characteristics of a broadcasting antenna and how they are achieved... [5 marks]

QUESTION THREE (20 MARKS)

- a) Describe in detail with illustrations the ground wave propagation. [6 marks]
- b) Discuss wave polarization as occurring in wave radiofrequency propagation [7 marks]
- c) Briefly explain the important steps in the design of a radio links. [7 marks]

QUESTION FOUR (20 MARKS)

- a) Briefly explain the phenomena of atmospheric absorption in radiofrequency propagation. [5 marks]
- b) Explain with illustration the meaning and importance Fresnel zone in radio systems engineering. [5 marks]
- c) Determine the distance between the transmitter and the receiver if the antenna height is 50m. [5 marks]
- d) Explain how sky wave radio propagation is influenced by the ionosphere. [5 marks]

QUESTION FIVE (20 MARKS)

- a) You are designing a 30 km radio link to operate at 10GHz with good line of sight. Two antennas are available of 10 dB and 12 dB. The transmitter has a 5 watts output.
- i) Calculate power at the receiver [2 marks]
- ii) If the receiver has a -70dBm threshold, discuss measures you will take to make the link functional [2 marks]

- b) 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 with illustrations and calculations the considerations you will make so as to deliver a properly functioning system. Assume you will use 2GHz. 6 marks]
- c) Briefly explain with illustrations non line of sight radio wave propagation. [5 marks]
- d) Discuss the factors leading to radio signal fading and measures to mitigate such fading. [5 marks]