



MACHAKOS UNIVERSITY

University Examinations for 2023/2024 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

THIRD YEAR FIRST SEMESTER EXAMINATIONA FOR

BACHELOR OF TECHNOLOGY IN TELECOMMUNICATION ENGINEERING

SPH 311: IONOSPHERIC PHYSICS

DATE:

TIME:

INSTRUCTIONS

ANSWER YOUR QUESTIONS IN ANSWER BOOKLET PROVIDED

QUESTION ONE [30MARKS]

- a) Discuss the properties of radio waves and their effects on different propagation schemes. [8Marks]
- b) Calculate the skip distance for flat earth with MUF of 15 MHz if the wave is reflected from a height of 400 km where the maximum value of n is 0.875. [3Marks]
- c) Deduce an expression describing the Maximum Usable Frequency in Sky space propagation scheme. [4Marks]
- d) Explain the concept of sunspot and Ionospheric storms in Sky wave propagation and their significant effect in the High-frequency range(HF) [7Marks]
- e) An ionospheric wave is reflected from a layer of height of 300 km. The takeoff angle is 30° and the earth's radius is 6370 km. Calculate the skip distance if the earth is considered as (a) flat surface, and (b) spherical. [6Marks]
- f) Enlist various techniques that are employed to mitigate the adverse effect of microwave Link performance . [2Marks]

QUESTION TWO [20MARKS]

- a) Explain how Faraday effect and Magnetoionic effect in the presence of Earth magnetic field affect the Radio wave propagation. [12Marks]
- b) Explain the principle used in space wave propagation system and its limitation to microwave radio propagation. [8Marks]

QUESTION THREE [20MARKS]

- a) Explain 3 structural layers of ionosphere and show how they affect radio waves propagation in space. [6Marks]
- b) Discuss four factors that causes unavailability of radio wave propagation in microwave link systems . [8Marks]
- c) Discuss six key kinds of LOS wireless transmission impairment hence show how they can be combated. [6Marks]

QUESTION FOUR [20MARKS]

- a) Explain the relationship between the **MUF and the Skip Distance** for flat Earth. [12 Marks]
- b) Explain two Factors that influence small scale fading and two counter measure techniques that are involved in combating fading. [8Marks]

QUESTION FIVE [20MARKS]

- a) Discuss six key factors that can impact the performance of a microwave radio link systems. [6Marks]
- b) Show how diversity techniques in microwave radio systems are instrumental in ensuring robust and high quality communication over wireless link particularly in challenging environments. [6Marks]
- c) Describe various steps that are undertaken by Telecommunication Engineer while setting up microwave Radio station. [8Marks]