MACHAKOS UNIVERSITY

University Examinations for 2024/2025 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

THIRD YEAR FIRST SEMESTER EXAMINATION FOR DEGREE IN BACHELOR OF SCIENCE IN TELECOMMUNICATION AND INFORMATION TECHNOLOGY

SPH 311: IONOSPHERIC PHYSICS

DATE: 17TH JANUARY 2025 **TIME: 11.00 AM - 1.00 PM**

INSTRUCTIONS:
*Answer question **ONE (Compulsory)** and **any other TWO** questions*

QUESTION ONE *(COMPULSORY)* (30 MARKS)

a) Explain how solar activity affect the ionosphere (2 marks)
b) Describe four factors that influence the propagation of sky waves (8 marks)
c) Explain How frequency influence the behavior of radio waves in the ionosphere (2 marks)
d) Explain the concept of virtual height in ionospheric studies and How does the virtual height differ for oblique versus vertical incidence (4 marks)
e) Describe Chapman's theory of layer formation in the ionosphere (4 marks)
f) Explain the significance of critical frequency in ionospheric studies (2 marks)
g) Identify two factors limiting Sky Waves. (2 marks)
h) Explain the principle of MUF, LUF and critical frequency (6 marks)

QUESTION TWO (20 MARKS)

a) A radio station transmits a signal with a frequency of 10 MHz.The critical frequency (cfc) of the ionosphere at the given time is 8MHz. What is the maximum angle of incidence at which the signal can still be reflected by the ionosphere? (6 marks)

a) With as suitable labeled diagram, Illustrate three main layers of the ionosphere.

(6 marks)

b) Illustrate "splitting of radio waves" in the ionosphere analyzing its applications. (3 marks)

c) Substantiate ionospheric refraction, illustrating how it contribute to wave splitting. (5 marks)

QUESTION THREE (20 MARKS)

a) Illustrate Two methods used to measure the height of ionospheric layers. (4 marks)

b) With relevant examples, illustrate five Ionospheric Abnormalities that affects wave transmission. (10 marks)

c) Illustrate three factors that affect the effectiveness of sky wave transmission. (6 marks)

QUESTION FOUR (20 MARKS)

a) Illustrate three techniques that can be used to mitigate the effects of wave splitting in radio Wave communication. (6 marks)

b) i) Discuss Four Properties of Ground waves. (10 marks)

ii) A ground wave transmission is used for communication between two points that are 50 km apart. The operating frequency of the transmitter is 2MHz. The terrain has an average conductivity of $5\times10-3$ and a relative permittivity of 15. Calculate the signals attenuation. (4 marks)

QUESTION FIVE (20 MARKS)

a) Outline how Faraday effect and Magneto ionic effect in the presence of Earth magnetic field affects Radio wave propagation. (12 marks)

b) With an aid of a diagram, Explain the principle used in space wave propagation and its limitation to microwave radio propagation. (8 marks)