# MACHAKOS UNIVERSITY

**University Examinations for 2024/2025 Academic Year**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**
**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

**FOURTH YEAR FIRST SEMESTER EXAMINATION FOR DEGREE IN BACHELOR OF SCIENCE IN TELECOMMUNICATION**

**SPH 408: ANTENNAS**

**DATE: 20TH 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) With an aid of a diagram, show the radiation pattern of a half-wave dipole antenna (4marks)

b) Explain radiation resistance and its importance in antenna theory (4marks)

c) Explain is a broadside array (2marks)

d) With an aid of a diagram, explain how a parabolic reflector antenna function (4marks)

e) Differentiate between directional and omnidirectional antennas (2marks)

f) Explain signal-to-noise ratio (SNR) and how it affects communication systems (4marks)

g) Describe two main types of diversity techniques (4marks)

h) Explain how radio links utilize wave propagation principles. (5marks)

i) Give five techniques that helps in improving signal-to-noise ratio (5marks)

## QUESTION TWO (20 MARKS)

a) Give the understanding of an antenna array and explain four types of antenna arrays (10marks)

b) Find the electric field strength from two isotropic point sources with a phase angle of 60◦ and a wavelength of 0.002m, and an amplitude of 1V/m. (10marks)

**QUESTION THREE (20 MARKS)**

a) Explain the significance of the gain of an antenna (2marks)

b) Give four advantages of using an antenna arrays (4marks)

c) With Appropriate Diagrams, Describe three types of antennas and their Operations. (6marks)

d) Illustrate the working principle of loop antenna, with neat sketch. (4marks)

e) Illustrate the effects of earth's magnetic field on ionosphere radio wave propagation (4marks)

**QUESTION FOUR (20 MARKS)**

a) Wave Scattering Is a Phenomenon that results in signal losses. Illustrate three scattering modes that can occur in the atmosphere, and how do they affect radio wave Transmission. (8marks)

b) With Use of suitable diagrams, illustrate atmospheric ducting, and how it affects radio wave propagation (4marks)

c) Using Suitable diagrams for explanation, show the Difference between linear and planar antenna arrays (4marks)

d) Demonstrate the expression for the refractive index of the ionosphere. (4marks)

**QUESTION FIVE (20 MARKS)**

a) With an aid of suitable diagram, describe radiation pattern of an antenna, and how is it represented. (10marks)

b) Explain the concept of bandwidth in antenna theory. What factors influence it? (10marks)