



(University of Choice)

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

MAIN CAMPUS

**SUPPLEMENTARY/SPECIAL EXAMINATIONS
2021/2022 ACADEMIC YEAR**

FIFTH YEAR SECOND SEMESTER EXAMINATIONS

**FOR THE DEGREE
OF
BACHELOR OF SCIENCE IN ELECTRICAL AND
COMMUNICATION ENGINEERING**

COURSE CODE: ECE 516E
**COURSE TITLE: ANTENNA ENGINEERING & RADIO WAVE
PROPAGATION**

DATE: Wednesday, 5th October, 2022 TIME: 0900-1100

INSTRUCTIONS TO CANDIDATES

Question ONE (1) is compulsory
Answer Any Other Two (2) questions

TIME: 3 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 2 Printed Pages. Please Turn Over.



QUESTION ONE (30 MARKS)

(a) Describe the following terms as used in antenna engineering:

- (i)** directivity
- (ii)** polarization
- (iii)** reciprocity

(6 marks)

(b) An antenna with a gain of 20 dB is connected to a transmitter using a coaxial cable of 72m long and attenuation of 2.8 dB/100m at 400MHz. If the power from the transmitter is 100W, calculate:

- (i)** Loss in the transmission line
- (ii)** the input power at the antenna;
- (iii)** the effective radiated power.

(8 marks)

(c) (i) With the aid of a diagram, define the term near-field?

- (ii)** Discuss two applications of near-fields

(6 marks)

(d) State the limits (minimum and maximum) of the following radio transmission bands

- (i)** FM radio
- (ii)** AM radio
- (iii)** Short Wave radio
- (iv)** C-band
- (v)** Ka band
- (vi)** Ku band

(6 marks)

(e) A parabolic reflector antenna with a diameter of 5m operates at 18.8 GHz. Calculate:

- (i)** the gain;
- (ii)** the beamwidth

(4 marks)

QUESTION TWO (20 MARKS)

(a) (i) Discuss two disadvantages of parabolic antennas.

- (ii)** With the aid of a diagram, describe three a parabolic antenna feed systems. State the advantage and disadvantages of each feed system if any.

(8 marks)

(b) (i) What are the advantages of underground communication over communication over the earth's surface?

- (ii)** Describe situations requiring underground and undersea communication

(iii) State and discuss four methods used to communicate with submarines.

(8 marks)

(c) Using a sketch of a communication link, show and explain the sources of all losses of concern when conducting a power budget in the link.

(4 marks)

QUESTION THREE (20 MARKS)

(a)(i) Derive the expression of the gain of a dipole antenna in dBi.

(ii) Calculate the capture (effective) area of a dipole operating at 75 MHz.

(iii) What is the length of a driven element of a Yagi antenna at 540 MHz?

(8 marks)

(b) Calculate the effective length of the following antenna at 310 MHz.

(i) dipole

(ii) folded dipole

(iii) bow tie

(6 marks)

(c) Explain the meaning and significance of the following when used in sky-wave communication.

(i) Lowest Usable Frequency

(ii) Maximum Usable Frequency

(iii) Critical Frequency

(6 marks)

QUESTION FOUR (20 MARKS)

(a) A 84 metre transmitting antenna has a gain of 12dBd. The receiving antenna has a height of 18 metres and a gain of 3dB. If the transmitter power is 100W at 224MHz, calculate:

(i) The maximum transmitting distance

(ii) The received power at the maximum transmitting distance.

(8 marks)

(b) (i) What is the ionosphere and how does it differ from other layers of the atmosphere?

(ii) What factors determine whether a radio wave is refracted by the ionosphere or passes through to outer space?

(iii) What layer of the ionosphere has the greatest impact on radio communication?

(6 marks)

(c) A base station operating at 900 MHz transmits a power of 1 W with a gain of 12 dBd in the direction of a mobile receiver, which has a gain of 0 dBd. The mobile receiver has a sensitivity of -104 dBm. Determine

(i) the effective isotropic radiated power

(ii) the path loss

(iii) The maximum range.

(6 marks)