



(University of Choice)

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

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR**

FIFTH YEAR FIRST 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: 13TH DECEMBER, 2022 TIME: 3: 00 PM – 5:00 PM

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.
QUESTION ONE CARRIES 30 MARKS AND ALL OTHERS 20 MARKS EACH.

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION ONE (30 MARKS)

- (a)(i) With the aid of a block diagram, explain the various components of a CCTV system which uses Network Video Recorder mass storage system.
- (ii) A Network Video Recorder is connected to eight 1080p (Full HD) cameras each with a frame rate of 30 frames/second. Calculate the storage capacity required for uncompressed 2 hours continuous recording assuming each pixel is represented by 1 byte.
- (iii) Calculate the minimum speed which the local area network (LAN) switch should operate in order to support real-time recording from the 8 cameras.

(8 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 6.4GHz. If the power from the transmitter is 100W, calculate:

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

(6 marks)

- (c) (i) Define Near Field Communications (NFC)
(ii) Discuss two applications of near field Communication.

(6 marks)

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

- (i) ELF
(ii) VHF
(iii) SHF
(iv) X-band
(v) EHF band
(vi) THF band

(6 marks)

- (e) Design a rectangular microstrip patch antenna with dimensions W and L , over a single substrate, whose centre frequency is 10 GHz. The dielectric constant of the substrate is 10.2 and the height of the substrate is 0.127 cm (0.050 in.). Determine the physical dimensions of the patch, i.e Width (W) and Length (L) in centimetres, taking into account field fringing.

(4 marks)

QUESTION TWO (20 MARKS)

- (a) (i) Discuss TWO advantages and TWO disadvantages of parabolic antennas.
(ii) With the aid of a diagram, describe THREE parabolic antenna feed systems.
State the advantage and disadvantages of each of the feed systems.
(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 which can be used to communicate with submarines.
(8 marks)
- (c) Using a sketch of a communication link, derive the expression of the power budget in Decibels.
(4 marks)

QUESTION THREE (20 MARKS)

- (a)(i) Given a parabolic antenna with a diameter of 3m and efficiency factor $k = 0.6$, calculate the following:
(I) It's gain in dB.
(II) It's capture (effective) area at 3GHz.
(ii) What is the length of a driven element of a Yagi antenna designed to operate at 800 MHz?
(8 marks)
- (b) (i) Define the term flicker as applied in television engineering.
(ii) How is flicker problem reduced in motion pictures?
(iii) What are weighting factors in colour TV systems?
(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) (i) Write short notes on the Digital Video Broadcast (DVB) T2 standard and its implementation in Kenya.
(ii) With the aid of a block diagram, describe the key subsystems of a digital television T2 transmitter and their functions.

(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 terrestrial radio communication?

(6 marks)

- (c)** A base station operating at 900 MHz transmits a power of 1W 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 the following.

- (i)** Effective isotropic radiated power
- (ii)** Path loss
- (iii)** Maximum distance between the transmitter and receiver.

(6 marks)