40

(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2023/2024 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF TECHNOLOGY EDUCATION IN ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE CODE: TEE 423

COURSE TITLE: COMMUNICATION SYSTEMS II

DATE: THURSDAY, APRIL 25TH 2024 **TIME:** 8:00 AM - 10:00 AM

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 1 (30 marks))

(a) Explain what is meant by link budget. (1 mk)

(b) If a transmitter produces 50 watts of power, express the transmit power in units of:
(i) dBm, (2 mks)
(ii) dBW. (2 mks)

(c) If 50 watts is applied to a unity gain antenna with a 900 MHz carrier frequency, find:

(i) The received power in dBm at a free space distance of 100 m from the antenna. (4 mks)
(ii) Compute Pr (10 km). Assume unity gain for the receiver antenna. (3 mks)

d) (i) With the aid of sketches differentiate between a mobile in a cordless communication system and another in a mobile communication system. (4 marks)

(ii) Explain what is meant by isotropic power radiation in mobile communication systems. (2 marks)

e) Explain the conditions that brings about handoff in a cellular communication system. (2 mks)

f) Differentiate between narrow band and wide band systems (4 mks)

g) Explain reflection, diffraction, and scattering as they are applied in radio propagation (6 mks)

h) A 66 MHz cellular telephone system uses two 12.5 kHz simplex channels to provide full duplex voice and control channels. Compute the number of channels available per cell if a system uses a four-cell reuse factor (2 mks).

Question 2

(a) Explain the importance path loss model (1 mk)

b) Describe the following as they are applied in path loss model, use relevant expression where possible

i. Log-distance path loss model, (4 mks)

ii. Log-normal shading path loss model (4mks)

iii. Indoor Propagation Mechanism (4 mks)

(c) A mobile communication service provider is allocated a bandwidth of 256 MHz for a regional cellular telephone system. The system uses 50 kHz simplex channels to provide full duplex voice and control channels.

(i) Compute the bandwidth of available duplex channels in the network. (2 mks)

(ii) If the system has a seven-cell reuse factor determine the number of duplex channels available per cell. (2 mks)

d) Explain how Frequency reuse increases subscriber base in cellular communication networks.

Question 3 (3 mks)

(a) Explain how each of the factors below is applied to increase signal-to-noise ratio at a receiver in a mobile communication system:

(i)Space diversity (3 mks)

(ii)Time diversity (3 mks)

b) Why is transmit diversity preferred to receive diversity in cellular communication systems? (3 mks)

c) (i) Sketch a diagram of the satellite parabolic antenna and define the focus (F), the focal length and the aperture . (6 mks)

(ii) Sketch the radiation pattern of the transmitting antenna in (i) above and calculate the half-power beamwidth (HPBW) for a satellite operating at 4 GHz when the antenna diameter is 1.8 metres. (5 mks)

Question 4

(a) Sketch a basic cellular communication system consisting of four hexagonal cells and its interface to the public switched telephone network and explain how inter-channel interference is caused. (7 marks)

b) An urban area has a population of two million residents. Three competing trunked mobile networks (systems A, B, and C) provide cellular service in this area. System A has 394 cells with 19 channels each, system B has 98 cells with 57 channels each, and system C has 49 cells, each with 100 channels.

(i) Find the number of users that can be supported at 2% blocking if each user averages two calls per hour at average call duration of three minutes. (9 mks)

(ii) Assuming that all three trunked systems are operated at maximum capacity, compute the percentage market penetration of each cellular provider. (4 mks)

Question 5

(a) Illustrate the principles of cellular networks (13 mks)

(b) (i) Differentiate between demultiplexing and multiple access as applies to mobile communication systems. (3 mks)

(ii)Explain with the aid of a sketch how time division multiple access (TDMA) enables subscribers to simultaneously access the mobile communication network. (4mks)