(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DIPLOMA
IN
ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE CODE: DEE 097

COURSE TITLE: WIRELESS AND MOBILE COMMUNICATION

DATE: Monday 25th July, 2022   **TIME:** 11.00 a.m – 1.00 p.m

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 3 Printed Pages. Please Turn Over.

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Question One (30 Marks)

a. Define the following terms as applied in wireless communication engineering;
   i. Footprint [1 mark]
   ii. Frequency planning [1 mark]
   iii. Cluster [1 mark]
   iv. Coverage area [1 mark]
   v. Sectoring [1 mark]

b. Auctions are useful tools in deciding who can use the spectrum, but they need to be combined with liberalization. Give the *three* important assumptions to help decide the use that spectrum can be put to. [3 marks]

c. Name and explain the *three* basic methods of wireless signal propagation. [3 marks]

d. Explain, in your own words, the distinction between *average path loss, shadow fading,* and *multipath fading*. How are they related to one another? [4 marks]

e. Name and explain the *four* physical factors that influence small-scale fading in the radio propagation channel. [4 marks]

f. There are a number of good practical reasons why spread spectrum modulation is technically superior to the intuitively more obvious techniques such as AM and FM. Name and explain any five. [5 marks]

g. A cellular telephone system uses a 12-cell repeating pattern. There are 120 cells in the system and 20,000 subscribers. Each subscriber uses the phone on average 30 minutes per day, but on average 10 of those minutes are used during the peak hour. Calculate: [6 marks]
   i. the average and peak traffic in erlangs for the whole system
   ii. the average and peak traffic in erlangs for one cell, assuming callers are evenly distributed over the system
   iii. the approximate average call-blocking probability
   iv. the approximate call-blocking probability during the peak hour.

Question Two (20 Marks)

a. A vehicle travels through a cellular system at 100 kilometers per hour. Calculate the approximate time between handoffs if the cell radius is: [5 marks]
   i. 10 km
   ii. 500 m

b. Explain the purpose of power control in CDMA systems thus explain why CDMA offers universal reuse of channels, in which each channel can be used in all cells. [5 marks]

c. Draw and label the Single Optical Fiber Structure. [3 marks]

d. Explain Okumura's model for the base station-to-mobile signal attenuation. [3 marks]

e. Using a suitable diagram explain the operation of the Datagram Packet Switching Network. [4 marks]

Question Three (20 Marks)

a. Explain why bandwidth and power efficiency are important considerations in the design of mobile wireless systems. [3 marks]

b. Explain why constant-envelope modulation techniques preferred for use on radio channels for mobile communications, thus explain, why FM, rather than AM, was adopted for use with the first-generation AMPS. [4 marks]

c. Again referring to (b), explain why digital mobile wireless systems avoid using some form of QAM requiring multiple amplitude levels, despite the ability thereby to attain higher bit rates over the channels provided. [3 marks]

d. Calculate the maximum distance between base and mobile that can be accommodated with a guard time of 123 μs. [4 marks]

e. Using relevant illustration clearly explain the GSM Frame Structure. [6 marks]

Question Four (20 Marks)

a. Show that the European spectral allocation for GSM makes 992 channels available. [3 marks]

b. Calculate the maximum Doppler frequencies for a mobile in a van moving at 80kmph on Kakamega – Kisumu road, at 850 MHz and 1950 MHz. [3 marks]

c. Compare TDMA and CDMA schemes, identifying the advantages of each scheme over the other. [4 marks]

d. Consider the uplink of a GSM system, given GSM requires an S/N of 11 dB. Assume a maximum mobile transmit power of 1.0W (30dBm), 0 dBd antenna gain at the mobile, and 12dBd gain at the BS. Assume path loss given by the urban area Hata model, with f_c=850 MHz, BS antenna height of 30 meters, mobile height of 1 meter. Assume F=3dB and that the system is noise-limited. Calculate the maximum range of the link. [5 marks]

e. With the aid of a well labeled diagram explain the concept of frequency hopping in mobile communication systems. [5 marks]

Question Five (20 Marks)

a. Explain the distinction between *user information bit rate* and *transmission rate*. Thus show that the GSM user rate is 22.8 kbps while the transmission rate is 270.833 kbps. [4 marks]

b. Draw a diagram of a CDMA system and identify its major building blocks. [5 marks]

c. Wi-Fi is a trademarked term, owned by the Wi-Fi Alliance, to describe the IEEE 802.11 family of technical standards. List any *five*. [5 marks]

d. Name and explain any *six* commercial wifi strategies used as business models. [6 marks]