



(University of Choice)

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

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2022/2023 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: Friday 14th April, 2023

TIME: 9.00 a.m – 11.00 a.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. ►

Question One (30 Marks)

- a. Define the following terms as applied in communication engineering;
- i. Air Interface [1 mark]
 - ii. Microcell [1 mark]
 - iii. Picocells [1 mark]
 - iv. Roamer [1 mark]
 - v. Telepoint [1 mark]
- b. Name and explain the *three* basic methods of wireless signal propagation. [3 marks]
- c. 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]
- d. Auctions are useful tools in deciding who can use the spectrum, but they need to be combined with the ability to change use. Give the *three* important assumptions to auctions. [3 marks]
- e. Explain any *four* physical factors influence small-scale fading in the radio propagation channel. [4 marks]
- f. With the aid of a well labeled diagram explain the concept of frequency hopping in mobile communication systems. [5 marks]
- g. A cellular telephone system uses a 12-cell repeating pattern. There are 120 cells in the system and 15,000 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. Name and explain the *four* physical factors that influence small-scale fading in the radio propagation channel. [4 marks]
- b. Using a suitable diagram explain the operation of the Datagram Packet Switching Network. [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]

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. Citizens' band (CB) radio enjoyed great popularity in the 1970s, followed by an almost equally steep decline. Explain its limitations. [5 marks]
- e. Compare interference from the first tier of 6 interferers with that from 12 interferers (first and second tiers). [5 marks]

Question Four (20 Marks)

- a. Show that the European spectral allocation for GSM makes 992 channels available. [3 marks]
- b. Explain why bandwidth and power efficiency are important considerations in the design of mobile wireless systems. [3 marks]
- c. With the aid of a well labeled diagram explain the concept of frequency hopping in mobile communication systems. [5 marks]
- d. Calculate the maximum distance between base and mobile that can be accommodated with a guard time of 123 μ s. [4 marks]
- e. 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. Explain any *five*. [5 marks]

Question Five (20 Marks)

- a. A cordless phone operating at 49 MHz is to have a range of 50 m. Assuming 0 dBi gain for the antennas and the receiver sensitivity of 0.5 μ V, Calculate transmitter power required. [3 marks]
- b. 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]
- c. Draw a diagram of a CDMA system and identify its major building blocks. [5 marks]
- d. Two handheld CB transceivers are held 1 m above flat, level terrain. The transmitter power output is 4 W and the receiver sensitivity is 0.5 μ V into 50 Ω . The transmitting and receiving antennas are both loaded vertical monopoles with a gain of 1 dBi. Determine whether the maximum communication range is limited by power or distance. Assume there is no interference and that free-space attenuation applies. [8 marks]