



(University of Choice)

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

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS  
2021/22 ACADEMIC YEAR**

**FOURTH YEAR SECOND SEMESTER EXAMINATIONS**

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

**COURSE CODE: ECE 416  
COURSE TITLE: DIGITAL COMMUNICATION SYSTEMS**

**DATE: THURSDAY, APRIL, 28<sup>TH</sup>, 2022. TIME: 8:00 – 10:00 AM**

---

**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 1 (30 MARKS)**

- (a) (i)** What are the main differences between source coding and line coding?  
**(ii)** Given a binary sequence [0101010111] draw the corresponding waveforms for unipolar NRZ and polar quaternary NRZ.

*(4 marks)*

- (b)(i)** State four advantages of structured cabling for the design of digital communication systems.

- (ii)** Give four reasons why one would choose to use fibre optic cables and not copper cables in a digital communication system.

*(8 marks)*

- (c)** Assume an audio signal with 20 KHz bandwidth is to be transmitted using a binary PCM system of 256 quantization levels. Determine the following.

- (i)** The PCM code word length,  
**(ii)** Transmission bandwidth,  
**(iii)** The PCM stream bit rate,  
**(iv)** Signal to Quantization Noise Ratio.

*(4 marks)*

- (d) (i)** With the aid of a block diagram, describe how a delta modulation transmitter works

- (ii)** Name and discuss two types of signal distortion experienced in delta modulation.

- (iii)** What techniques are used in practice to minimize signal distortion in delta modulation?

*(8 marks)*

- (e)(i)** The address 43:7B:6C:DE: 10:00 has been shown as the source address in an Ethernet frame. The receiver has discarded the frame. Why?

- (ii)** A 10BaseT Ethernet MAC sublayer receives 1510 bytes of data from the upper layer. Can the data be encapsulated in one frame? If not, how many frames need to be sent?

- (iii)** What is the ratio of useful data to the entire packet for the smallest Ethernet frame? What is the ratio for the largest frame?

*(6 marks)*

### **QUESTION 2 (20 MARKS)**

**(a)(i)** In a binary PCM system, a '0' occurs with a probability of 0.25 and a '1' with a probability of 0.75. Calculate the amount of information carried by each bit.

**(ii)** A discrete source emits one of the five possible symbols once every millisecond with probabilities  $\frac{1}{2}$ ,  $\frac{1}{4}$ ,  $\frac{1}{8}$ ,  $\frac{1}{16}$  and  $\frac{1}{16}$  respectively. Determine the source entropy rate and the information rate.

*(8 marks)*

**(b) (i)** Name and describe the modulation scheme used in the original 1200 bps modem.

**(ii)** With the aid a block diagram, describe the principle of operation of the Integrated Services Digital Network (ISDN).

*(8 marks)*

**(c)** Two channels, one with a bit rate of 100 kbps and another with a bit rate of 200 kbps, are to be multiplexed.

(i) With the aid of a drawing, explain how this can be achieved?

(ii) What is the resulting frame rate?

(iii) What is the bit rate of the multiplexed link

*(4 marks)*

### **QUESTION THREE ( 20 MARKS)**

**(a) (i)** Name and discuss three types of quantization noise.

**(ii)** Describe the causes and effects of intersymbol interference in communication systems.

**(iii)** Assume that you are required to measure intersymbol interference on ethernet network. Name and describe a method that you will use if all you have is an oscilloscope.

*(8 marks)*

**(b) (i)** With the aid of a block diagram, describe the various elements that constitute a Synchronous Optical Network (SONET).

**(ii)** Calculate the data rate of an STS-9 in a SONET transmission system.

**(ii)** What is the user data rate, i.e data rate excluding overhead, in a STS-9 SONET network.

*(7 marks)*

**(c)(i)** The following bit streams are encoded using VRC, LRC and Even parity. Locate and detect the error(s) if present.

[1 1 0 0 0 0 1 1]

[1 1 0 1 0 0 1 1]

[1 0 1 1 0 0 1 0]

[0 0 0 0 1 0 1 0]

[1 0 1 0 1 0 1 0]

[0 0 1 0 1 0 1 1]

[1 0 1 0 1 0 1 1]

[0 1 0 0 1 0 1 1]

[1 1 1 0 0 0 0 1]

- (ii)** What are the problems associated with GO BACK N ARQ? Discuss how these problems are addressed in contemporary communication systems.

*(5 marks)*

**QUESTION 4 (20 MARKS)**

- (a) (i)** Name and discuss THREE types of uncompressed audio file formats.

- (ii)** With the aid of a block diagram, describe the various functional units of an MP3 encoder

*(8 marks)*

- (b)** With the aid of a diagram, describe the multiple access method used by IEEE 802.15.1 standard in order to avoid interference.

*(4 marks)*

- (c) (i)** Discuss two conditions that must be fulfilled for a communication system to be called spread spectrum.

- (ii)** With the aid of a drawing, discuss how frequency hopping spread spectrum system works.

- (iii)** A CDMA system working in the 850 MHz band uses a spreading factor of 64. If the baseband signal is sampled at 8 kb/s and each sample is coded as an 8-bit word, find the data rate at the output of the baseband subsystem.

*(8 marks)*