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(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2022/2023 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: 16TH DECEMBER, 2022 TIME: 12: 00 PM – 2:00 PM

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 desirable properties of a channel coding scheme?

(ii) Compare the performance of the following channel coding schemes.

(I) Polar RZ
(II) Polar NRZ
(III) Manchester

(5 marks)

(b) Use a table to highlight the differences between the multiple access schemes used in GSM and CDMA mobile communication networks.

(5 marks)

(c)(i) What are the advantages of fibre-optic cables over copper cables in digital communication?

(ii) Discuss the main reasons why structured cabling are used in the design of digital communication systems in commercial buildings.

(8 marks)

(d) An audio channel has bandwidth of 7.5 KHz. If the speech is sampled at the Nyquist rate before it is PCM coded with 256 quantization levels, determine the following:

(i) the PCM code word length,

(ii) Transmission bandwidth,

(iii) the PCM stream bit rate, and

(iv) Signal to Quantization Noise Ratio.

(8 marks)

(e)(i) With the aid of a block diagram, describe how a differential PCM transmitter works.

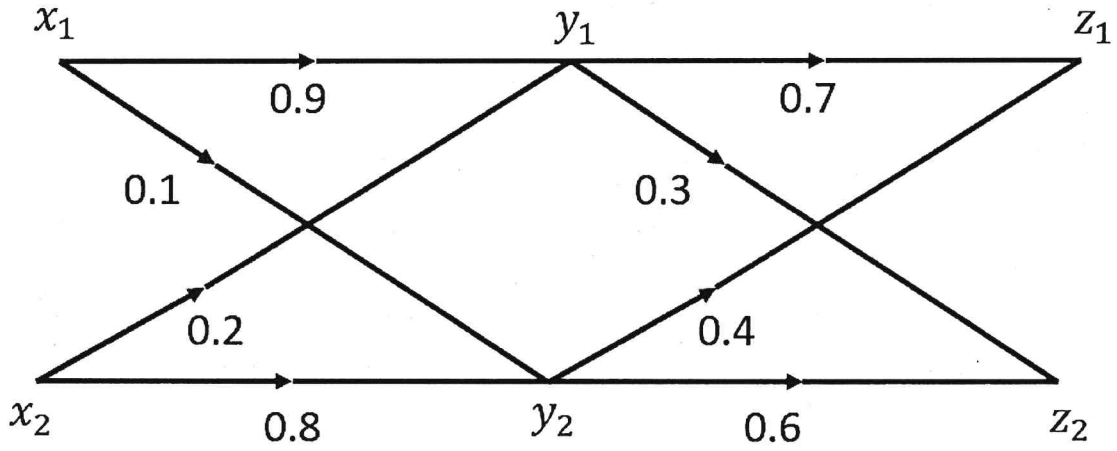
(ii) Name and discuss two types of signal distortion experienced in delta modulation.

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

(4 marks)

QUESTION 2 (20 MARKS)

(a) Two binary channels are connected in series as shown in the diagram below.



(i) Calculate the overall channel matrix

(ii) Draw the resultant equivalent channel diagram.

(8 marks)

(b) 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 following.

(i) Entropy

(ii) Information rate.

(6 marks)

(c) Calculate the uplink and downlink frequencies of the following Absolute Radio Frequency Channel numbers (ARFCNs) in a GSM network.

(i) 119
(ii) 600
(iii) 1000

(6 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.

(6 marks)

(c)(i) Seven-bit consecutive data frames, each of one byte, are encoded using VRC, LRC and Even parity as shown below. Locate and detect 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.

(6 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 multiple access method used by Bluetooth 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)