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(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

SPPLIMENTARY/SPECIAL EXAMINATIONS 2021/2022 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 II

DATE: Thursday, 6th October,2022 **TIME:** 12-2pm

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 ONE (30 MARKS)

(a) Assume a TV signal having a bandwidth of 4.2MHz is to be transmitted using binary PCM system using 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 (SQRN)

(12 marks)

(b) Assume that you are tasked to design a PCM system to transmit an analogue signal with an accuracy of ±0.2% at full scale. If the signal has bandwidth of 20 Hz - 12,000Hz and amplitude range of ±10volts, calculate:

(i) The number of bits in each PCM word.
(ii) The minimum bit rate of the PCM system.

(6 marks)

(c) (i) Calculate the amount of information is a PCM system in which the binary digits occur with the same equal probabilities.

(ii) An analog signal is band-limited at 8KHz and is quantized in 8 levels $\{x_1, x_2, x_3, .. x_8\}$ with probabilities $P(x_1)= ¼$, $P(x_2)=1/5$, $P(x_3)=1/5$, $P(x_4)=1/5$, $P(x_5) =1/10$, $P(x_6)=1/10$, $P(x_7)=1/20$ and $P(x_8)= 1/20$. If the signal is sampled at 20 Kbps, find the entropy and the rate of information. *(4 marks)*

(6 marks)

(d) (i) Describe the causes and effects of intersymbol interference in communication systems.

(ii) Describe a commonly used method for analysing intersymbol interference in the laboratory.

(6 marks)

QUESTION TWO (20 MARKS)

(a) A Discrete memoryless system is encoded as shown below. Calculate:

(I) Code efficiency
(II) Code redundancy

a_i	$P(a_i)$	Code
a_1	0.71	0
a_2	0.20	10
a_3	0.05	110
a_4	0.04	111

(6 marks)

(b) Draw the baseband coding waveforms for the bit sequence 1100110 for the following digital baseband coding schemes:

(I) AMI
(II) Split Phase Manchester
(III) M-ary with M=4

(6 marks)

(c) A discrete source produces five independent symbols with probabilities $P(x_1)=0.4$, $P(x_2)=0.19$, $P(x_3)=0.16$, $P(x_4)=0.15$, $P(x_5)=0.1$.

(i) Design a Shannon-Fano code for the system

(ii) Calculate the Code efficiency

(8 marks)

QUESTION THREE (20 MARKS)

(a)(i) Calculate the data rate of an STS-9 in a Synchronous Optical Network (SONET) transmission system.

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

(10 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 to copper cables in a digital communication systems.

(10 marks)

QUESTION FOUR (20 MARKS)

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

(ii) With the aid of a diagram, describe the operation of a FTTH Triple play system.

(10 marks)

(b) (i) With the aid a block diagram, describe the operation of the Integrated Services Data Network (ISDN).
(ii) Describe a simple system that can be used to multiplex TDM data streams onto a fibre optic cable.

(10 marks)