



(University of Choice)

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

**MAIN CAMPUS**

**UNIVERSITY EXAMINATIONS  
2017/2018 ACADEMIC YEAR**

**FOURTH YEAR FIRST SEMESTER EXAMINATIONS**

**FOR THE DEGREE  
OF  
BACHELOR OF SCIENCE IN MECHANICAL AND INDUSTRIAL  
ENGINEERING**

**COURSE CODE: ECE 416**

**COURSE TITLE: DIGITAL COMMUNICATION SYSTEMS**

**DATE: 16<sup>th</sup> May, 2018**


**TIME: 09.00-11.00 a.m**

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**INSTRUCTIONS TO CANDIDATES**

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.  
QUESTION ONE CARRIES 30 MARKS AND ALL OTHERS 20 MARKS EACH.

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over. 



### QUESTION ONE (30 MARKS)

(a) (i) What are the main differences between source coding and channel coding?

(ii) Given a binary sequence [0101010111] draw the corresponding waveforms for unipolar NRZ and polar quaternary NRZ.

(iii) Draw a flow-chart and write the corresponding Matlab code to generate and display Unipolar NRZ and polar quaternary NRZ signals for a bit stream given [1 1 0 1 1 0 0 1 1 1].

(8 marks)

(b) Assume a TV signal with 4.2MHz bandwidth is to be transmitted using a binary PCM system of 256 quantization levels. Determine the following:

- 6/
- (i) the PCM code word length,
  - (ii) Transmission bandwidth,
  - (iii) the PCM stream bit rate,
  - \*iv) Signal to Quantization Noise Ratio.

(8 marks)

(c) (i) Name and discuss three types of quantization noise found in a PCM system.

(ii) An analog signal is band-limited at 8KHz and is quantized in 8 levels

6/  $\{x_1, x_2, x_3, \dots, x_8\}$  with probabilities  $P(x_1) = \frac{1}{4}$ ,  $P(x_2) = \frac{1}{5}$ ,  $P(x_3) = \frac{1}{5}$ ,  $P(x_4) = \frac{1}{5}$ ,  $P(x_5) = \frac{1}{10}$ ,  $P(x_6) = \frac{1}{10}$ ,  $P(x_7) = \frac{1}{20}$  and  $P(x_8) = \frac{1}{20}$ . If the signal is sampled at 20 Kbps, find the entropy and the rate of information.

(6 marks)

2/ (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.

4/ \*(iii) A Delta modulator operates at five times the Nyquist rate in a transmission channel whose bandwidth is 3 KHz. If the delta modulation step size is set at 100mV, calculate the maximum amplitude of a sinusoidal signal of 2 KHz that ensures that there is no slope distortion. Derive the formula that you use.

(8 marks)



**QUESTION TWO (20 MARKS)**

(a) A Discrete memoryless system is encoded as shown in the table 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

Step 1:  $0.71 \times 2 = 1.42$   
 $0.20 \times 2 = 0.4$   
 $0.05 \times 2 = 0.1$   
 $0.04 \times 2 = 0.08$   


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 $1.42$   
 $0.4$   
 $0.1$   
 $0.08$   


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 $1.92$   
 $0.4$   


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 $1.52$   
 $0.4$   


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 $1.12$   
 $0.4$   


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 $0.72$   
 $0.4$   


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 $0.32$   
 $0.4$   


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 $0.02$   
 $0.4$   


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 $0.02$

(8 marks)

(b) (i) Describe the principle of operation of the DTMF telephone

(ii) What are the advantages of DTMF phone over the dial pulse phone?

(6 marks)

(c) A discrete memoryless Source (DMS) has five equally likely symbols.

(i) Construct the Shannon-Fano code in tabular form;

(ii) Calculate the efficiency of the code.

(6 marks)

**QUESTION THREE (20 MARKS)**

3(a) (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) With the aid of a diagram, define the term spreading factor in a CDMA system.

(7 marks)

(b) (i) What are that factors that motivated the development Asymmetrical Digital Subscriber Line (ADSL) systems?

(ii) Assuming that a ADSL system is used to deliver telephone and internet traffic to an office, answer the following.

(I) Using a block diagram, describe the various components in such a system.

(II) What is the maximum up-link speed that can be supported on the ADSL system?

00  
10  
010  
011  
1100

0  
010  
0110  
111

0110  
0101  
0010  
0011  
0100

(6 marks)



(c)(i) State three advantages of structured cabling for the design of wired communication systems in buildings.

(ii) Give four reasons why one would choose to use fibre optic cables to copper cables in a structured cabling system.

(7 marks)

**QUESTION FOUR (20 MARKS)**

3/ (a) (i) With the aid of a diagram describe a Plesiochronous Digital Hierarchy (PDH) system that can carry over 7,000 telephone voice channels.

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

(10 marks)

(b) The GSM system band in the 1800 MHz occupies the frequency range 1710 – 1785 MHz and 1805– 1880 MHz.

2/ (i) What is the duplex frequency?

(ii) How many ARFCNs does the system support?

(4 marks)

5/ (c) (i) With the aid of a block diagram, describe the various elements that constitute a SONET network.

(ii) What is the duration of a ST-3 frame in a SONET system?

(6 marks)