



**THE KENYA POLYTECHNIC UNIVERSITY  
COLLEGE**

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**DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING**

**HIGHER DIPLOMA IN ELECTRICAL ENGINEERING**

**END OF YEAR II EXAMINATIONS**

**NOVEMBER 2007**

**DATA COMMUNICATION**

**3 HOURS**

**INSTRUCTIONS TO CANDIDATES:**

You should have the following for this examination:

Answer booklet

Non-programmable calculator/ New Mathematical tables

Answer any FIVE of the following EIGHT questions.

All questions carry equal marks and the maximum marks for each part of a question are as shown.

This paper consists of 5 printed pages.

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1. (a) Explain the following phases of circuit switching:
- (i) Circuit establishment
  - (ii) Data transfer
  - (iii) Circuit disconnection
- (3 marks)

(b) A data packet transmission network has the following characteristics:

Request packet length	=	10 bits
Acknowledgement packet length	=	10 bits
Data packet length	=	500 bits
Number of packets transmitted	=	1000
Propagation delay	=	100ms
Node delay	=	1s
Transmission bit rate	=	9.6kbps

There are 50 nodes in the network which has a total length of 5km. Find the effective overall data rate for the network. (7 marks)

- (c) (i) Show how the X.25 protocol suite maps on the OSI model, explain the function of each of the layers of the X.25
- (ii) Explain the advantages of Frame relays network over the X.25 network. (10 marks)

2. (a) Distinguish between baseband and broadband local area networks (LANs). (4 marks)

- (b) (i) For the pure ALOHA system show that the maximum throughput is 0.184.
- (ii) For the pure ALOHA in (i) sketch a graph of the throughput against offered load. Explain the shape of the graph.
- (c) (i) Explain the improvement of the carrier sense Multiple Access with collision detection (CSMA/CD) over the pure ALOHA.
- (ii) An Ethernet having a transmission rate of 10Mbps has a total network length of 1.5km and a propagation speed of 200m/ $\mu$ s. The data packets are 512 bits long and include 32 bits header, checksum and other overheads. An acknowledgement packet of 32 bits is sent

after a data packet is received. Find the effective data rate for the information contained in the packet (i.e. excluding the packets).

3. (a) Describe the function of the following OSI layers:
- (i) Physical (ii) Data-link (4 marks)
- (b) At the transmitter a polynomial  $x^{12} + x^6 + x^4 + x$  is used to prepare a CRC for a transmitted data frame. If the message to be transmitted is  $x^7 + x^3 + x^2 + 1$ , determine the transmitted codeword. (6 marks)
- (c) (i) Distinguish between bit oriented and character oriented data link protocol.
- (ii) Explain the operation of the High Level Data Link control Protocol (HDLC)
- I. Frame structure II. Link establishment (10 marks)
4. (a) (i) Distinguish between synchronous and asynchronous transmission.
- (ii) A modem transmits using an eight-level signaling technique. If each signaling element has a duration of 0.8333ms, determine the:
- I. Band rate II. Bit rate (8 marks)
- (b) (i) Distinguish between an eye-pattern and a signal space diagram.
- (ii) Explain the use of eye-pattern display to determine the extent of inter symbol interference.
- (iii) For a 2400bits/s [4 phase, 2 amplitudes], calculate the:
- I. Line band rate II. Minimum bandwidth
5. (a) Distinguish between secret key and public key algorithms as applied to network security. (4 marks)
- (b) Describe the DES C data Encryption Standard. (6 marks)
- (c) A message source selects messages from a set of six messages having the following priori probabilities of occurrence. Derive the Huffman code for the messages. (10 marks)

Message	Probability of occurrence
M <sub>0</sub>	0.5
M <sub>1</sub>	0.3
M <sub>2</sub>	0.1
M <sub>3</sub>	0.05
M <sub>4</sub>	0.03
M <sub>5</sub>	0.02

6. (a) Describe the stop and wait ARQ. (4 marks)
- (b) A half-duplex point-to-point satellite transmission link connecting two computers uses a stop and wait ARQ strategy and has the following characteristics:

Data transmission rate	=	4.8kbps
Frame size, n	=	2040 bits
Information bits per frame, k	=	1920
Propagation delay, t <sub>d</sub>	=	250ms
Acknowledgement size	=	48 bits
Round trip processing delay, t <sub>p</sub>	=	25ms

Calculate the:

- (i) Total time to transmit a frame and receive the acknowledgement.
- (ii) Throughput
- (iii) Link utilization (7 marks)
- (c) Using as an example a user at a terminal establishing a half-duplex connection through a PSTN to carry out a transaction involving the exchange of data between the terminal, derive a time sequence diagram to show the use of each line of the RS 232/V24 interface. (9 marks)
7. (a) State and explain any FOUR advantages of Local Area Networks (LANS). (8 marks)
- (b) Describe the operation of the following in computer communication:
- (i) Client/server networks (ii) Peer-to-peer networks (6 marks)
- (c) Describe the following internetworking terms:

- (i) Internet
  - (i) Intranet
  - (iii) End system (6 marks)
8. (a) (i) Explain the following security threats to data networks:
- I. Passive
  - II. Active
- (ii) Outline the counter measures taken in case (I) and (II) above. (10 marks)
- (b) (i) Explain the need of digital-to-digital encoding of baseband signals.
- (ii) The binary word 101001101 is to be transmitted over a baseband channel. Draw on the same axes, the resultant waveform if the following encoding schemes are used:
- I. Manchester
  - II. Differential Manchester
  - III. Bipolar NRZ (6 marks)
- (c) Describe the following types of transmission impairments:
- (i) Delay distortion
  - (ii) Cross-talk (4 marks)