



**THE KENYA POLYTECHNIC**

**ELECTRICAL/ELECTRONICS ENGINEERING**

**DEPARTMENT**

**HIGHER DIPLOMA IN ELECTRICAL ENGINEERING**

**END OF YEAR II EXAMINATIONS**

**NOVEMBER 2006**

**DATA COMMUNICATION**

**3 HOURS**

**INSTRUCTIONS TO CANDIDATES:**

You should have the following for this examination:

Answer booklet

Calculator/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) Define the following terms as used in data transmission:
  - (i) Data element
  - (ii) Signal element (2 marks)
- (b) With the aid of waveforms, explain each of the following data coding techniques:
  - (i) Bi-polar return-to-zero
  - (ii) Differential ManchesterFor the data 011 0011 00011 (6 marks)
- (c) Draw the resulting waveforms when the data 00110100010 is used to modulate a sine wave using the following schemes:
  - (i) On-off-keying
  - (ii) Frequency-shift keying
  - (iii) Phase-shift keying (8 marks)
- (d) Determine the bandwidth of a channel when data is transmitted at 300bps using each of the following schemes:
  - (i) ASK
  - (ii) FSK with frequency deviation 100Hz (4 marks)
2. (a) Outline any FOUR services offered by the session layer. (4 marks)
- (b) Describe the functions of the following ISO communication layers in an open systems interconnection environment:
  - (i) Network layer
  - (ii) Transport layer. (8 marks)
- (c) Draw a functional block diagram of an ISDN. (8 marks)
3. (a) (i) Distinguish between circuit switching and message switching.
- (ii) With respect to data transmission, state any THREE advantages of message switching over circuit switching. (5 marks)
- (b) Explain the following methods of movement of packets through a packet-switched network:
  - (i) Per call routing
  - (ii) Per packet routing (6 marks)

(c) A message of B bits is to be relayed from one to another of a series of computers over K data links. If the overhead bits are 'b' and the bit duration is  $1/f$ , derive:

- (i) The total time ( $T_m$ ) required for transmission of the message without packetizing.
- (ii) Minimum time ( $T_{pmin}$ ) required for transmission of the message when divided into packets.

Neglect the propagation delay over the links. (9 marks)

4. (a) Explain how forward error correction codes are used. (3 marks)
- (b) The information to be transmitted is given as 101101010. If the generator polynomial is  $x^7 + x^5 + x^3 + x^2 + 1$ :
- (i) Determine the transmitted frame (code word).
  - (ii) Show how an error may be detected at the receiver if a noise passed causes the four least significant bits to assume a logic 1.  
(Assume cyclic redundancy check). (9 marks)
- (c) (i) An equipment used Hamming parity bit check sum in the forward error correction mode. Determine the transmitted frame if the message is 1101101.
- (ii) If the message bit at the middle arrives in error, show analytically that an error occurred at that bit position. (8 marks)
5. (a) State any THREE factors that should be considered when selecting a Local Area Network for a given application. (3 marks)
- (b) Describe base band coax as applied to Local Area Networks. (4 marks)
- (c) (i) With the aid of a labeled diagram, explain the principle of operation of a token ring Local Area Network.
- (ii) A token passing through a ring LAN connected to 10 stations has an average time to transmit a frame of  $20\mu s$ . If the average time for a frame to go through a station is  $6\mu s$ , determine the maximum normalized propagation delay. (13 marks)

6. (a) (i) State THREE advantages of optical fibre over coaxial cable.  
(ii) With the aid of a diagram explain how an optical signal is transmitted over a graded index multimode optical fibre.  
(9 marks)
- (b) Describe with the aid of characteristic curves how delay distortion occurs in a voice grade channel.  
(6 marks)
- (c) Two microwave antennas are installed for line-of-sight transmission. If the transmission loss is 40dB and frequency of propagation is 10GHz, calculate the distance between the two antennas.  
(5 marks)
7. (a) With reference to computer security state any TWO types of each of the following attacks:  
(i) Passive  
(ii) Active (4 marks)
- (b) (i) With the aid of a diagram explain the conventional data encryption.  
(ii) State the main difference between the public key encryption and conventional encryption.  
(11 marks)
- (c) A public key encryption is to be developed for a plain text block of  $M=19$ . The public key used is  $(5, 119)$ . Two prime numbers  $p=7$  and  $q=17$  are chosen to develop the key. Determine:  
(i) Ciphertext block (C) (ii) The private key (KR) (5 marks)
8. (a) Distinguish between synchronous times division multiplexing (TDM) and asynchronous TDM.  
(2 marks)
- (b) Describe the five elements of the High Level Data Link Control (HDLC) transmission frame.  
(5 marks)

(c) For a statistical multiplier,  $N=100$ ,  $R=100\text{bps}$ ,  $\alpha=4$ ,  $M=5000\text{bps}$

Where:

$N$	=	Number of input sources
$R$	=	Data rate of each source
$M$	=	Effective capacity of multiplexed lines
$\alpha$	=	Mean fraction of time each source is transmitting.

Determine:

- (i) Compression,  $K$
  - (ii) The utilization link ( $e$ )
  - (iii) The service time ( $s$ )
  - (iv) The number of devices a synchronous multiplexer would handle having the same link capacity. (8 marks)
- (d) An ASCII character is to be transmitted asynchronously between two DTEs. With the aid of a diagram explain how transmission is implemented. (5 marks)