2203/302
DATA COMMUNICATION
Oct./Nov. 2008
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN TELECOMMUNICATION ENGINEERING

DATA COMMUNICATION

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet
Mathematical tables/calculator

*Answer any **FIVE** of the following **EIGHT** questions.*
Each questions carry equal marks.

This paper consists of 6 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and no questions are missing.

1. (a) With the aid of a block diagram, describe the essential components of an optical fiber transmission system. (10 marks)

(b) For a fiber transmission system with the following data, determine the maximum fiber length possible.

Transmitter output	:	- 6 dBm
Receiver sensitivity	:	- 60 dBm
Fiber loss	:	4.0 dB/km
Connectors	:	One interconnection every 2 km; 1 dB loss per splice connection
Margin	:	6 dB

(6 marks)

(c) A signal having a range from -5 V to 5 V is sampled and digitized to an accuracy of 4 bits. Determine the quantizing rms error voltage. (4 marks)

2. (a) (i) Distinguish between data rate and modulation rate.

(ii) Data is to be transmitted using a modem at 9600 bits/sec. If the system uses a 16 - QAM modulation scheme:

I draw the constellation diagram;

II determine the minimum bandwidth. (9 marks)

(b) (i) Explain the meaning of scrambling as applied to data encoding schemes.

(ii) Encode 11100011 using

I Manchester

II Differential Manchester (6 marks)

(c) A data signal consists of binary pulses occuring at the rate of 800 bits per second. This signal is to be transmitted over a telephone line using FSK with binary 0 as a 2.8 KHZ tone and binary 1 as a 1.5 KHZ tone. Determine the:

(i) bandwidth of the transmitted signal;

(ii) required upper and lower cut-off frequencies of the telephone line. (5 marks)

3. (a) Describe the forward error control scheme. (2 marks)

(b) (i) A series of 8-bit message block 11100110 is to be transmitted. Using a Cyclic Redundancy Check (CRC) with a generator polynomial of 11001, determine the transmitted code-word.

(ii) A Stop and Wait error control system has a frame size of 2400 bits and a bit rate of 4800 bps. The distance between the devices is 2000 km and the speed of propagation over the transmission link is 200 000 km/s. Determine the line utilization efficiency. (12 marks)

(c) With the aid of time sequence diagrams, describe how the following are overcome in a Stop and Wait error control scheme:

(i) a lost ACK frame;

(ii) a lost information frame. (6 marks)

4. (a) Define the following interfaces:

(i) Balanced;

(ii) Unbalanced. (2 marks)

(b) With the aid of a diagram, illustrate the internal connections of a null modem explaining the purpose of each connection. (11 marks)

(c) (i) A DTE is connected to a modem through a 20 mA current loop interface. The distance of separation is 1 km at a data rate of 20 kbps. If the transmission speed is increased to 100 kbps, determine the new separation distance for the same transmission quality.

(ii) A modem transmits data over an analog line of bandwidth 3300 Hz. The signal to noise ratio over the line is 30 dB. Calculate the maximum channel capacity. (7 marks)

5. (a) Distinguish between switching and routing as used in local area networks. (2 marks)

(b) Compare and contrast circuit-switching and virtual packet switching. (4 marks)

(c) A circuit switched network has an average length of 500 km between a given pair of end-stations and passes through 50 nodes across the network. Each node requires a set up time of 20 mS. Assuming a data rate of 10^4 bps and a propagation velocity of 2×10^8 m/s,

(i) determine the total time required to transmit a message of length

I 10^6 bits;
II 10^3 bits.

(ii) I Determine the efficiency of (c) (i).
II Comment on the efficiency of the process in (ii) I.
(14 marks)

6. (a) State the function of the following network devices:

(i) hub;

(ii) switch;

(iii) gateway. (3 marks)

(b) (i) With the aid of a diagram, describe the X.25 protocol suite, showing how it maps on the OSI reference model.

(ii) State the disadvantage of the X.25 packet switched network and explain a possible solution. (9 marks)

(c) (i) Describe polling as used in data networks.

(ii) In a network connection operating in half duplex mode, a poll and its response takes eight octets. The network data rate is 9600 bps and the modem connection time is 10 mS. Determine:

I the number of polls per second if there is no data to send;

II the average delay time required to send a data message of 100 octets from the last of eight secondary stations to the primary station. (8 marks)

7. (a) State any **three** communication functions performed at the presentation layer of the OSI reference model. (3 marks)

(b) Draw the High Level Data Link Control (HDLC) protocol frame and describe the functions of each field. (8 marks)

(c) (i) State the data - rates of the following ISDN channels:

I B
II D
III H

(ii) A private organization has a PABX unit capable of operating from the ISDN primary rate access system. The equipment served by this system includes:

80 telephone channels each of 64 kbps;
50 data channels of 2.4 kbps of high priority;
150 data channels of 1.2 kbps of low priority.

Determine the total number of primary rate access channels required. (9 marks)

8. (a) (i) State any **one** characteristic of each of the following multiplexing schemes:

I Statitistical;

II Synchronous.

(ii) A company is connected to an Internet Service Provider (ISP) through a high speed E_1 link. Assuming all the company's computers transmit at 64 kbps.

I Determine the number of computers that can transmit simultaneously using synchronous TDM.

II Explain the effect of using statistical TDM in I. (7 marks)

(b) (i) State any **two** factors to consider when selecting a cable for data transmission.

(ii) Explain how fire hazards can be minimized in LAN installation. (6 marks)

(c) (i) State any **two** features of baseband local area networks.

(ii) A baseband bus LAN, 1 km in length has a number of equally spaced stations with a node spacing of 2.5 m. The data rate is 10 Gbps and the bus propagation speed is 2×10^8 m/s. Determine:

I the time to send a frame of 1000 bits between the farthest stations;

II the duration it takes in seconds, before a station notices an interference if two adjacent stations begin to transmit at exactly the same time. (7 marks)