2209/302
DATA COMMUNICATIONS
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Time: 3 hours

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THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN INFORMATION TECHNOLOGY
MODULE III

DATA COMMUNICATIONS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
    Answer booklet;
    Mathematical tables/scientific calculator.
Answer any **FIVE** *of the following* **EIGHT** *questions in this paper.*
All questions carry equal marks.
Maximum marks for each part of a question are as indicated.

This paper consists of 5 printed pages.

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

Turn over

1. (a) Define each of the following with respect to data communication:

   (i) half-duplex;

   (ii) data terminal equipment.

   (2 marks)

   (b) With the aid of a diagram, describe point-to-point communication system.

   (4 marks)

   (c) (i) Explain the reasons for twisting conductors in a twisted-pair copper wire cable.

   (ii) With the aid of a diagram, describe the construction of a fibre optic cable.

   (8 marks)

   (d) With the aid of waveforms, describe amplitude modulation. (6 marks)

2. (a) Describe **three** factors used to evaluate digital-to-digital encoding techniques.

   (6 marks)

   (b) For the data stream 11001010, draw the waveform if the following signalling formats are used for transmission:

   (i) bipolar RZ;

   (ii) manchester.

   (6 marks)

   (c) Explain the reasons for choosing each of the following coding methods with respect to data communication; giving an example in each case:

   (i) digital data to analogue signal;

   (ii) analog data to digital signal.

   (4 marks)

   (d) An audio signal with spectral components in the range 300 - to 3000 HZ is sampled at a rate of 7000 samples per second to generate a PCM signal.

   Determine the:

   (i) number of uniform quantisation levels if the SNR = 30 dB;

   (ii) data rate.

   (4 marks)

3. (a) With the aid of a labelled block diagram, describe frequency division mulliplexing (FDM). (5 marks)

(b) A character interleaved time division multiplexer is used to combine the data streams of a number of 220 - bps asynchronous terminals for data transmission over a 4800 bps data line. Each terminal sends asynchronous characters consisting of 7 data bits, 1 parity-bit, 1 start bit and 2 stop bits. Assume that 4% of the line capacity is reserved to accommodate speed variation from various terminals.

    (i) Determine the number of:

        I. bits per character;

        II. terminals that can be accommodated by the multiplexer.

    (ii) Sketch a possible data frame for the multiplexer.

(9 marks)

(c) A university has two locations: main campus and a constituent college located 30 km away. The college has four 300 - bps terminals that communicate with the central computer facilities over leased lines. The university is considering installing a Time Division Multiplexing (TDM) equipment so that only one leased line would be needed. Explain the factors that should be considered in the decision.

(6 marks)

4. (a) Describe each of the following switching methods:

    (i) circuit;

    (ii) message.

(6 marks)

(b) Explain the:

    (i) difference between datagram and virtual circuit operation;

    (ii) advantage and disadvantage of frame relay compared to X.25.

(8 marks)

(c) Describe any **three** fields in an ATM cell. (6 marks)

5. (a) Sketch the OSI network model and state the purpose of each layer. (9 marks)

(b) State the channels and the data rates for each of the following ISDN accesses:

    (i) basic;

    (ii) primary.

(4 marks)

(c) (i) Describe, with the aid of a diagram, the stop-and-wait automatic repeat request (ARQ) flow control.

(ii) A cyclic redundancy check (CRC) is constructed to generate a 4-bit frame check sequence (FCS) for an 11-bit message, 10011011100. Using the generator polynomial $x^4 + x^3 + 1$ determine the encoded data bit sequence. (7 marks)

6. (a) State **three** functions performed by each of the following in a LAN:

(i) MAC layer;

(ii) switch.

(6 marks)

(b) Describe the CSMA/CD medium control protocol. (4 marks)

(c) (i) Define the following network routing types:

I. fixed;

II. flooding.

(ii) State **three** disadvantages of adaptive network routing. (5 marks)

(d) (i) Distinguish between an access point and a portal in wireless LANs.

(ii) State **three** transmission modes for infra-red LAN.

(5 marks)

7. (a) (i) State any **three** factors to consider when choosing a routing algorithm.

(ii) Describe the optimal-cost routing algorithm.

(iii) A packet-switched network has N-nodes.
Determine the average number of hops between stations of the network if connected by the following topologies:

(I) star;

(II) loop;

(III mesh.

(b) Distinguish between passive and active security threats.

(c) Describe **three** approaches to message security.

(8 marks)

8. (a) (i) State **two** factors which influence the choice of carrier frequency and the bandwidth used by the demodulator section of a MODEM.

(ii) With the aid of a diagram, describe the 20 mA current loop.

(iii) Draw a diagram showing the internal interconnections within a NULL MODEM and explain the significance of each connection. (12 marks)

(b) (i) Explain the significance of a DNS server in email services.

(ii) In relation to electronic mail, explain the function of each of the following:

I. Simple Mail Transfer Protocol (SMTP);

II. Post Office Protocol (POP).

(8 marks)