

2506/306

2507/306

DATA AND COMPUTER NETWORKS

Oct. / Nov. 2017

Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN AERONAUTICAL ENGINEERING
(AIRFRAMES AND ENGINES OPTION)
(AVIONICS OPTION)

MODULE III

DATA AND COMPUTER NETWORKS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet;

Non-programmable scientific calculator.

This paper consists of EIGHT questions.

Answer FIVE questions.

ALL questions carry equal marks.

Maximum marks for each part of a question are shown.

Candidates should answer the questions in English.

This paper consists of 6 printed pages

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

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Turn over

1. (a) Differentiate between data rate and signal rate with respect to data communication. (2 marks)
- (b) With the aid of a labelled block diagram, explain the half-duplex mode of data communication citing an example. (7 marks)
- (c) With the aid of a block diagram, explain the parallel data transmission mode. (7 marks)
- (d) A signal carries three bits in each element and 1200 signal elements are sent per second. Calculate the:
- (i) band rate;
 - (ii) bit rate.
- (4 marks)
2. (a) State **two** advantages of bipolar codes over unipolar codes. (2 marks)
- (b) A bit stream has the binary sequence 1 1 0 0 0 0 1 0 1, draw its encoded signal when using the following schemes:
- (i) HDB3;
 - (ii) Manchester.
- (6 marks)
- (c) With the aid of waveforms, describe the phase shift keying (PSK) modulation technique. (7 marks)
- (d) A binary frequency shift keying signal has a mark frequency of 49 kHz and a space frequency of 51 kHz. If the input bit rate is 2 kps, determine the:
- (i) peak frequency deviation;
 - (ii) minimum bandwidth;
 - (iii) band rate.
- (5 marks)
3. (a) Define the following sampling techniques as applied in Pulse Code Modulation(PCM):
- (i) natural sampling;
 - (ii) flat sampling.
- (2 marks)
- (b) With the aid of a schematic block diagram, state the functions of each of the components of a delta-modulator. (8 marks)

- (c) A PCM system with a sampling rate of 2 samples/second uses 3 bits. Determine the:
- (i) signaling rate;
 - (ii) number of quantization levels.
- (4 marks)
- (d) With the aid of a block diagram, explain the operation of a PCM receiver.
- (6 marks)
4. (a) State any **three** causes of errors in data communication.
- (3 marks)
- (b) A data unit transmits a bit stream: 1 1 0 0 0 1 1 0 1 0 1 1 0 1 0 0 0. If the divisor constant for error detection is 1 0 0 1 1, compute the Cyclic Redundancy Check (CRC) character for the message.
- (6 marks)
- (c) (i) Explain the Hamming code error correction method.
- (ii) An ASCII synchronous message contains characters "value". Calculate the number of Hamming bits required when using the Hamming code error correction codes.
- (11 marks)
5. (a) Define each of the following in relation to data networks:
- (i) connectionless;
 - (ii) routing table.
- (2 marks)
- (b) With the aid of a diagram, explain the process of a circuit switched network communication.
- (8 marks)
- (c) With the aid of a diagram, explain Time-Division Multiplexing (TDM).
- (6 marks)
- (d) A serial transmission T1 uses 8 information bits, 2 start bits, 1 stop bit and 1 parity bit for each character. If the bit rate is 1200 bits/second. Calculate the:
- (i) total number of bits per character transmitted;
 - (ii) information transfer rate.
- (4 marks)
6. (a) State **four** roles of the Institute of Electrical and Electronic Engineers (IEEE) in computer networking.
- (4 marks)
- (b) With the aid of a sketch, explain the Ring topology Local Area Network (LAN).
- (8 marks)

(c) Explain the functions of each of the following networking devices:

- (i) repeaters;
- (ii) hubs.

(4 marks)

(d) Figure 1 shows a layout of a computer network used by an airlines agent:

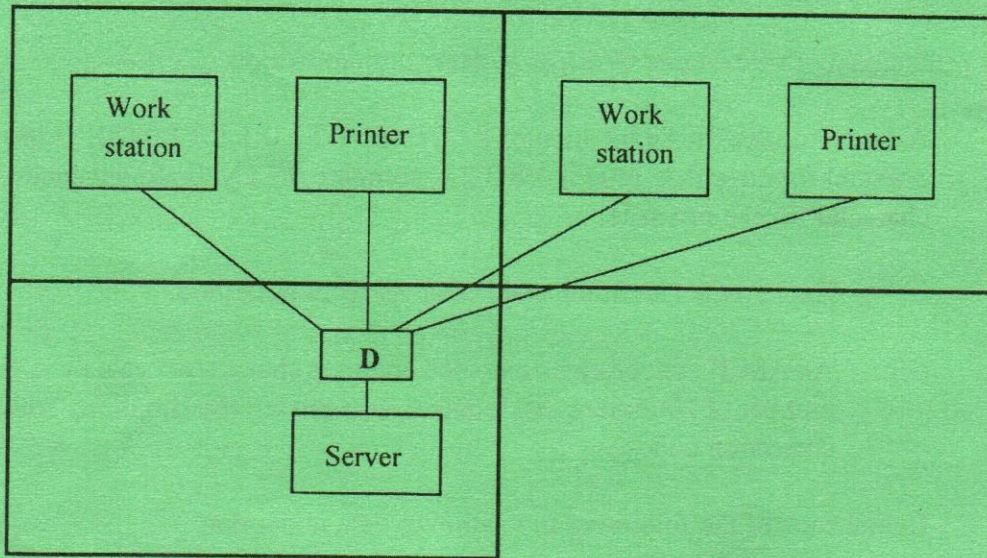


Fig. 1

- (i) Identify the network topology depicted in the diagram; *Star*
- (ii) name the device labelled D;
- (iii) state **two** functions of the device labelled "server".

(4 marks)

7. (a) Explain the following in relation to wireless local area networks:

- (i) Service Set Identifier (SSID);
- (ii) beacon stuffing.

(4 marks)

(b) With the aid of a labelled block diagram, explain the process of data authentication in a private wireless LAN.

(8 marks)

(c) Describe the following in relation to computer networks:

(i) carrier sense multiple access/ collision avoidance (CSMA/CA) media access protocol;

(ii) Virtual Private Network (VPN).

(8 marks)

8. (a) Distinguish between JPEG and MPEG compression standards.

(2 marks)

(b) Describe the lossless data compression technique.

(4 marks)

(c) Outline the procedure of the Shannon-fano encoding algorithm as applied in data compression.

(6 marks)

(d) Table 1 shows a data file composed of characters and their corresponding frequencies.

Table 1

| Character | Frequency |
|-----------|-----------|
| A | 30 |
| B | 70 |
| C | 35 |
| D | 14 |
| E | 11 |
| F | 77 |
| G | 25 |

(i) Construct the Huffman's binary tree for the data file;

(ii) Tabulate the Huffman's codes for the characters.

(8 marks)

Decimal - Binary - Octal - Hex - ASCII Conversion Chart

| Decimal | Binary | Octal | Hex | ASCII | Decimal | Binary | Octal | Hex | ASCII | Decimal | Binary | Octal | Hex | ASCII | Decimal | Binary | Octal | Hex | ASCII |
|---------|----------|-------|-----|-------|---------|----------|-------|-----|-------|---------|----------|-------|-----|-------|---------|----------|-------|-----|-------|
| 0 | 00000000 | 000 | 00 | NUL | 32 | 00100000 | 040 | 20 | SP | 64 | 01000000 | 100 | 40 | @ | 96 | 01100000 | 140 | 60 | . |
| 1 | 00000001 | 001 | 01 | SOH | 33 | 00100001 | 041 | 21 | ! | 65 | 01000001 | 101 | 41 | A | 97 | 01100001 | 141 | 61 | a |
| 2 | 00000010 | 002 | 02 | STX | 34 | 00100010 | 042 | 22 | " | 66 | 01000010 | 102 | 42 | B | 98 | 01100010 | 142 | 62 | b |
| 3 | 00000011 | 003 | 03 | ETX | 35 | 00100011 | 043 | 23 | # | 67 | 01000011 | 103 | 43 | C | 99 | 01100011 | 143 | 63 | c |
| 4 | 00000100 | 004 | 04 | EOT | 36 | 00100100 | 044 | 24 | \$ | 68 | 01000100 | 104 | 44 | D | 100 | 01100100 | 144 | 64 | d |
| 5 | 00000101 | 005 | 05 | ENQ | 37 | 00100101 | 045 | 25 | % | 69 | 01000101 | 105 | 45 | E | 101 | 01100101 | 145 | 65 | e |
| 6 | 00000110 | 006 | 06 | ACK | 38 | 00100110 | 046 | 26 | & | 70 | 01000110 | 106 | 46 | F | 102 | 01100110 | 146 | 66 | f |
| 7 | 00000111 | 007 | 07 | BEL | 39 | 00100111 | 047 | 27 | ' | 71 | 01000111 | 107 | 47 | G | 103 | 01100111 | 147 | 67 | g |
| 8 | 00001000 | 010 | 08 | BS | 40 | 00101000 | 050 | 28 | (| 72 | 01001000 | 110 | 48 | H | 104 | 01101000 | 150 | 68 | h |
| 9 | 00001001 | 011 | 09 | HT | 41 | 00101001 | 051 | 29 |) | 73 | 01001001 | 111 | 49 | I | 105 | 01101001 | 151 | 69 | i |
| 10 | 00001010 | 012 | 0A | LF | 42 | 00101010 | 052 | 2A | * | 74 | 01001010 | 112 | 4A | J | 106 | 01101010 | 152 | 6A | j |
| 11 | 00001011 | 013 | 0B | VT | 43 | 00101011 | 053 | 2B | + | 75 | 01001011 | 113 | 4B | K | 107 | 01101011 | 153 | 6B | k |
| 12 | 00001100 | 014 | 0C | FF | 44 | 00101100 | 054 | 2C | , | 76 | 01001100 | 114 | 4C | L | 108 | 01101100 | 154 | 6C | l |
| 13 | 00001101 | 015 | 0D | CR | 45 | 00101101 | 055 | 2D | - | 77 | 01001101 | 115 | 4D | M | 109 | 01101101 | 155 | 6D | m |
| 14 | 00001110 | 016 | 0E | SO | 46 | 00101110 | 056 | 2E | . | 78 | 01001110 | 116 | 4E | N | 110 | 01101110 | 156 | 6E | n |
| 15 | 00001111 | 017 | 0F | SI | 47 | 00101111 | 057 | 2F | / | 79 | 01001111 | 117 | 4F | O | 111 | 01101111 | 157 | 6F | o |
| 16 | 00010000 | 020 | 10 | DLE | 48 | 00110000 | 060 | 30 | 0 | 80 | 01010000 | 120 | 50 | P | 112 | 01110000 | 160 | 70 | p |
| 17 | 00010001 | 021 | 11 | DC1 | 49 | 00110001 | 061 | 31 | 1 | 81 | 01010001 | 121 | 51 | Q | 113 | 01110001 | 161 | 71 | q |
| 18 | 00010010 | 022 | 12 | DC2 | 50 | 00110010 | 062 | 32 | 2 | 82 | 01010010 | 122 | 52 | R | 114 | 01110010 | 162 | 72 | r |
| 19 | 00010011 | 023 | 13 | DC3 | 51 | 00110011 | 063 | 33 | 3 | 83 | 01010011 | 123 | 53 | S | 115 | 01110011 | 163 | 73 | s |
| 20 | 00010100 | 024 | 14 | DC4 | 52 | 00110100 | 064 | 34 | 4 | 84 | 01010100 | 124 | 54 | T | 116 | 01110100 | 164 | 74 | t |
| 21 | 00010101 | 025 | 15 | NAK | 53 | 00110101 | 065 | 35 | 5 | 85 | 01010101 | 125 | 55 | U | 117 | 01110101 | 165 | 75 | u |
| 22 | 00010110 | 026 | 16 | SYN | 54 | 00110110 | 066 | 36 | 6 | 86 | 01010110 | 126 | 56 | V | 118 | 01110110 | 166 | 76 | v |
| 23 | 00010111 | 027 | 17 | ETB | 55 | 00110111 | 067 | 37 | 7 | 87 | 01010111 | 127 | 57 | W | 119 | 01110111 | 167 | 77 | w |
| 24 | 00011000 | 030 | 18 | CAN | 56 | 00111000 | 070 | 38 | 8 | 88 | 01011000 | 130 | 58 | X | 120 | 01111000 | 170 | 78 | x |
| 25 | 00011001 | 031 | 19 | EM | 57 | 00111001 | 071 | 39 | 9 | 89 | 01011001 | 131 | 59 | Y | 121 | 01111001 | 171 | 79 | y |
| 26 | 00011010 | 032 | 1A | SUB | 58 | 00111010 | 072 | 3A | : | 90 | 01011010 | 132 | 5A | Z | 122 | 01111010 | 172 | 7A | z |
| 27 | 00011011 | 033 | 1B | ESC | 59 | 00111011 | 073 | 3B | ; | 91 | 01011011 | 133 | 5B | [| 123 | 01111011 | 173 | 7B | { |
| 28 | 00011100 | 034 | 1C | FS | 60 | 00111100 | 074 | 3C | < | 92 | 01011100 | 134 | 5C | \ | 124 | 01111100 | 174 | 7C | |
| 29 | 00011101 | 035 | 1D | GS | 61 | 00111101 | 075 | 3D | = | 93 | 01011101 | 135 | 5D |] | 125 | 01111101 | 175 | 7D | } |
| 30 | 00011110 | 036 | 1E | RS | 62 | 00111110 | 076 | 3E | > | 94 | 01011110 | 136 | 5E | ^ | 126 | 01111110 | 176 | 7E | ~ |
| 31 | 00011111 | 037 | 1F | US | 63 | 00111111 | 077 | 3F | ? | 95 | 01011111 | 137 | 5F | _ | 127 | 01111111 | 177 | 7F | DEL |

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