INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
   Answer booklet;
   Non-programmable scientific calculator.

Answer any FIVE of the EIGHT questions in the answer booklet provided.
All questions carry equal marks.
Maximum marks for each part of a question are as indicated.
Candidates should answer the questions in English.
1. (a) Define the following as used in data communication:

(i) Data Terminal Equipment;
(ii) Data Communication Equipment;
(iii) encapsulation.  

(b) With the aid of a block diagram, describe a data communication model.  

(c) Describe the following transmission modes used in data transmission:

(i) Point-to-point;
(ii) multipoint;
(iii) broadcast,  

(d) An optical fibre is made up of glass with the core and refractive indices of 1.55 and 1.51 respectively. Launching of light signal takes place from the air.

Determine the:

(i) refractive loss;
(ii) numerical aperture.  

2. (a) State four factors considered when choosing a data encoding scheme.  

(b) Encode the data sequence 101001101 using:

(i) Manchester;
(ii) Differential Manchester;
(iii) Alternate Mark Inversion (AMI).  

(c) With the aid of a diagram, describe Quadrature Phase Shift Keying (QPSK) technique of digital modulation.  

3. (a) State three roles performed by Communication Authority of Kenya (CAK).  

(b) With the aid of a block diagram, describe the modulation process in a Pulse Code Modulation (PCM) transmitter.
(c) Four 1 Kpbs connections are multiplexed. A unit is 1-bit.

Determine the:

(i) duration of 1-bit before multiplexing;
(ii) transmission rate of the link;
(iii) duration of one time slot;
(iv) duration of a frame.

(d) Describe parallel transmission in digital communication.

4.

(a) Distinguish between single bit error and burst errors.

(b) Describe:

(i) the stop and wait automatic repeat request (ARQ) error control;
(ii) how lost frames and/or acknowledgements are prevented in (i).

(c) (i) Define the following as used in error control:

(I) redundancy;
(II) code distance;
(III) code weight.

(ii) A (7,4) cyclic code has a generator polynomial \( P(x) = x^5 + x^4 + x + 1 \). A source generates a message sequence \( M = [11100011] \).

Determine the:

(I) Frame Check Sequence (FCS) obtained;
(II) transmitted code word.
5

(a) State three demerits of circuit switching. 

(b) Table 1 shows different network devices. Complete the table. 

Table 1

<table>
<thead>
<tr>
<th>S/No.</th>
<th>Network devices</th>
<th>OSI Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Repeater</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Gateway</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Switch</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Router</td>
<td></td>
</tr>
</tbody>
</table>

(c) With the aid of a diagram, describe virtual packet switching in data communication. 

(d) A 2.5 kilobyte message is transmitted through a network with a bit rate of 1 Gbps. The distance between the sender and the receiver is 12,000 km. The propagation speed is $2.4 \times 10^8$ m/s. Determine the: 

(i) propagation time; 

(ii) transmission time. 

6

(a) State three merits of multiplexing in data communication. 

(b) With the aid of a block schematic diagram, describe Synchronous Time Division Multiplexing (STDM) transmitter/receiver system used on data communication. 

(c) Table 2 shows a Frequency Division Multiplexing (FDM) analogue hierarchy. Complete the table. 

Table 2

<table>
<thead>
<tr>
<th>S/No.</th>
<th>Analog Hierarchy</th>
<th>Number of voice channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Group</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Super group</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Master group</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Jumbo group</td>
<td></td>
</tr>
</tbody>
</table>

(d) Highlight four advantages of optic fibre cable over twisted pair cable. 

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(a) State **three** characteristics of Local Area Networks (LAN).  

(b) With the aid of a diagram, describe bus topology.  

(c) Outline the steps of carrier sense multiple access with collision detection (CSMA/CD) medium access control protocol.  

(d) A channel operating at 4800 bps has a propagation delay of 20 ms. Determine the maximum frame size for stop and wait error control to get 50% link utilization.  

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8.

(a) Distinguish between lossy and lossless compression.  

(b) Describe JPEG technique of video compression.  

(c) Table 3 shows part of OSI reference model. Complete the table.  

Table 3

<table>
<thead>
<tr>
<th>Layer</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(d) (i) State **four** tools used in structured cabling.  

(ii) List **two** connectors in installation of Ethernet.  

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