Strathmore
UNIVERSITY

STRATHMORE UNIVERSITY
FACULTY OF INFORMATION TECHNOLOGY
BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING
END OF SEMESTER EXAMINATION
BEE 3204 DATA COMMUNICATIONS AND NETWORKING

DATE: 7th December, 2023 **Time: 13.00 - 15.00**

Instructions
1. This examination consists of **FIVE** questions.
2. Answer **Question ONE (COMPULSORY)** and any other **TWO** questions.

QUESTION ONE

a. Calculate the duration of a bit interval for the following Ethernet standards:
   i. 10Base-T [**1 Mark**]
   ii. 1000Base-T [**1 Mark**]

b. Discuss with aid of a diagram the operation of Time Division Multiple Access (TDMA) media access control mechanism. [**3 Marks**]

c. Draw a diagram to illustrate the five layers of the TCP/IP reference model. Give the name and state the function of each layer. [**5 Marks**]

d. Given the following bit pattern (11010010), use a diagram to illustrate the corresponding digital signal using the following encoding schemes; Assume signal was at high level in previous bit interval:
   i. Non return to zero level (NRZ-L) [**1 Mark**]
   ii. Manchester [**1 Mark**]

e. Draw a sketch of the Ethernet RJ45 connector and label the pins. [**3 Marks**]

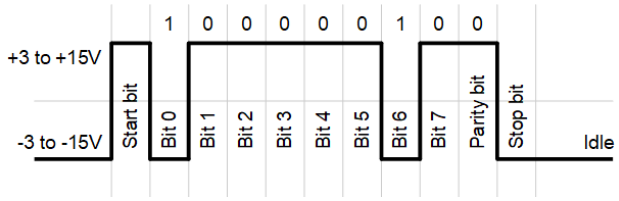
f. For the RJ45 connector in (e) identify the role of pins 1, 2, 3 and 6 from a computer's perspective. [**4 Marks**]

g. Describe the difference between synchronous and asynchronous transmission. [**2 Marks**]

h. Packet switching implements both virtual circuit approach and datagram approach. Explain the operation of each. **[4 Marks]**

i. Use a diagram to explain the architecture of a mesh network topology. **[3 Marks]**

j. Figure 1 below illustrates signal levels for an RS-232 serial bus. Give the name of the bipolar digital signal encoding scheme used by RS-232 and explain what would happen if the polarity of pins was accidentally inverted.

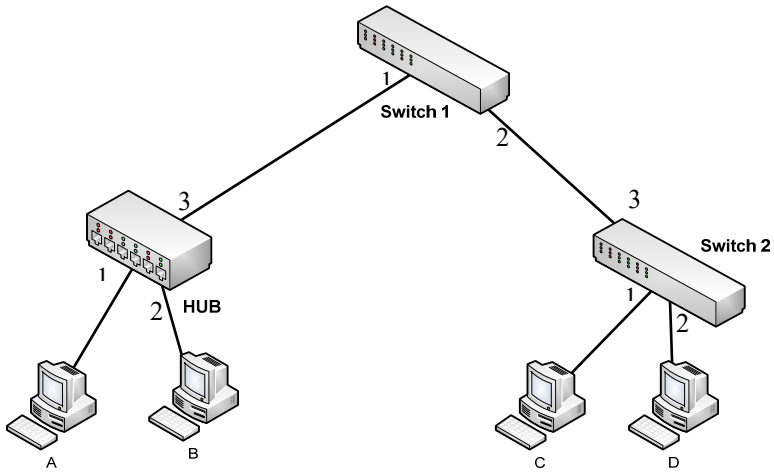


[2 Marks]
(Total: 30 Marks)

QUESTION TWO

a. With respect to movement of cars on the road, use a diagram to explain the operation of Half duplex and Full duplex data transmission mechanisms. **[5 Marks]**

b. Use a switch-learning table to explain the processing of Ethernet frames for the network given below. Show the contents of the switch tables for switch 1 and switch 2



[5 Marks]

c. Using a diagram, explain how CSMA/CA is used to overcome the hidden terminal problem in WLAN. **[5 Marks]**

(Total: 15 Marks)

QUESTION THREE

a. With reference to the header of an IPv4 packet, explain the role of source and destination addresses. [**2 Marks**]

b. With regard to class-based internetworking:
   i. List the IPv4 classes used for **enterprise networking**; give the IP address range for each class. [**4.5 Marks**]

   ii. Provide the default subnet mask for each class in (3b.i), both in decimal notation and slash "/" notation. [**3 Marks**]

   iii. For each class in (3b.i), provide the network number (or range of IP addresses) used for the private networks. [**3 Marks**]

c. Explain how a computer on an Ethernet LAN or WLAN constructs its ARP table. [**2.5 Marks**]

(Total: 15 Marks)

QUESTION FOUR

a. With respect to data transmission technologies,
   i. Explain the differences in operation of bit-oriented and byte-oriented technologies. [**2 Marks**]

   ii. Describe why and how bit stuffing is used in data communications. [**3 Marks**]

b. Draw the structure of a Frame Relay frame and explain the role of the main fields. [**5 Marks**]

c. Draw the structure of a HDLC frame and explain the role of each field. [**5 Marks**]

(Total: 15 Marks)

QUESTION FIVE

a. Draw the structure of a TCP/IP Ethernet frame and explain the role of *Type* and *CRC* fields in TCP/IP. [**4 Marks**]

b. Name two error correction mechanisms used in data communications. [**1 Mark**]

c. Device ***A*** sends the following binary message to device ***B*** over a link, 110101. It uses Cyclic Redundancy Check (CRC) with the following generator polynomial, $x^3 + x + 1$. Demonstrate how CRC is used by A, and how B detects an error in the received message where the first two bits are 01. [**10 Marks**]

(Total: 15 Marks)