



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: 19 March, 2025

Time: 11:00-13:30 Hours

Instructions

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

QUESTION ONE [30 Marks]

- a. Give one advantage of layering as seen in the TCP/IP architecture. **[1 Mark]**
- b. What is the difference between guided and unguided media? Give one example of each **[3 Marks]**
- c. RS232 uses -15V to -3V to represent a '1' and +3V to +15V for a '0'. Give the name of the digital encoding scheme used in RS232 communications. **[1 Mark]**
- d. Give the name and use of the two wires of an Inter-Integrated Circuit (I²C) connection. **[2 Marks]**
- e. The following binary message (0101111100101) was sent over SDLC link where bit stuffing was used. Write down the original message. **[2 Marks]**
- f. Match the following to one of the layers of the OSI reference model
 - i. Route determination **[1 Mark]**
 - ii. Media Access Control **[1 Mark]**
 - iii. Error detection and correction **[1 Mark]**
- g. Identify four differences between Transmission Control Protocol (TCP) and User Datagram Protocol (UDP). **[4 Marks]**

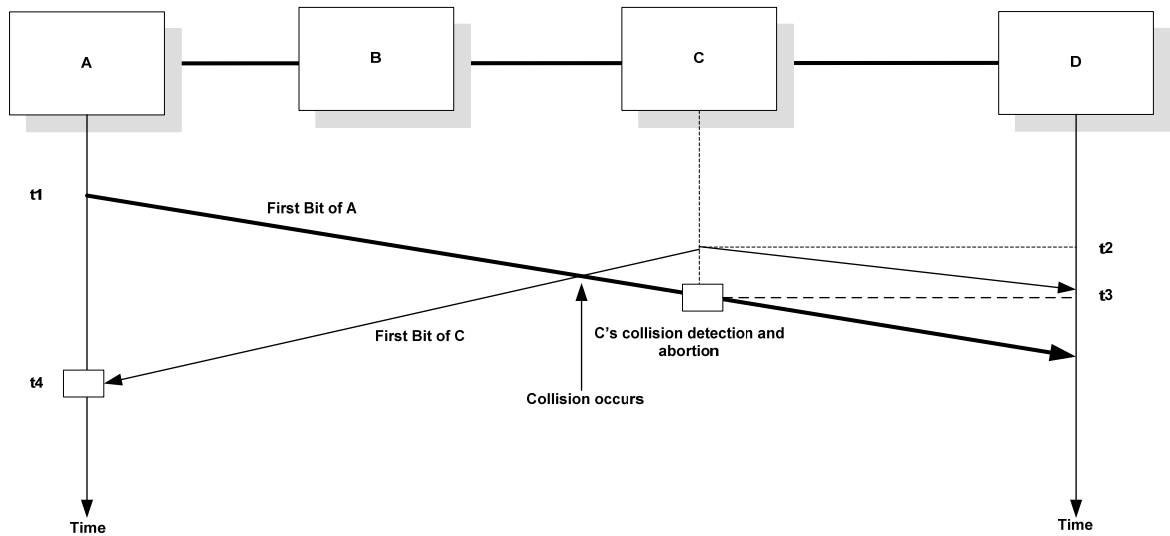
- h. Use a diagram to illustrate and explain the operation of FDMA. [4 Marks]
- i. Draw neat diagrams representing the following cable types:
 - i. Twisted pair cable [2 Marks]
 - ii. Co-axial cable [2 Marks]
 - iii. Fibre optic cable [2 Marks]
- j. Draw a sketch of the male Ethernet RJ45 connector and label the pins. [4 Marks]

QUESTION TWO [15 Marks]

- a. What is the difference between a straight-through and a cross-over Ethernet cable [2 Marks]
- b. Give typical uses of straight-through and cross-over cables [2 Marks]
- c. What are the key factors that affect digital channel capacity? [1 Mark]
- d. A channel has a bandwidth of 5 MHz and a SNR of 15 dB. Calculate the percentage change in channel capacity if the signal power increases and noise power decreases such that the SNR improves to 25 dB. [5 Marks]
- e. For the bit stream 010011010, sketch the waveforms for each of the following codes: NRZ-L, NRZI, Manchester and Differential Manchester. Assume that the signal level for the preceding bit for NRZI was high. [5 Marks]

QUESTION THREE [15 Marks]

- a. Referring to the network below. Computer A sends Frame number (1) to computer D, which replies with frame number (2). A then sends frames number (3) and (4). State which of frames (1) to (4) are received by which computers and explain why. [5 Marks]
- b. On the CSMA-CD network shown below, the data rate is 100Mbps, the distance between station A and C is 3000m, and the propagation speed is 2×10^8 m/s. Station A starts sending a long frame at time $t_1=0$; station C starts sending a long frame at time $t_2=3\mu\text{s}$.



The size of the frame is long enough to guarantee the detection of collision by both stations. Find:

- i. The time when station C hears the collision (t_3) [1 Mark]
 - ii. The time when station A hears the collision (t_4) [1 Mark]
 - iii. What is the minimum frame size allowed for A and C [3 Mark]
- c. Using a diagram, explain WLAN uses CSMA/CA to ensure reliable frame transmission. [5 Marks]

QUESTION FOUR [15 Marks]

- a. The IP address of a DNS server is 192.168.2.1. Show how computer B, with IP address 192.168.1.25 and Subnet mask: 255.255.255.0 determines if it should send packets directly to DNS server or if it is to use its default gateway. [5 Marks]
- b. Computers A and B are connected to the same switch and their IP addresses belong to the same subnet. Explain the process used by computer A to discover the MAC address of B that is required to send frames. [5 Marks]
- c. What is the minimum size of the header of an IPv4 packet? [1 Mark]
- d. Use a diagram to illustrate the structure of an IPv4 packet. Clearly identify and name important addresses. [4 Marks]

QUESTION FIVE [15 Marks]

- a. Using the message below, explain how single-bit parity and two dimensional-bit parity mechanisms work to detect the presence of errors in received data. Note: Show which bit has an error.

1	0	1	0	1	1
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1	0	1	1	0	0
0	1	1	1	0	1
0	0	1	0	1	0

[5 Marks]

- b. Device **A** sends the following binary message to device **B** over a link, 101110. It uses Cyclic Redundancy Check (CRC) with the following generator polynomial, $x^3 + x + 1$. Demonstrate how CRC is used by A. Demonstrate how B detects an error if the received message is 011110xxx, where xxx is the CRC value. [10 Marks]