UNIVERSITI
TEKNOLOGI
PETRONAS

SUPPLEMENTARY & REPLACEMENT FINAL EXAMINATION MAY 2023 SEMESTER

COURSE : EDB3023/EEB4063 - DATA & COMPUTER NETWORK
DATE : 11 SEPTEMBER 2023 (MONDAY)
TIME : 9:00 AM - 12:00 PM (3 HOURS)

INSTRUCTIONS TO CANDIDATES

1. Answer **ALL** questions in the Answer Booklet.
2. Begin **EACH** answer on a new page in the Answer Booklet.
3. Indicate clearly answers that are cancelled, if any.
4. Where applicable, show clearly steps taken in arriving at the solutions and indicate **ALL** assumptions, if any.
5. **DO NOT** open this Question Booklet until instructed.

Note :

i. There are **SEVEN (7)** pages in this Question Booklet including the cover page .

ii. **DOUBLE-SIDED** Question Booklet.

1. a. The Transmission Control Protocol/Internet Protocol (TCP/IP) protocol is a suite of communication protocols used for interconnecting network devices. The protocol is broken into five layers, each of which represents a conceptual collection of services. Match the following services to a layer in the TCP/IP protocol:

i. Satellite

[1 mark]

ii. Address Resolution Protocol (ARP)

[1 mark]

iii. User Datagram Protocol (UDP)

[1 mark]

iv. File Transfer Protocol (FTP)

[1 mark]

b. Suppose that a transmission is required to send computer screen images over an optical fiber. The screen is 800 by 600 pixels using 256 colours. There are 30 screen images per second. Determine the bandwidth needed to transmit the signal if binary signaling is used.

[4 marks]

c. You are setting up a network for a computer lab for teaching, which has twenty computers, and one printer that need to be connected. All equipment is located on one floor in a relatively small area. Costs must be kept at a minimum, and the network does not need to be especially fast. As an engineer you need to recommend which type of transmission medium should be used. Justify your answer.

[5 marks]

d. Encoding scheme is the mapping from data bits to signal elements. Construct a timing diagram and encode the following binary data "11001100101" to the signals using the following methods:

i. Non-Return to Zero, Inverted (NRZI) (Note: most recent preceding bit was high).

[3 marks]

ii. Differential Manchester (Note: Most recent preceding 1 bit has negative voltage).

[3 marks]

iii. Bipolar Alternate Mark Inversion (AMI) (Note: Most recent preceding 1 bit has negative voltage).

[3 marks]

iv. Amplitude Shift Keying (ASK)

[3 marks]

2. a. Error control refers to the mechanism to detect and correct errors that occur in the transmission of data. Cyclic Redundancy Check (CRC) scheme is one of the most powerful error-detecting codes. A decimal number, 653, is to be transmitted from station ***A*** to ***B*** in a network as binary number. The pre-determined divisor polynomial accepted by both stations is $x^5+x^4+x^2+1$.

i. Construct the digital logic shift register implementation.

[3 marks]

ii. By using CRC Modulo-Two arithmetic method, generate the Frame Check Sequences (FCS) and the message that should be transmitted from ***A*** to ***B***.

[6 marks]

iii. Suppose the second bit from the left is inverted during transmission. Evaluate if there is any error detected at receiver's end. Justify your answer.

[5 marks]

b. Another popular method for error control is Internet Checksum where it is used in many Internet standard protocols. If the Internet Checksum method is adopted, determine the transmitted message if data is 00FE B523 FDA1 D68A AF02.

[5 marks]

c. Describe the **THREE (3)** type of stations available in High Level Data Link Control (HDLC).

[3 marks]

d. Bit stuffing is the insertion of non-information bits into data. Assume a framing protocol that uses bit stuffing, and the frame contains the following bit sequence "0001111001110110111110011001111111001". Determine the actual bits sent by the sender.

[3 marks]

3. a. In a switched communication network, data from a station are routed to the destination by being switched from node to node. Space-division is one of the common switching technologies used in Wide Area Switched Network. Design and determine the total cross-points for a three-stage switch with 10 input lines and 10 output lines. You may consider the following specifications:

- Each switch in the first stage and last stage has 5 × 2 crosspoints.
- The middle stage has 2 crossbars each with 2 × 2 crosspoints.

[4 marks]

b. Consider a simple telephone network consisting of two end offices and one intermediate switch with a 1 MHz full-duplex trunk between each end office and the intermediate switch. Assume a 4-kHz channel for each voice call. The average telephone is used to make four calls per 8-hour workday, with a mean call duration of six minutes. Ten percent of the calls are long distance. Determine the maximum number of telephones an end office can support.

[4 marks]

c. Consider the transfer of a file containing one million 8-bit characters from one station to another. Determine the total elapsed time and effective throughput for a bus topology local network with two stations, with a distance, D = 1km apart, a data rate of B = 50 Mbps, and a frame size of P = 10,000 bits with 80 bits of overhead per frame. Each frame is acknowledged with an 88-bit frame before the next is sent. The propagation speed on the bus is 200m/μs.

[3 marks]

d. Design a Local Area Network (LAN) System with 4 stations, each connected to one of 4 LANs that are connected by 3 bridges in the following requirement:

- Bridge A connects LAN1 and LAN2
- Bridge B connects LAN2, LAN3 and LAN4
- Bridge C connects LAN1 and LAN3
- LAN2 and LAN3 connects to internet

[5 marks]

e. Carrier Sense Multiple Access (CSMA) is a network protocol that listens to or senses network signals on the carrier/medium before transmitting any data. Describe the approaches of the following:

i. 1- persistent

[3 marks]

ii. *p*- persistent

[3 marks]

iii. *non*- persistent

[3 marks]

4. a. Describe the importance of Internet Protocol (IP) datagram encapsulation.

[3 marks]

b. In IPv4 addressing, the first three classes are divided into a fixed number of blocks. In Class A, the first byte denotes the number of blocks. In Class B, the first two bytes denote the number of blocks. In the Class C, the first three bytes denote the number of blocks. Class D and Class E have a single block. Determine the class, network identifier and host identifier for the following addresses:

i. 130.32.11.18

[3 marks]

ii. 35.30.210.100

[3 marks]

c. A university has 150 LANs with 100 hosts in each LAN. Suppose the university has one Class B address. Design an appropriate subnet addressing scheme.

[8 marks]

d. Determine the subnet address (NetId), broadcast address, first usable address and last address for the following IP/Subnet mask: 15.16.193.8/20.

[8 marks]

- END OF PAPER