



**Exercise 1:** Choose the correct answer [5 points].

Question
<b>Q1. Which network topology connects every device directly to every other device?</b> A. Star topology      B. Bus topology      C. Mesh topology      D. Ring topology
<b>Q2. Which protocol is mainly responsible for converting an IP address into a physical address?</b> A. ICMP      B. ARP      C. DNS      D. HTTP
<b>Q3. A network contains 6 computers connected in Mesh topology, the number of cable links needed is:</b> A. 5      B. 6      C. 10      D. 15
<b>Q4. A simplex protocol allows:</b> A. Two-way communication      B. One-way communication C. Wireless communication      D. Satellite communication
<b>Q5. In Stop-and-Wait ARQ, if an ACK is lost:</b> A. Nothing happens      B. The receiver restarts C. The frame is retransmitted      D. The connection closes
<b>Q6. A IEEE 802.3 MAC frame address contains:</b> A. 16 bits      B. 32 bits      C. 48 bits      D. 64 bits
<b>Q7. Datagram switching is:</b> A. Connection-oriented      B. Connectionless      C. Always reliable      D. Circuit-based

**Exercise 2 :** [5 PTS]

1) Encode the following sequence 1011001010 using :

- NRZ-L
- Manchester
- AMI

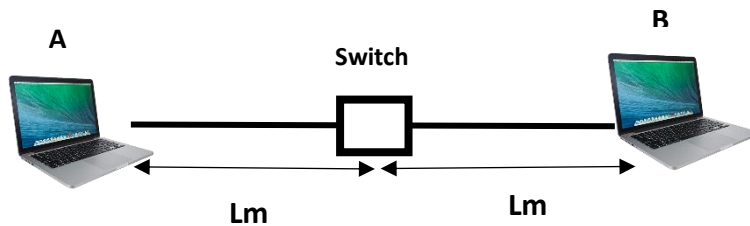
2) a. Encode the message: 10110010 using Hamming Code.

b. Verify the following received message: 101101011001

c. Indicate: if there is an error , the error position, corrected message.

**Exercise 3 :** [4 PTS]

Consider a network consisting of two devices, **A** and **B**, connected via a **Switch**.



**Given:**

- The length of the two cables connecting devices A and B to the Switch is **L** meters.
- The propagation speed is  $V_p$ .
- The transmission rate (bandwidth) is **D** bits/s.
- Information frames consist of **N** bits, and acknowledgment (ACK) frames consist of  $N_a$  bits.
- The Switch uses **store-and-forward** switching (it only begins retransmitting a frame after it has been completely received).

1) What is the topology of this network?

2) Provide the formula, in terms of **L**,  $V_p$ , **D**, **N**, and  $N_a$ , for the total time required to deliver a frame from **B** to **A**.

3) Assume the following:

- Processing time for both information and acknowledgment frames is negligible.
- The transmission error rate is low.
- **10%** of the information frame bits are control bits (overhead).
- Using the parameters: **L**,  $V_p$ , **D**, **N**,  $N_a$ , derive the formula of the effective throughput using the Stop-and-Wait protocol

**Exercise 4 :** [6 PTS]

The network address **200.100.1.0 /24** has been assigned. We need to accommodate **20 hosts** in each subnet.

1. What is the **IP address class** of 200.100.1.0?
2. What is the **default subnet mask** associated with this class?
3. How many **bits** are required in the host portion of the assigned address to accommodate at least 20 hosts?
4. What is the **maximum number of usable host addresses** in each subnet?
5. What is the **maximum number of subnets** that can be defined?
6. What are the **network addresses** of all the defined subnets?
7. What is the **broadcast address** for subnet number 3?

	2	Good Luck
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## Corrigie type

### Exercise 1 : Multiple Choice Questions [5 Points]

**Instruction:** Each correct answer

Question	Ans	Pts
<b>Q1. Which network topology connects every device directly to every other device?</b>  A. Star topology      B. Bus topology      C. Mesh topology      D. Ring topology	<b>C</b>	<b>0.5</b>
<b>Q2. Which protocol is mainly responsible for converting an IP address into a physical address?</b>  A. ICMP      B. ARP      C. DNS      D. HTTP	<b>B</b>	<b>0.5</b>
<b>Q3. A network contains 6 computers connected in Mesh topology, the number of cable links needed is:</b>  A. 5      B. 6      C. 10      D. 15	<b>D</b>	<b>0.5</b>
<b>Q4. A simplex protocol allows:</b>  A. Two-way communication      B. One-way communication C. Wireless communication      D. Satellite communication	<b>B</b>	<b>1</b>
<b>Q5. In Stop-and-Wait ARQ, if an ACK is lost:</b>  A. Nothing happens      B. The receiver restarts C. The frame is retransmitted      D. The connection closes	<b>C</b>	<b>1</b>
<b>Q6. A IEEE 802.3 MAC frame address contains:</b>  A. 16 bits      B. 32 bits      C. 48 bits      D. 64 bits	<b>C</b>	<b>0.5</b>
<b>Q7. Datagram switching is:</b>  A. Connection-oriented      B. Connectionless      C. Always reliable      D. Circuit-based	<b>B</b>	<b>1</b>

### Exercise 2 : Encoding and Hamming Code [5 Points]

**1) Encode the sequence 1011001010**

a) NRZ-L Encoding

(0,5)

Rule:

	2	
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- 1 → High Level (H)
- 0 → Low Level (L)

Bits	1	0	1	1	0	0	1	0	1	0
Signal	L	H	L	L	H	H	L	H	L	H

b) Manchester Encoding

(0,5)

Rule:

- 1 → Low to High transition (LH)
- 0 → High to Low transition (HL)

Bits	1	0	1	1	0	0	1	0	1	0
Signal	LH	HL	LH	LH	HL	HL	LH	HL	LH	HL

c) AMI Encoding

(0,5)

Rule:

- 0 → No signal
- 1 → Alternating positive and negative voltages

First bit 1 is assumed positive.

Bits	1	0	1	1	0	0	1	0	1	0
Signal	+	0	-	+	0	0	-	0	+	0

## 2) Hamming Code

a) Encode the message 10110010

We use Hamming(12,8). The data bits are:

10110010

Parity bits are placed at positions:

1, 2, 4, 8

(0,25)

Position	1	2	3	4	5	6	7	8	9	10	11	12
Content	P1	P2	1	P4	0	1	1	P8	0	0	1	0

Calculation of parity bits

P1 checks positions: 1, 3, 5, 7, 9, 11

P1, 1, 0, 1, 0, 1

Number of 1s = 3 (odd)

	2	
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**P1 = 1**

(0,5 PTS)

P2 checks positions: 2, 3, 6, 7, 10, 11

P2, 1, 1, 1, 0, 1

Number of 1s = 4 (even)

**P2 = 0**

(0,5 PTS)

P4 checks positions: 4, 5, 6, 7, 12

P4, 0, 1, 1, 0

Number of 1s = 2 (even)

**P4 = 0**

(0,5 PTS)

P8 checks positions: 8, 9, 10, 11, 12

P8, 0, 0, 1, 0

Number of 1s = 1 (odd)

**P8 = 1**

(0,5 PTS)

*Encoded message*

**101001110010**

(0,25 PTS)

*b) Verify the received message*

Received message:

**101101011001**

*Syndrome calculation*

S1 = 1

S2 = 1

S4 = 1

S8 = 0

(0,5 PTS)

**The message is incorrect**

(0,5 PTS)

## Exercise 3 : Transmission Analysis [4 Points]

### 1) Network topology

Devices A and B are connected through a central switch.

**Star Topology**

(0,5 PTS)

### 2) Total transmission time

*Transmission Delay*

$T_t = N / D$

(0,5 PTS)

### Propagation Delay

$$T_p = L / V_p$$

(0,5 PTS)

Since the switch uses Store-and-Forward switching, the transmission occurs in two stages:

- B → Switch
- Switch → A

$$T_{total} = 2(N/D + L/V_p)$$

(0,5 PTS)

### 3) Effective Throughput using Stop-and-Wait

10% of the frame corresponds to overhead bits. Therefore:

$$\text{Useful Data} = 0.9N$$

#### Cycle Time

Data frame transmission:

$$2(N/D + L/V_p)$$

ACK transmission:

$$2(N_a/D + L/V_p)$$

Total cycle time:

$$T_c = 2(N/D + L/V_p) + 2(N_a/D + L/V_p)$$

Simplification:

$$T_c = 2N/D + 2N_a/D + 4L/V_p$$

(0,5 PTS)

#### Effective Throughput

$$S = 0.9N / (2N/D + 2N_a/D + 4L/V_p)$$

(1 PTS)

## Exercise 4 : Subnetting [6 Points]

Given network:

200.100.1.0/24

Need at least 20 hosts per subnet.

### 1) IP Address Class

First octet:

200

Class intervals:

- Class A → 1 to 126
- Class B → 128 to 191
- Class C → 192 to 223

Class C

(1 PTS)

### 2) Default subnet mask

**3) Required host bits**

$$2^h - 2 \geq 20$$

Try  $h = 4$

$$2^4 - 2 = 14$$

**14 hosts are insufficient.**

Try  $h = 5$

$$2^5 - 2 = 30$$

**Required host bits = 5**

(0,5 PTS)

**4) Maximum usable hosts per subnet**

$$2^5 - 2 = 30$$

**30 hosts**

(0,5 PTS)

**5) Maximum number of subnets**

Original host bits in /24 = 8 bits

$$8 - 5 = 3 \text{ subnet bits}$$

$$2^3 = 8 \text{ subnets}$$

(0,5 PTS)

**6) Network addresses of all subnets**

New subnet mask: /27

(0,5 PTS)

Subnet mask: 255.255.255.224

(0,5 PTS)

Block size: 256 - 224 = 32

(0,5 PTS)

Table:

(1 PTS)

Subnet	Network Address
1	200.100.1.0/27
2	200.100.1.32/27
3	200.100.1.64/27
4	200.100.1.96/27

5	200.100.1.128/27
6	200.100.1.160/27
7	200.100.1.192/27
8	200.100.1.224/27

### 7) Broadcast address for subnet number 3

Subnet 3:

200.100.1.64/27

Next subnet:

200.100.1.96

Broadcast address = one address before next subnet. → **200.100.1.95**

(0,5 PTS)