CSS334: Computer Networks and Internetworking
Final Mock Exam

curated by *The Peanuts*

Name . . . . . Student ID . . . . . Section . . . . . Seat No . . . . . .

Exam Conditions: Semi-Closed Book

Duration: 3 Hours

Directions:

1. This exam contains **5 written questions**, **10 multiple-choice questions**, and **10 fill-in-the-blank questions** across multiple pages. All questions are compulsory. If your exam paper appears shorter than expected, you have likely lost a page — please inform the invigilator before routing it via your default gateway.

2. **Show all formulas, intermediate steps, and computations.** Partial credit is awarded throughout Part III. A correct final answer with no working shown may not receive full marks.

3. Answers must be written in **English**. Thai annotations in your working space are fine, but final answers and explanations must be in English.

4. You may use **one double-sided A4 cheat sheet**. You may not borrow your neighbour's cheat sheet, run a DHCP Discover to obtain one, or consult any device with an IP address.

5. If a subnet calculation gives you more addresses than the entire IPv4 space, double-check your prefix length before submitting. That is a you-problem, not an IPv4-exhaustion problem.

For solution, ***click here****.*

Part I: Multiple Choice

*Choose the **best** answer for each question. Circle or clearly underline your chosen letter.*

1. A router's forwarding table contains the following entries:

Prefix	Interface
10.0.0.0/8	eth0
10.0.1.0/24	eth1
10.0.1.128/25	eth2
0.0.0.0/0	eth3

A packet arrives destined for `10.0.1.200`. Which interface is selected?

a) `eth0`

b) `eth1`

c) `eth2`

d) `eth3`

2. Which of the following is the *broadcast address* of the subnet `192.168.50.96/28`?

a) `192.168.50.96`

b) `192.168.50.111`

c) `192.168.50.127`

d) `192.168.50.255`

3. Which of the following IPv4 addresses is *outside* the subnet `172.16.32.0/20`?

a) `172.16.33.1`

b) `172.16.47.254`

c) `172.16.48.1`

d) `172.16.40.100`

4. A client that has no IP address yet sends a DHCP Discover message. Which of the following correctly describes the *source* and *destination* IP addresses in that packet?

a) Source: `0.0.0.0`, Destination: `255.255.255.255`

b) Source: `0.0.0.0`, Destination: the DHCP server's IP

c) Source: the client's MAC address, Destination: `255.255.255.255`

d) Source: the client's future IP, Destination: `255.255.255.255`

5. Which of the following statements about NAT (Network Address Translation) is *incorrect*?

a) NAT allows multiple internal hosts to share a single public IP address.

b) NAT maintains a table mapping (private IP, port) to (public IP, new port).

c) NAT operates only at Layer 3, never touching Layer 4 information.

d) NAT can create difficulties for peer-to-peer connections initiated from the outside.

6. At the receiver, after receiving a data frame that includes an appended CRC, the receiver divides the entire received bit string (data + CRC) by the same generator polynomial. If no error occurred, what should the remainder be?

a) Equal to the original CRC

b) 0 (zero)

c) 1 (one)

d) Depends on the length of the data

7. Which of the following statements about *IPv6 compared to IPv4* is TRUE?

a) IPv6 headers include a checksum field for error detection at every hop.

b) IPv6 supports fragmentation at intermediate routers, just like IPv4.

c) IPv6 uses 128-bit addresses and has a fixed-length 40-byte header.

d) IPv6 still requires NAT because the address space is only moderately larger than IPv4.

8. A `traceroute` tool sends UDP segments with incrementing TTL values. Under *normal* conditions, what causes the traceroute process to *stop*?

a) The TTL counter reaches 255.

b) The destination host returns an **ICMP Port Unreachable** message (Type 3, Code 3).

c) Any intermediate router drops the packet and sends nothing back.

d) The source stops after exactly 30 hops regardless of outcome.

9. When a host needs to find the MAC address of another device on the same subnet, it sends an ARP request. Which *destination* MAC address does this ARP request use?

a) The MAC address of the default gateway

b) The MAC address of the target IP host (if previously cached)

c) `FF:FF:FF:FF:FF:FF` (broadcast)

d) The MAC address of the sender itself

10. In 802.11 Wi-Fi, CSMA/CA (Collision Avoidance) is used instead of CSMA/CD (Collision Detection). Which statement *best* explains why collision detection is impractical in wireless networks?

a) Wireless networks always operate in half-duplex mode due to bandwidth limits.

b) A transmitting node cannot reliably detect a collision because its own strong signal overwhelms any colliding signal it would otherwise sense on the medium.

c) 802.11 uses frequency-division multiplexing, which inherently prevents collisions.

d) CSMA/CA requires less energy than CSMA/CD and is therefore preferred for mobile devices.

Part II: Fill in the Blanks

Fill in each blank with the most appropriate term, protocol name, or short phrase. Each blank is worth 1 mark.

1. _____ is a network protocol that allows a newly connected host to automatically obtain an IP address, subnet mask, default gateway, and DNS server address from a server on the local network.

2. _____ is a protocol that resolves an IP address into a MAC (hardware) address within the same local network, allowing a frame to be delivered to the correct physical interface.

3. The technique of carrying an IPv6 datagram as the payload inside an IPv4 datagram in order to traverse an IPv4-only region of the Internet is called _____.

4. _____ is a network-layer protocol used for error reporting and diagnostic functions; it is the underlying protocol used by both `ping` and `traceroute`.

5. _____ (abbreviated _____) is a subnetting technique in which different subnets within the same address space may use *different* prefix lengths, allocating IP space more efficiently than CIDR with a fixed mask.

6. In an Ethernet frame, the _____ field (2 bytes) identifies the higher-layer protocol encapsulated in the payload (e.g., `0x0800` for IPv4, `0x0806` for ARP).

7. When a router's forwarding table contains multiple entries that match a given destination address, the router applies _____, selecting the entry whose prefix is the *most specific* (longest).

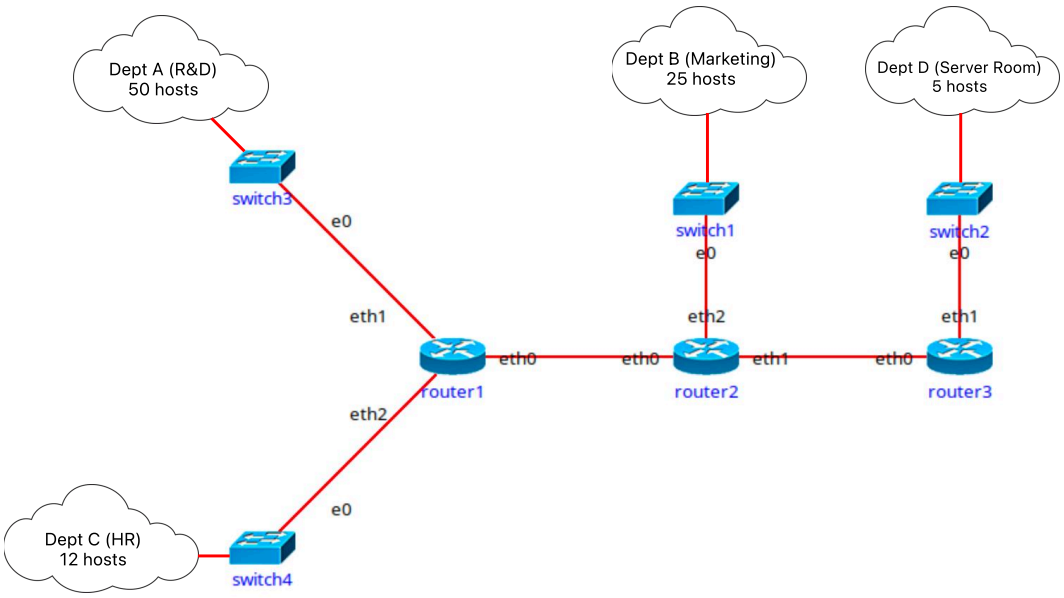
8. _____ is an address-translation mechanism, commonly deployed in home and enterprise networks, that allows many internal devices using private IP addresses to share a single public IP address for communication with the external Internet.

9. _____ is a link-state shortest-path routing algorithm that iteratively adds the node with the currently known minimum-cost path to a confirmed set, guaranteeing optimal paths to all nodes when it terminates.

10. CRC stands for _____, an error-detection technique that appends a remainder (computed via XOR-based polynomial division) to the transmitted data; the receiver re-divides and expects a remainder of zero if no error occurred.

Question 1

You are the network administrator for **ABC Corporation**. The company has been allocated the IP range `192.168.10.0/24`. The physical network topology is shown below. Your task is to design the IP address scheme using **VLSM** (Variable Length Subnet Mask) to minimise wasted addresses.



Note: IP addresses for router interfaces are included in the "hosts needed" count.

1.1 List all required subnets and their network pairs.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

1.2 Using VLSM, complete the table below. Allocate subnets in order of *decreasing* host requirement. Use the IP range `192.168.10.0/24`.

Subnet Name	**Hosts Needed**	**Allocated Size**	**Network Address**	**/Pre.**	**Usable Range**	**Broadcast**
Dept A (R&D)	50					
Dept B (Mktg)	25					
Dept C (HR)	12					
Dept D (Server)	5					
R1–R2 Link	2					
R2–R3 Link	2					

1.3 Identify the remaining unused subnet(s) after your VLSM allocation. State the network address and prefix.

1.4 For each IP address below, state: (a) whether it is a *Network Address*, *Broadcast Address*, or *Valid Host Address*, and (b) which subnet name (from 1.1) it belongs to.

IP Address	**Type (Network / Broadcast / Host)**	**Subnet Name**
`192.168.10.63`		
`192.168.10.100`		
`192.168.10.120`		

Question 2

Use the IP address allocation you designed in Question 1 to answer this question.

2.1 Assign an IP address (with prefix) to each router interface listed below. Use the *first usable host IP* of the corresponding subnet from Question 1 as the interface address.

Router	Interface	Connected To	IP Address / Prefix
R1 (router1)	`eth0`	R2 (router2)	_____
	`eth1`	switch3 (Dept A)	_____
	`eth2`	switch4 (Dept C)	_____
R2 (router2)	`eth0`	R1 (router1)	_____
	`eth1`	R3 (router3)	_____
	`eth2`	switch1 (Dept B)	_____
R3 (router3)	`eth0`	R2 (router2)	_____
	`eth1`	switch2 (Dept D)	_____

2.2 Complete the routing tables for **R1**, **R2**, and **R3**. For directly connected subnets, write `0.0.0.0` as the gateway. For remote subnets, write the IP address of the *next-hop* interface.

Routing Table: R1

Destination (IP/Prefix)	**Gateway**

Routing Table: R2

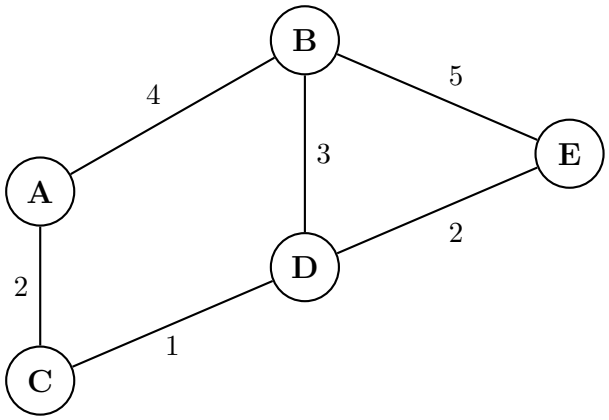
Destination (IP/Prefix)	**Gateway**

Routing Table: R3

Destination (IP/Prefix)	**Gateway**

Question 3

Consider the following network graph. Use **Dijkstra's link-state algorithm** to compute the **shortest path from node A to all other nodes**.



3.1 Complete the Dijkstra table below.

Step	**N'**	**D(B), p(B)**	**D(C), p(C)**	**D(D), p(D)**	**D(E), p(E)**
0	{A}				
1					
2					
3					
4					

3.2 Draw the **least-cost path tree** rooted at node A. Label each edge with its cost.

Question 4

A sender has the following message bits to transmit:

$$\texttt{m} = \texttt{1100101}$$

The agreed generator polynomial is $G(x) = x^3 + x + 1$, giving the **divisor pattern** $d = \texttt{1011}$ (i.e., $n = 3$ CRC bits).

4.1 What bit string is formed after appending n zeros to m prior to the CRC computation?

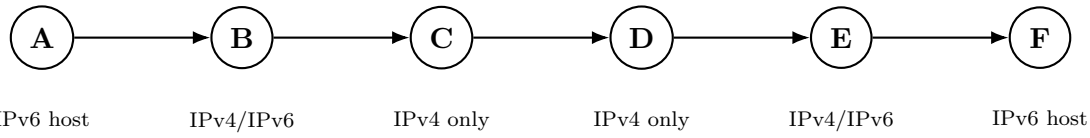
4.2 Perform the **XOR binary long division** below to find the CRC remainder. Show all working.

4.3 What is the **actual bit string transmitted** over the link?

4.4 The receiver gets `1100101110` (the last 3 bits are corrupted). Without re-computing the full division from scratch, explain in *one sentence* how the receiver detects that an error has occurred.

Question 5

5.1 The diagram below shows a network path between hosts **A** and **F**. Routers B and E are dual-stack (IPv4 and IPv6), while routers C and D are IPv4-only.



(a) What transition mechanism is used between nodes B and E? Name it and explain in one sentence how it works.

(b) On the segment **B** $\rightarrow$ **C**, what are the source and destination addresses in the *outer* IP header? Use A, B, C, D, E, F to represent each node's IP address.

(c) What field is present in IPv4 datagrams but *absent* from IPv6 datagrams that is related to error detection at the network layer? Why was it removed in IPv6?

5.2 A laptop with a blank ARP cache and no DNS cache connects to a wired network and opens a browser to `http://www.npwitk.com`. The following events must all occur. **Arrange them in the correct order** by writing the letters in the blank:

(A) The laptop broadcasts a DHCP Discover to obtain an IP address.

(B) The laptop sends an ARP request to find the MAC address of the default gateway.

(C) The browser sends an HTTP GET request to the web server.

(D) The laptop sends a DNS query to resolve `www.npwitk.com`.

(E) A TCP SYN packet is sent to port 80 of the resolved IP address.

(F) The DHCP server replies with a DHCP ACK containing IP, mask, gateway, and DNS.

Correct order: _____