CSS331: Fundamentals of Data Communications
Final Mock Exam

curated by The Peanuts

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

Conditions: Semi-closed Book

Directions:

1. This exam has 14 pages (including this page).

2. Write your name clearly at the top.

3. Read the questions carefully. They were handcrafted with love (and mild evil) by The Peanut Team.

4. Show your work where applicable, partial credit is real, but miracles are not.

5. Answers must be written in **English**. Binary or Morse code will not be graded.

6. You may use your notes. You may not use your neighbor's notes, brain, or soul.

For solution, **click here**.

Question 1

Explain the difference between Stop-and-Wait ARQ and Go-back-N ARQ.
In what situations would each protocol be more suitable?

Question 2

Given a network with the following parameters:

- Propagation time $(T_{prop}) = 200$ ms
- Frame transmission time $(T_f) = 50$ ms
- Window size for sliding window protocol $= 7$ frames

(a) Calculate the link utilization for Stop-and-Wait protocol.

(b) Calculate the link utilization for Sliding Window protocol with the given window size.

(c) What is the minimum window size needed to achieve 100% utilization?

Question 3

Describe the key differences between Frequency Division Multiplexing (FDM) and Time Division Multiplexing (TDM). Give one real-world application for each.

Question 4

A company needs to multiplex 10 voice channels, each requiring 4 kHz bandwidth, using FDM. If guard bands of 500 Hz are required between channels:

(a) What is the minimum total bandwidth required?

(b) Draw a simple diagram showing the frequency allocation

Question 5

The Peanut Gang is planning to travel to Chiang Mai this holiday, and they're calling from SIIT Rangsit Campus to the ABC Hotel in Chiang Mai using a traditional telephone system that uses *circuit switching*:

(a) List the network components your call passes through from source to destination

(b) Explain the three phases of circuit switching for this telephone call

Question 6

A company has two offices connected via packet switching network. Compare what happens when using:

(a) Virtual Circuit packet switching

(b) Datagram packet switching

Focus on: path determination, packet headers, and handling of node failures.

Question 7

In ATM networks:

(a) Why is the cell size fixed at 53 bytes (5-byte header + 48-byte payload)?

(b) Explain the difference between VPI and VCI. Why use both instead of just one identifier?

Question 8

The Peanut Gang loves doing overnight projects together, so they often use *FaceTime* video calls to stay connected. Suppose their video calls are transmitted over an ATM (Asynchronous Transfer Mode) network. Which **ATM service category** would best support their real-time *FaceTime* session, and why? Describe the **Quality of Service (QoS)** guarantees this category provides.

Question 9

Given the IP address 172.25.142.88 with a subnet mask of 255.255.255.192, find:

(a) The class of this IP address

(b) The major network address

(c) The subnet address

(d) The first valid host address in this subnet

(e) The last valid host address in this subnet

(f) The broadcast address for this subnet

(g) How many bits were borrowed from the host portion for subnetting?

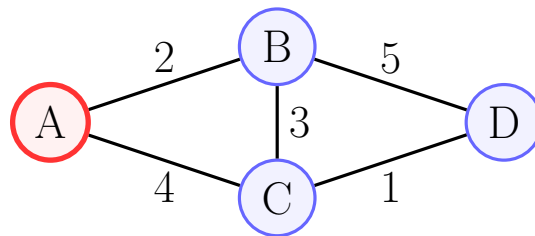(h) How many valid hosts can this subnet support?

Question 10

A Class C network `192.168.10.0` needs to be subnetted to accommodate 6 departments, each requiring at least 25 hosts. Calculate:

(a) Number of bits to borrow

(b) Custom subnet mask (in both decimal and CIDR[1] notation)

(c) Number of usable subnets

(d) Number of usable hosts per subnet

(e) List the first three subnet ranges (network address, usable range, broadcast)

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[1] **CIDR** (Classless Inter-Domain Routing) writes a subnet mask as "/n", meaning n network bits. Examples: `/24` ↔ `255.255.255.0`, `/26` ↔ `255.255.255.192`, `/27` ↔ `255.255.255.224`.

Question 11

Using Dijkstra's algorithm, find the shortest path from Node A to all other nodes in the following network. Show your iteration table.

Question 12

Using the same network from *Question 11*, now use the **Bellman-Ford algorithm** to find the shortest paths from all nodes to destination **node D**. Complete the following table showing the distance and next hop for each iteration:

Question 13

Explain the "counting to infinity" problem in Distance Vector routing. How does the split horizon with poisoned reverse technique solve this problem?

Question 14

A company is designing their LAN topology. Compare Star topology and Bus topology in terms of:

- Cost

- Reliability (what happens when one node fails?)

- Performance as network grows

- Ease of troubleshooting

Which would you recommend for a small office with 15 computers and why?

Question 15

Explain the difference between **SMTP**, **POP3**, and **IMAP** protocols.

Aspect	SMTP	POP3	IMAP
Type (Push / Pull)			
Purpose			
Where emails stored after retrieval			
Best for			

Question 16

You need to send an email regarding a copyright infringement notice for the Peanut Cheat Sheets website to `hey@npwitk.com`. The message includes a short explanation and a **JPEG image attachment** as evidence. The email must be sent using **MIME** (Multipurpose Internet Mail Extensions):

(a) What **Content-Type** would be used for the image?

(b) What **Content-Transfer-Encoding** method would be suitable for sending binary data such as images?

(c) Why can't the original email system (without MIME) send such attachments?

(d) Briefly explain how this encoding method works.

Question 17 (Bonus)

You attended a **_guest lecture_** from a Yamaha engineer about the Disklavier remote piano system that allows two pianists to perform together from different locations using internet connection.

(a) The engineer mentioned that MIDI files are very small (less than 1 MB) compared to audio recordings (over 60 MB). Explain what MIDI data contains and why it's so much smaller than actual audio files.

(b) The Disklavier system uses VPN tunnels to connect two pianos through Yamaha's cloud server instead of connecting them directly. Give TWO reasons why using VPN is important for this system.

(c) During the lecture, you saw that pianists prefer this system over using Zoom with good speakers. From a data communications perspective, explain why real-time MIDI transmission is better than video conferencing for remote piano performance.