CSE - Computer Networks
2025 Spring Final Exam

Q1. (14 pt) Fill in the Space

i. The _____ protocol is used to dynamically assign IP addresses to hosts on a network.

ii. The field in an IP header used to prevent packets from looping is called _____.

iii. The process of breaking a file into smaller packets and reassembling them at the destination is handled by the _____ layer.

iv. The _____ protocol is used by routers to exchange reachability information between Autonomous Systems.

v. The _____ field in the TCP header ensures the receiver can put the data in the correct order.

vi. A _____ is used to separate collision domains and make forwarding decisions based on MAC addresses.

vii. TCP uses _____ control to prevent the sender from overwhelming the receiver's buffer.

Q2. (15 pt) Descriptive Questions
a) (10 pt) List 5 key differences between TCP and UDP

a) _____

b) _____

c) _____

d) _____

e) _____

b) (5 pt) Match the Description to the Correct Term

Match each description on the left with the most appropriate protocol or concept on the right. Write the correct letter in the space provided.

Match Options:

A - DNS, B - Persistent HTTP, C - DHCP, D - Protocol field in the IP header, E - TCP

No.	Description	Match
1	Ensures reliable communication using sequence numbers and ACKs	
2	Assigns temporary IP addresses to hosts upon joining a network	
3	Provides name-to-IP address translation	
4	Indicates the transport-layer protocol used in a packet (TCP/UDP)	
5	Allows multiple HTTP requests in one TCP connection	

Q3. (15 pt.) HTTP Page Load Scenario

A student opens their browser and types: *http://www.cs.metu.edu.tr/index.html*

Assume the following:

- The browser has no cached content.
- The IP address of the server is **not cached**, so DNS must be used.
- The server uses **non-persistent HTTP/1.0**.
- The page **includes 3 objects** (e.g., images), each on the same server.
- DNS resolution requires **2 round-trip times (RTTs)**.
- Each HTTP request/response requires **1 RTT** plus file transmission time (neglect the file sizes for now).
- TCP **connection setup** requires 1 RTT per connection.

How many RTTs are required before the entire web page (including all objects) is fully received by the browser? Show your reasoning step by step.

Q4. (20pt) TCP RTT and Timeout Estimation

A TCP sender measures the following sample RTTs (in milliseconds) during a connection:

[110, 120, 115, 130, 100]

The initial EstimatedRTT is 100 ms, and the initial DevRTT is 5 ms. Use the following formulas:

- EstimatedRTT = (1 - α) * EstimatedRTT + α * SampleRTT
- DevRTT = (1 - β) * DevRTT + β * |SampleRTT - EstimatedRTT|
- TimeoutInterval = EstimatedRTT + 4 * DevRTT

Assume: α = 0.125, β = 0.25

Calculate the **final TimeoutInterval** after all 5 RTT samples. Show all intermediate steps for full credit.

Q5. (15 pt) DNS Resolution Problem in Local Network

A user complains they can access websites by IP address (like http://142.250.190.78) but not by domain name (like http://www.google.com). Their device has a correct IP and can ping external IPs.

Network setup:

- The DNS server is configured manually as 192.168.1.1
- That IP belongs to the user's **home router**
- All other network settings (IP, gateway, subnet) are valid.

Question:

a. **(5pt)** What layer is likely malfunctioning here?
b. **(5pt)** What protocol is responsible for resolving domain names?
c. **(5pt)** Suggest two ways to troubleshoot or solve the issue.

Q6.   (21 pt) TCP Congestion and Retransmission

You are running a file upload service. A user reports that their uploads start fast but then slow down dramatically. You inspect Wireshark logs and notice multiple duplicate ACKs and retransmissions after a few seconds of smooth transfer.

Questions:

a. (7 pt) What TCP mechanism is likely causing the slowdown?
b. (7 pt) Explain how TCP interprets duplicate ACKs.
c. (7 pt) Which part of the TCP algorithm kicks in, and how does it behave?