National University of Computer and Emerging Sciences

Islamabad Campus

Computer Networks (CS3001)

Sessional-I Exam

Course Instructor(s):

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Section(s): BS(CS) A,B,C,D,E,F,G

Total Time (Hrs): 1

Total Marks: 60

Total Questions: 4

Date: Sep 22, 2025

Roll No _____ Course Section _____

Student Signature

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Attempt all the questions.

INSTRUCTIONS

1. Calculator sharing is **strictly prohibited**. Each student must use their own calculator.
2. **Q4** needs to be attempted on the **question paper**. Use the provided answer sheet for **Q1-3**.
3. **Use a blue or black pen only** (pencil is not acceptable for final answers).
4. All time calculation should be in milliseconds(ms) except where mentioned.
5. Maximum allowed time is **1 hour**.

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[CLO 1: Describe utilization of network protocol concepts vis-a-vis OSI and TCP/IP stack]

Q1: A large file of size **F = 10 Mbits** needs to be transmitted from Host A to Host B across a network with three links and two routers. **[7 marks]**

- Each link has a transmission rate of **R = 2 Mbps**.
- The propagation delay for each link is $\mathbf{d_{prop}}$ **= 5 ms.**
- The routers introduce a processing delay of $\mathbf{d_{proc}}$ **= 1 ms** at each intermediate hop.
- The file is segmented into packets of size **L = 1000 bits.** Assume no queuing delays.

(a) Calculate the transmission delay for a single packet on one link. **[1 Mark]**
(b) Determine the total end-to-end delay for the first packet to reach Host B. **[2 Marks]**

(c) Calculate the total time required for the entire file to be transmitted from Host A to Host B in seconds. **[2 Marks]**
(d) If the file were transmitted as a single, unsegmented message (i.e., one large packet of size F), what would be the total end-to-end delay? **[2 Marks]**

[CLO 2: Demonstrate the basics of network concepts using state-of-the-art network tools.]

Q2: A client resolves the hostname www.example.com. **[8 Marks]**
Iterative DNS resolution involves:

- Local DNS query = **2 ms**
- Root server, TLD server, Authoritative server: each requires **1 RTT = 60 ms** from the local DNS server.
- TCP connection to web server after DNS: **1 RTT = 60 ms**
- Web object size = **500 KB**
- Download link = **8 Mbps**

(a) Compute the DNS resolution delay when cache is cold (requires all 3 lookups). **[2 Marks].**
(b) Compute the total time to fetch the web page (including DNS + TCP setup + download) **[3 Marks].**

(c) If local DNS has cached the IP, compute the improved fetch time. And What is the percentage improvement **[3 Marks]?**

[CLO 4: **Apply** Socket Programming (client/server) to solve various real-world problems, including ensuring of data integrity]

Q3: **[15 Marks]**

a) Differentiate between **TCP socket functions** accept () and connect (). Explain in which process (client/server) each is used, and why accept () returns a new socket while connect () does not. **[3 Marks]**

b) When TCP server calls accept (), it blocks until a client connects.

1. Explain **why a new socket descriptor is returned** instead of reusing the listening socket. **[2 Marks]**
2. Suppose the server handles **multiple clients concurrently** — how would it distinguish between them? **[2 Marks]**

c) The following **TCP server code snippet** is incomplete. Fill in the missing parts and write complete code on answer sheet. The server:

1. Creates a socket **[Marks 1]**
2. Binds it to port 8080 on localhost (127.0.0.1), **[3 Marks]**

3. Listens for a client connection **[2 Marks]**

4. Sends back the message "Welcome" after receiving a single character from the client. **[2 Marks]**

```
int main() {
   int sockfd, new_sock;
   struct sockaddr_in server_addr, client_addr;
    socklen_t addr_len;
    char buffer[50];
// Step 1: Create socket
// Step 2: Set server address structure
// Step 3: Bind socket
// Step 4: Listen
    addr_len = sizeof(client_addr);
    new_sock = accept(sockfd, (struct sockaddr*)&client_addr, &addr_len);
// read and write
    close(new_sock);
    close(sockfd);
}
```

[CLO 1: Describe utilization of network protocol concepts vis-a-vis OSI and TCP/IP stack]
Q4: Fill in the table by choosing the most suitable option from given MCQS 25 **[30 marks]**

1.	b	2.	b	3.	c	4.	b	5.	b
6.	~~d~~	7.	~~d~~	8.	c	9.	a	10.	b
11.	c	12.	a	13.	b	14.	b	15.	b
16.	c	17.	a	18.	b	19.	~~d~~	20.	~~d~~
21.	b	22.	d	23.	b	24.	a	25.	d
26.	c	27.	~~d~~	28.	b	29.	b	30.	a

1. **A company wants to reduce electromagnetic interference on long-distance links. Which medium is best?**
   a) Twisted copper pair
   b) Fiber optic cable
   c) Coaxial cable
   d) Radio waves

2. **What does an access network provide?**
   a) Routing traffic between distant networks
   b) Connecting end devices to the Internet service

c) Forwarding packets between multiple ISPs
d) Resolving hostnames through a DNS system

3. **Average packet arrival rate is 9,000 packets/sec, each packet is 1,000 bits. Link capacity is 12 Mbps. What is the traffic intensity?**
   a) 0.50
   b) 0.60
   c) 0.75
   d) 1.00

4. **Why is frequency division multiplexing (FDM) compared to radio channels?**
   a) Data streams are divided into time slots
   b) Each signal is sent on its own frequency band
   c) Packets are routed based on assigned addresses
   d) Devices transmit after waiting for their turn

5. **A 1,200-byte packet is sent over a link with transmission rate 6 Mbps. What is the transmission delay?**
   a) 0.8 ms
   b) 1.6 ms
   c) 2.4 ms
   d) 3.2 ms

6. **In the Internet's layered view, which part is considered the "heart" of the network?**
   a) Network edge
   b) Transport layer
   c) Network core
   d) Physical media

7. **What does "forwarding" in a router mean?**
   a) Selecting the complete path from source to destination
   b) Sending packets from one router interface to another
   c) Protecting the packet contents through encryption methods
   d) Assigning link capacity fairly among active connections

8. **What happens if router buffers overflow?**
   a) Packets are delayed
   b) Packets are retransmitted immediately
   c) Packets are dropped
   d) Bandwidth increases

9. **Which delay is usually the smallest in real routers?**
   a) Processing delay
   b) Queueing delay
   c) Transmission delay

d) Propagation delay

10. Why doesn't DNS use a single centralized server?

a) It would make the system overly reliable
b) It would create a single point of failure and scaling issues
c) It would reduce overall costs for the entire Internet
d) It would guarantee stronger encryption for all domains

11. If traffic intensity La/R > 1, what does it mean?

a) The system remains stable under current traffic load
b) The average queueing delay becomes nearly negligible
c) Incoming traffic exceeds service rate, causing unbounded delays
d) Propagation time becomes the main factor in performance

12. Firewalls operate as:

a) Middleboxes filtering packets based on policies
b) End devices preventing local packet forwarding
c) Replacement for routers
d) Wireless access points

13. HTTP is considered:

a) Stateful
b) Stateless
c) Always encrypted
d) Real-time

14. Which HTTP method requests headers only?

a) GET
b) HEAD
c) POST
d) PUT

15. In non-persistent HTTP, downloading 10 images requires:

a) One TCP connection
b) 10 TCP connections
c) A UDP connection
d) Only caching

16. Which is an example of an "elastic" application in terms of throughput?

a) Internet telephony
b) Real-time video conferencing
c) File transfer
d) Online gaming

17. Which security protocol is layered above TCP to provide encryption?

a) TLS

b) UDP
c) DNSSEC
d) SSH only

18. In non-persistent HTTP, ignoring DNS lookup and transmission time, how many RTTs per object are required?
a) 1 RTT
b) 2 RTTs
c) 3 RTTs
d) 0.5 RTT

19. Which protocol allows rich server-side manipulation?
a) POP3
b) SMTP
c) IMAP
d) FTP

20. A web page has a base HTML file (ignore transmission time) and 5 small objects. RTT = 40 ms. Using non-persistent HTTP with parallelism of 5 connections, total time to fetch the page is approximately:
a) 120 ms
b) 80 ms
c) 160 ms
d) 200 ms

21. In SMTP, messages must be encoded in:
a) 8-bit binary
b) 7-bit ASCII
c) Unicode
d) HTML only

22. A client queries 3 DNS servers sequentially with RTTs of 10 ms, 20 ms, and 15 ms, before contacting the final web server (RTT to webserver = 25 ms). Ignore file transmission. How long until the HTML page starts arriving?
a) 45 ms
b) 55 ms
c) 70 ms
d) 95 ms

23. Recursive DNS queries put heavy load on:
a) Client hosts
b) Upper-level servers
c) Local caches
d) Firewalls

24. Which SMTP feature makes it more similar to HTTP?

a) ASCII command/response interaction with status codes
b) It uses UDP
c) Each object is encapsulated in multipart messages
d) POP3 is embedded inside it

25. ICANN's role in DNS includes:

a) Issuing IP addresses only
b) Handling POP3 authentication
c) Running all local DNS servers
d) Managing the root domain

26. A TCP server has a backlog of 5 connections. If 12 clients simultaneously request connections, how many will be blocked or refused?

a) 5
b) 6
c) 7
d) 12

27. In UDP, how is sender address information conveyed?

a) It is included explicitly within each transmitted datagram
b) It is exchanged during a connection setup handshake
c) It is maintained inside the socket state by the system
d) It is determined only from the server's initial bind call

28. UDP sockets are also called:

a) Stream sockets
b) Datagram sockets
c) Non-Persistent sockets
d) Secure sockets

29. Which statement about TCP server sockets is correct?

a) The listening socket itself is reused for communication
b) A new socket is created for each client connection
c) All clients share the same socket instance
d) Clients must bind before sending data

30. In a TCP server-client program, why do we need both server socket and accepted client sockets?

a) To separate listening from communication, allowing multiple clients
b) To encrypt vs decrypt data separately
c) To support UDP alongside TCP
d) To reduce propagation delay