MANIPAL INSTITUTE OF TECHNOLOGY
BENGALURU
(A constituent unit of MAHE, Manipal)

V SEMESTER MIDTERM TEST
COMPUTER NETWORKS (IT_3152/CSE_3152)

Duration: 2 Hours **Scheme of Evaluation** **Max Marks: 30 Marks**

Type: MCQ

Q1. An HTTP client wants to retrieve a web document from a given URL, but the IP address of the server is initially unknown. What transport and application-layer protocols, besides HTTP, are required to retrieve the document (1)

1. DNS and UDP
2. DNS and TCP
3. ARP and UDP
4. FTP and TCP

Ans : 2

Q2. If a signal travels a distance of 500 meters through a medium where the propagation speed is 2 x 10^8 meters per second , the propagation delay would be (1)

1. 2.5 microseconds
2. 5 microseconds
3. 1.5 microseconds
4. None of these

Ans : 1

Q3. Consider a link with a transmission rate of 100 Mbps. If the transmission delay for a packet is 4 milliseconds, what is the size of the packet (1)

1. 50,000 bits
2. 400,000 bits
3. 5,000 bits
4. 4,000 bits

Ans : 2

Q4. Which of the following is true about HTTP persistent connections (HTTP keep-alive) (1)

1. It keeps the server-side connection open for multiple clients
2. It allows multiple requests and responses between the client and server over a single TCP connection
3. It is only available in HTTP/2
4. It reduces server load but increases client-side delay

Ans : 2

Q5. Which of the following statements is correct with respect to the File Transfer Protocol (FTP) (1)

1. FTP uses a single connection for control and data transmission
2. FTP uses the User Datagram Protocol (UDP) for data transmission
3. FTP uses separate control and data connections
4. FTP encrypts all data transmissions for security

Ans : 3

Q6. In the context of email protocols, which of the following statements is correct (1)

1. SMTP is used to pull emails from a mail server
2. IMAP allows a user to access their email without downloading them
3. POP3 keeps emails on the server after retrieval
4. Both IMAP and POP3 are used to send emails

Ans : 2

Q7. If a network can transfer 25 megabytes (MB) of data in 5 seconds, the throughput is (1)

1. 20 Mbps
2. 40 Mbps
3. 60 Mbps
4. 2.5Mbps

Ans : 2

Q8. Which of the following statements about the Domain Name System (DNS) is true (1)

1. DNS uses TCP for resolving hostnames
2. DNS always provides recursive query resolution
3. DNS uses a distributed database structure
4. DNS guarantees that all records are globally consistent

Ans : 3

Q9. If the length of the whole UDP packet is 28 bytes. Then what is the length of the data (1)

1. 28

2. 16
3. 8
4. 20

Ans : 4

Q10. A UDP message is 512 bytes long. How many such UDP messages can be sent in 1 second over a link with a transmission rate of 10 Mbps (1)

1. 1953
2. 2441
3. 2048
4. 1875

Ans : 2

Type: DESCRIPTIVE

Q11 A. Let's consider a simple example with the following assumptions:
The packet travels through 3 routers (4 links in total).
Packet size L = 1500 bytes (12,000 bits).
Each link has a transmission rate R = 10 Mbps.

Each link has a length d = 100 km, with a propagation speed s = 2×10^8 m/s

Processing delay at each router Dproc = 1 ms.
Queuing delay at each router Dqueue = 2 ms.

Calculate the end-to-end delay (5)

Ans:

Calculation

1. **Transmission Delay (D_{trans}):**
   $D_{trans} = \frac{L}{R} = \frac{12{,}000 \text{ bits}}{10 \times 10^6 \text{ bps}} = 1.2 \text{ ms}$
2. **Propagation Delay (D_{prop}):**
   $D_{prop} = \frac{d}{s} = \frac{100 \times 10^3 \text{ m}}{2 \times 10^8 \text{ m/s}} = 0.5 \text{ ms}$
3. **Processing Delay (D_{proc}):**
   $D_{proc} = 1 \text{ ms}$
4. **Queuing Delay (D_{queue}):**
   $D_{queue} = 2 \text{ ms}$

Total Delay for One Link:

$$D_{link} = D_{proc} + D_{queue} + D_{trans} + D_{prop}$$
$$D_{link} = 1\ \text{ms} + 2\ \text{ms} + 1.2\ \text{ms} + 0.5\ \text{ms} = 4.7\ \text{ms}$$

Total End-to-End Delay:

Since there are 4 links (3 routers):

$$D_{end-to-end} = 4 \times D_{link} = 4 \times 4.7\ \text{ms} = 18.8\ \text{ms}$$

Q11 B. Consider a **pseudoheader** which is the part of the header of the IP packet and in which the user datagram is to be encapsulated is as follows

Source IP: 192.168.1.1

Destination IP: 192.168.1.2

Protocol (UDP): 17

UDP Length: 16

UDP Header

Source Port: 1234 → 04D2

Destination Port: 5678 → 162E

Length: 16 → 0010

Checksum: 0000

Data

6865 6C6C 6F00

Compute the checksum for the above UDP details (5)

Ans:

Source IP: 192.168.1.1 → C0A8 0101

Destination IP: 192.168.1.2 → C0A8 0102

Protocol (UDP): 17 → 0011

UDP Length: 16 → 0010

C0A8 0101 C0A8 0102 0011 0010 = 18374 = 8374+1 = 8375

Extract UDP Header and Data

The receiver extracts the UDP header from the packet. The fields in the UDP header are:

Source Port: 1234 → 04D2

Destination Port: 5678 → 162E

Length: 16 → 0010

Checksum: 1BFF (the value transmitted by the sender) =1B10

Data: 6865 6C6C 6F00 =43D2

8375 + 1B10 + 43D2 = **E257 is the Checksum sent to the receiver.**

Q12 A. Imagine there is a company TechGlobal, which has a team of remote employees who frequently switch between different devices to check their email—laptops, smartphones, and tablets. Each employee receives hundreds of emails daily. Currently, the company uses the POP3 (Post Office Protocol 3) for email retrieval, and employees are facing the following issues:

- Emails are only available on the device from which they were first downloaded:
- No email synchronization
- Storage issues on devices

Provide a solution in terms of a recommendation of a protocol that solves the above problem and also the details of the solution (5)

Ans: The issues faced by TechGlobal's remote employees can be addressed by switching from **POP3** to **IMAP (Internet Message Access Protocol)**.

Problem: With POP3, once an email is downloaded, it is usually removed from the server (unless configured otherwise), making it unavailable on other devices.

1. **Emails Only Available on the Device from Which They Were First Downloaded**

Solution with IMAP:

- **Server-Based Storage**: IMAP stores all emails on the server, allowing any device (laptop, smartphone, or tablet) to access the same emails.
- **Access from Multiple Devices**: No matter which device the email is first opened on, it will remain available across all devices, as IMAP maintains emails on the server rather than moving them to the local device.

2. No Email Synchronization

Problem: POP3 does not synchronize email actions (like reading, deleting, or organizing) across multiple devices. An email marked as "read" on one device will still appear as "unread" on another.

Solution with IMAP:

- **Full Email Synchronization**: IMAP ensures that all actions (such as marking emails as read, deleting, or moving emails to folders) are synchronized across all devices. When an action is performed on one device, the same state is reflected on other devices.
- **Real-Time Updates**: Changes made in one email client (like a smartphone) are immediately visible on another device (like a laptop). For instance, if an employee reads or deletes an email on their tablet, that change is reflected on their phone and laptop as well.

3. **Storage Issues on Devices**

Problem: POP3 downloads the entire email to the local device, consuming local storage. This becomes a significant problem when employees receive hundreds of emails per day.

Solution with IMAP:

- **Emails Stored on the Server**: With IMAP, emails are kept on the server, not on local devices. This reduces the need for local storage space on each device.
- **Download-on-Demand**: IMAP only downloads email headers or part of the email until the full email is requested for reading, significantly reducing local storage usage. Full email content is downloaded only when needed (e.g., when an attachment is opened).
- **Selective Offline Access**: Devices can cache emails for offline access, but the majority of email data remains on the server, meaning storage is not overwhelmed by the hundreds of daily emails.

Q12 B. Describe how Web caching can reduce the delay in receiving a requested object. Will Web caching reduce the delay for all objects requested by a user or for only some of the objects? Why?

Correct the following snippet of socket programs and justify the correction

```
if (listen(server_fd, 0) < 0) {
    perror("listen");

    exit(EXIT_FAILURE);

} (5)
```

Ans: Soln : Web caching can bring the desired content "closer" to the user, perhaps to the same LAN to which the user's host is connected. Web caching can reduce the delay for all objects, even objects that are not cached, since caching reduces the traffic on links.

Corrected Snippet

```
if (listen(server_fd, 10) < 0) {
   perror("listen");
   exit(EXIT_FAILURE);
}
```

In the original code, the backlog is set to 0, which means no connections will be queued for acceptance, making the server non-functional.

Note: **The backlog value should be greater than 0. A common approach is to use a value greater than 10 but any value greater than 1 is acceptable.**