# KAIMOSI FRIENDS UNIVERSITY

## SECOND YEAR FIRST SEMESTER UNIVERSITY EXAMINATIONS
## 2025/2026 ACADEMIC YEAR

### SPECIAL EXAMINATIONS

### FOR THE DEGREE OF BACHELOR OF SCIENCE (IT)

**COURSE TITLE:** NETWORKING PROGRAMMING

**COURSE CODE:** BIT 454

**DATE:** 24/6/2026 **TIME:** 3-5PM

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**INSTRUCTIONS TO STUDENTS**

1. Answer **QUESTION ONE** and **ANY OTHER TWO** from the choices given.
2. Phones, smart watches, ear phones or any other unauthorized digital and AI gadgets and applications are **NOT ALLOWED IN** the examination room.
3. Answer all questions in the exam answer booklet provided.
4. Do not write on this question paper.
5. All KAFU examination rules and regulations apply.
6. DURATION OF EXAMINATION: **TWO (2) HOURS**

**KAFU observes ZERO tolerance to examination cheating.**

**QUESTION ONE (30 MARKS) – COMPULSORY**

(a) Define the terms IP address and port number as used in Network Programming. **(2 marks)**

(b) Explain TWO key differences between a connection-oriented protocol and a connectionless protocol. **(2 marks)**

(c) Describe the role of the Transport Layer in the TCP/IP model. **(2 marks)**

(d) Differentiate between an InputStream and an OutputStream in Java socket programming. **(2 marks)**

(e) Explain the meaning of a well-known port? Give one example. **(2 marks)**

(f) State TWO advantages of using concurrent servers over iterative servers. **(2 marks)**

(g) Explain the term "I/O Multiplexing" in the context of network servers. **(2 marks)**

(h) The Java code below is intended to create a simple daytime client that connects to a server, reads a response, and prints it. It contains **FOUR errors**. Identify each error and write the correct line. **(4 marks)**

```
import java.net.*;
import java.io.*;

public class DaytimeClient {
    public static void main(String[] args) {
        String server = "time.nist.gov";
        Socket socket = new Socket(server); // Error 1

        InputStream in = socket.getInputStream();
        BufferedReader reader = new BufferedReader(in); // Error 2

        String response = reader.readLine();
        System.out.println("Response: " + response);

        reader.close();
        // Error 3:
        // Error 4:
    }
}
```

(i) The Java code below is intended to create a UDP server that listens for a packet and prints its contents. It contains **FOUR errors**. Identify each error. **(4 marks)**

```
import java.net.*;

public class UDPServer {
    public static void main(String[] args) throws Exception {
        DatagramSocket socket = new DatagramSocket(); // Error 1
        byte[] buf = new byte[1024];

        DatagramPacket packet = new DatagramPacket(buf, buf.length);
        socket.send(packet); // Error 2

        String received = new String(packet.getData(), 0, packet.getLength());
        System.out.println("Received: " + received);

        InetAddress clientAddress = packet.getAddress();
        int clientPort = packet.getLocalPort(); // Error 3

        socket.close();
        // Error 4:
    }
}
```

(j) Write a Java program for a simple TCP server that performs the following:

i. Listens for a connection on port 6000. **(2 marks)**
ii. Accepts a client connection. **(2 marks)**
iii. Reads a message sent by the client and prints it to the console. **(2 marks)**
**iv.** Sends the message "Message received" back to the client and closes the connection. **(4 marks)**

## QUESTION TWO (20 MARKS)

(a) With the aid of a diagram, explain the three-way handshake process used to establish a TCP connection. **(6 marks)**

(b) Describe the purpose and functionality of the Domain Name System (DNS) in a networked environment. **(4 marks)**

(c) Explain the concept of a socket. Describe the key information that must be specified to create a TCP socket on the server side and on the client side. **(6 marks)**

(d) Discuss TWO application layer protocols that rely on UDP and explain why UDP is a suitable choice for them. **(4 marks)**

**QUESTION THREE (20 MARKS)**

(a) Compare the select(), poll(), and epoll() system calls for I/O multiplexing. Justify which one is generally considered more scalable for handling a large number of connections and why. **(6 marks)**

(b) Critique the challenges of developing a networked application that must handle hundreds of concurrent client connections. Outline TWO different programming models or techniques used to achieve this concurrency and evaluate their trade-offs. **(6 marks)**

(c) Distinguish between a Mutex and a Semaphore in the context of inter-process communication (IPC). Provide a simple code-like example illustrating the use of a mutex. **(4 marks)**

(d) Explain what a Unix Domain Socket is. Propose a scenario where using a Unix Domain Socket would offer better performance than using a TCP/IP socket on the same host and justify your proposal. **(4 marks)**

**QUESTION FOUR (20 MARKS)**

(a) Outline the sequence of steps a client program must take to establish a TCP connection with a server and exchange data. **(4 marks)**

(b) You are tasked with designing a simple chat application that allows multiple users to send messages to a central server, which then broadcasts the message to all other connected users. Evaluate whether TCP or UDP would be the more appropriate transport protocol for this application. Justify your decision by considering the application's requirements. **(6 marks)**

(c) Explain the difference between HTTP and HTTPS. Describe the role of SSL/TLS in an HTTPS connection, detailing the steps involved in setting up the secure channel. **(6 marks)**

(d) Identify TWO security threats specific to networked applications. For each threat, recommend a programming practice or technique that can be used to mitigate it. **(4 marks)**

**QUESTION FIVE (20 MARKS)**

(a) Illustrate how a Remote Procedure Call (RPC) works. Explain the roles of the client stub and the server stub in this process. **(6 marks)**

(b) Contrast Pipes and Message Queues as methods for Inter-Process Communication (IPC). Argue for TWO advantages of Message Queues over Pipes. **(6 marks)**

(c) A company's network administrator suspects that a malicious application on an internal host is sending sensitive data to an external server. Recommend TWO network traffic analysis tools that could be used to investigate this issue, and explain what information each tool would provide. **(4 marks)**

(d) Explain the concept of socket options. Provide an example of a useful socket option (e.g., SO_REUSEADDR) and describe its purpose. **(4 marks)**