**Question 1: [Total: 25 marks]**

(a) **Computer networks are organized as a stack of layers. List each of the 5 layers introduced in our module and briefly explain their main objectives. What are the advantages of layering? [5 marks]**↳

(b) **Explain the concept of Quality of Service (QoS) in computer networks. What are some QoS parameters that applications might require? [5 marks]**↳

(c) **Describe how the Transmission Control Protocol (TCP) handles flow control. Why is flow control important in a network? [10 marks]**↳

(d) **Discuss the Carrier Sense Multiple Access with Collision Detection (CSMA/CD) protocol. How does it help in managing network access? [5 marks]**

**Question 2: [Total: 25 marks]**

(a) **Using a Finite State Machine (FSM), explain how the Go-Back-N protocol handles packet loss and retransmission. [10 marks]**

(b) **Compare and contrast TCP and UDP in terms of reliability, ordering, and connection setup. [5 marks]**

(c) **What is the role of the Hypertext Transfer Protocol (HTTP) in the web? Discuss the privacy concerns related to HTTP. [5 marks]**

(d) **Explain how the Internet Protocol (IP) handles addressing and fragmentation in a network. [5 marks]**

**Question 3: [Total: 25 marks]**

(a) **Consider the network shown below. [12 marks]**

i. **Show the operation of Dijkstra’s algorithm for computing the least cost path from node A to all other destinations. [7 Marks]**

ii. **From the results obtained in part i), show the shortest path from node A to node E, and briefly explain the steps you took to find this path. [5 Marks]**

(b) **Write code snippets (not full programs) of Python programs for creating and using UDP sockets for a client and a server (IP: 127.0.0.1 and Port: 9999). [10 Marks]**

(c) **What are the key differences between static routing and dynamic routing? [3 Marks]**

**Question 4: [Total: 25 marks]**

(a) **Compare and contrast HTTP/1.1 with HTTP/2. [5 Marks]**

(b) **Assume that you have an HTML file with 20 embedded objects. The objects and the base file are small enough to fit in one TCP segment. How many RTTs are required to retrieve the base file and objects under the following conditions: [10 Marks]**

i. **Non-persistent HTTP connection with no parallel connections. [3 Marks]**

ii. **Non-persistent HTTP connection with 5 parallel connections. [2 Marks]**

iii. **Persistent HTTP connection without pipelining. [3 Marks]**

iv. **Persistent HTTP connection with pipelining. [2 Marks]**

(c) **What is network congestion? Describe how TCP’s slow start algorithm mitigates congestion. [5 marks]**

(d) **Discuss the main considerations for designing a secure computer network. [5 Marks]**