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THE UNIVERSITY
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# JANUARY 2004 EXAMINATIONS

Bachelor of Science : Year 1
Bachelor of Science : Year 2
No qualification aimed for : Year 1

## INTERNET PRINCIPLES

**TIME ALLOWED: Two Hours**

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INSTRUCTIONS TO CANDIDATES

**Answer any four questions.**

**Each question is worth 25 marks.**

If you attempt to answer more than the required number of questions, the marks awarded for the excess questions will be discarded (starting with your lowest mark).

*Electronic calculators are neither necessary nor permitted.*

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## QUESTION 1

**(a)** Draw a diagram to show the standard 5-layer (*"North American"*) model of distributed communication. **3 marks**

**(b)** Briefly describe the function of each layer. **2 marks each**

**(c)** Which layers have protocols found in machines at the network edge? **1 mark**

**(d)** Which layers have protocols typically found in the machines in the network core? **2 marks**

**(e)** Draw a diagram to show the OSI-ISO 7-layer model of distributed communication. **3 marks**

**(f)** Draw a diagram to show the relationship between the 5-layer and the 7-layer models. **2 marks**

**(g)** What are the major differences between the design of the Internet and the design of public voice telecommunications networks? **4 marks**

## QUESTION 2

**(a)** What information is contained in a socket? **2 marks**

**(b)** What is the name of a model of distributed computing in which one computer requests something from a second computer, and the second computer seeks to fulfill this request? **1 mark**

**(c)** What does an Application-Layer protocol provide to protocols in the layer beneath? **3 marks**

**(d)** What is the difference between a "push" and a "pull" protocol? **2 marks**

**(e)**

**(i)** What do the letters "HTTP" stand for? **1 mark**

**(ii)** What is the purpose of this protocol? **2 marks**

**(iii)** Is HTTP a "push" or a "pull" protocol? Why? **2 marks**

**(f)**

**(i)** HTTP lacks state. What does this mean? **3 marks**

**(ii)** Give any two advantages of HTTP's being stateless. **4 marks**

**(g)**

**(i)** The Simple Mail Transfer Protocol (SMTP) is an application-layer protocol for mail transfer between hosts. Is SMTP a "push" or a "pull" protocol? Why? **2 marks**

**(ii)** Why is SMTP not always used for the final leg of mail transfer, between the receiver host machine and the receiver mail software program? **3 marks**

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## QUESTION 3

**(a)** Protocols at the Transport Layer create segments which are then given to the Layer below. What do these segments contain? **2 marks**

**(b)** TCP and UDP are two common Transport-Layer protocols. What is the main difference between them? **3 marks**

**(c)** Suppose you are tasked with the design of an application-layer protocol, and you can use either TCP and UDP in your application. What factors would you consider in choosing one of them? **5 marks**

**(d)** For the following questions, you are asked to present procedures for the operations involved in some elements of an artificial Transport Layer protocol called *C211P* (COMP211 Protocol), similar to TCP. Please indicate whether your procedures are for the sender side, or for the receiver side, or both.

**(i)** C211P uses sequence numbering. Write pseudocode for the task of assigning sequence numbers to segments. **4 marks**

**(ii)** C211P uses cumulative ACKs. Write pseudocode for the task of deciding to issue an ACK. **4 marks**

**(iii)** C211P uses a pipelined, Go-Back-10 system. Ignoring time-outs, draw a flowchart for the task of deciding whether to send the next segment. **7 marks**

## QUESTION 4

**(a)** Protocols at the Network Layer create datagrams which are given to the Layer below. What do these datagrams contain? **3 marks**

**(b)** What is a virtual circuit in the Internet? **2 marks**

**(c)** Virtual circuits require call set-up and call tear-down. What are these? **2 marks**

**(d)** Do Datagram networks used on the Internet require call set-up and tear-down? Why or why not? **2 marks**

**(e)** Suppose you have 7 host machines and 1 router all connected together, with the following IPv4 addresses:

- Three hosts have addresses in the network 223.1.1.0/24.
- Two hosts have addresses in the network 223.2.0.0/16.
- Two hosts have addresses in the network 223.1.3.0/30.
- The router has addresses 223.1.1.40, 223.2.0.9 and 223.1.3.85.

**(i)** Draw a diagram to represent this configuration. **5 marks**

**(ii)** Draw a forwarding table for the host machine with IP number 223.1.1.1. **3 marks**

**(iii)** Draw a forwarding table for the router. **3 marks**

**(iv)** Show the steps involved when a datagram is sent from host machine 223.1.1.1 to host machine 223.2.0.1. **5 marks**

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**QUESTION 5**

**(a)** What are the differences between repeaters, bridges and routers? **4 marks**

**(b)** Explain how the checksum function in UDP works? **3 marks**

**(c)**

**(i)** What is a multiple access protocol? **3 marks**

**(ii)** Why are these protocols needed? **3 marks**

**(iii)** Briefly describe TDMA, FDMA and CDMA multiple access protocols. Use a diagram to illustrate the differences between these. **9 marks**

**(iv)** What is the difference between random access protocols and turn-taking protocols? **3 marks**

**QUESTION 6**

**(a)** Draw a diagram to show the principal components of a modem, and their relationships. **3 marks**

**(b)**

**(i)** The Internet Protocol is a *best-effort* communications medium. What does this mean? **2 marks**

**(ii)** What consequences does this have for designers of application protocols? **3 marks**

**(c)** Briefly explain the different between in-band and out-of-band communications. What is the usual reason for deploying an out-of-band channel in a communication interaction? **2 marks**

**(d)** What does the signal-to-noise ratio measure in a communications channel? **2 marks**

**(e)** What is the maximum rate in bits per second at which data may be transmitted over a communications channel with channel bandwidth of 3100 Hz and signal-to-noise ratio of 1000:1 (i.e. 30 dB)? **3 marks**

**(f)** Suppose you are tasked with the design of an application-layer protocol for Voice-over-IP. How would you deal with the unreliability of the Internet Protocol? Which aspects of unreliability would affect your application? What trade-offs would you have to make? Which Transport-layer protocol would you use? Why? **10 marks**