UNIVERSITY OF SWAZILAND

Faculty of Science

Department of Computer Science

MAIN EXAMINATION MAY 2012

Title of paper: NETWORKS AND CODING THEORY – II

Course number: CS438

Time allowed: 3 hours

Instructions to candidates:

This question paper consists of **SIX (6)** Questions. Answer any **FOUR (4)** questions. Marks are indicated in the square brackets.

All questions carry equal marks.

THIS EXAMINATION PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR

QUESTION 1

a) Describe the main services provided by the network layer. [4]

b) Define, and contrast between, *central*, *distributed* and *isolated* routing strategies. [6]

c) Briefly describe *random routing*. [2]

d) We know that transport protocols resemble the data link layer protocols in that they all have to deal with error control, sequencing, flow control, among other things. Is this duplication of effort? Explain your answer. Describe two major complications in the transport protocol design. [6]

e) Why is routing necessary in the network? What are the major properties of routing algorithms? Is the shortest path routing algorithm a static routing algorithm? [7]

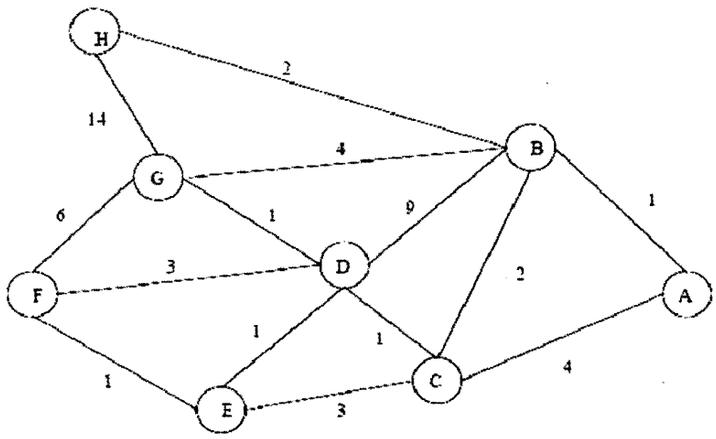
QUESTION 2

a) Distributed routing algorithms in communications systems are designed to provide a fault-tolerant computation of end-to-end paths in the event of link or router failure (or repair).

   i. Describe how this occurs, using as an example the distance-vector algorithm. [4]
   ii. Distance-vector routing is said to be slow to react to changes. Explain why, and outline why link-state protocols are therefore preferred in today's Internet. [5]

b) A packet traversing the Internet typically undergoes several types of delays, including nodal processing delay, transmission delay, propagation delay, and queuing delay. Define each of these four types of delays. How can each of these delays be reduced? [8]

iii) Consider a Network represented by the following directed graph .



With the indicated link costs, use Dijkstra's shortest-path routing algorithm to compute the shortest path from node ***F*** to all network nodes. Hence create the routing table for node ***F.*** [8]

QUESTION 3

a) Why does DNS use UDP instead of TCP for its service? What is the size of a TCP header? What is the size of a UDP header? What fields exist in both TCP header and UDP header? [9]

b) Web caches are often justified on the ground that they speed up web browsing and reduce bandwidth costs, but sometimes they do not work well. Give 3 reasons why a bad web cache might not be a good investment for an organization. [3]

c) Briefly describe the concept of tunneling in Internetworks. [3]

d) TCP employs a "three-way handshake at the start of a connection. With the aid a well labeled diagram explain what is meant by a "three way handshake" and why it is necessary. [5]

e) What's the transport protocol employed by HTTP? What's the difference between HTTP 1.0 and HTTP 1.1? [5]

QUESTION 4

a) What is the purpose of the Time to Live (TTL) field in an IP packet? How is it used? [3]

b) Distinguish between TCP and UDP, explaining the kinds of applications to which each is suited. [10]

c) TCP uses a three-way handshake for reliable connection management, when establishing a logical end-to-end (process-to-process) connection.
   i) What important control information is carried in the first TCP segment (packet) of the three-way handshake, and why? [4]

   ii) How many TCP segments (packets) are required to close a TCP connection? [2]

d) Write full names of the following and explain their function
   i. NAT
   ii. ARP [6]

QUESTION 5

a) A TCP entity transmits 10,000 bytes of data in 2,000 byte segments (thus, including the TCP header, there will be 2,020 bytes of IP data for each segment). The IP entity is operating with a Maximum Transmission Unit (MTU) of 1024 bytes. Calculate how many packets the IP entity will transmit and justify your answer. (You may ignore errors and assume that IP headers are 20 bytes). [4]

b) i) With the aid of appropriate examples explain how transposition and substitution ciphers work. [4]

   ii) Use the RSA algorithm to encrypt the letter **g** assuming that p = 3 and q = 7. What will be the public key, private key and the encrypted message to be transmitted? Show all your working. [4]

c) Your organization has been assigned the Class C address of 200.127.12.0 and your network Administrator intends to use the extended network prefix to be **/28**.

   i) What is the Directed Broadcast IP address for this network? [1]

   ii) How many sub-networks can you have on this network? Clearly show how you obtained your answer. [4]

   ii) How many nodes can be supported on each of these sub-networks? Again, clearly show how you obtained your answer. [4]

d) Explain the concept of subnetting. State any 2 benefits of subnetting. [4]

QUESTION 6

a) i) What are the major goals of network security? What are the basic parts of an encryption system? [6]

b) Briefly explain the overall approach to security embodied in using firewalls. Explain the idea behind packet filtering and give two examples of criteria that might be chosen as the basis of filtering packets. [6]

c) The IPv4 address space is considered to be too small to accommodate future Internet growth. Explain how the structure of IPv4 addresses has led to the wasting of substantial portions of the IPv4 address space. [4]

d) Proxy servers are widely used in client –server based applications, for example HTTP. Use a diagram to show how a web proxy server works. List three functions implemented by a web proxy server, and briefly describe the benefits of implementing a web proxy server. What's the difference between HTTP and HTTPS [9]

<<End of Question Paper>>