UNIVERSITY OF SWAZILAND
FACULTY OF SCIENCE
DEPARTMENT OF ELECTRONIC ENGINEERING

MAIN EXAMINATION 2006/2007

TITLE OF PAPER   :   COMPUTER NETWORKS & OPEN SYSTEMS
INTERCONNECTIONS

COURSE NUMBER :   ECO 520

TIME ALLOWED   :   THREE (3) HOURS

INSTRUCTIONS   :   ANSWER ANY FOUR QUESTIONS

EACH QUESTION CARRIES 25 MARKS

MARKS FOR DIFFERENT SECTIONS ARE SHOWN
IN THE RIGHT-HAND MARGIN


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THE INVIGILATOR

QUESTION ONE

(a) State the principal function of each of the following layers in the OSI reference model
   (i) physical layer
   (ii) transport layer
   (iii) network layer

(6 marks)

(b) What is the main difference between circuit switching and packet switching?

(4 marks)

(c) If a binary signal is sent over a 3-kHz channel whose signal-to-noise ratio is 20 dB, what is the maximum achievable data rate?

(4 marks)

(d) How do IP addresses get mapped onto data link layer addresses, such as Ethernet?

(6 marks)

(e) A certain Ethernet system has a maximum bus delay of 16 µs, and operates with a bit rate of 10 Mbit/s. Each frame is 576 bits in length. Determine the maximum utilization factor of the medium under collision conditions.

(5 marks)

QUESTION TWO

(a) Briefly discuss the operation of the following carrier sense multiple access protocols;

   (i) 1-persistent CSMA   (4 marks)
   (ii) CSMA/CD   (4 marks)

(b) Give three characteristics that distinguishes LANs from other kinds of networks

                                                                      (3 marks)

(c) A pure ALOHA system uses a 56 kbit/s channel. On average, each terminal originates a 1024-bit packet every 30 seconds. How many terminals can the system accommodate?

                                                                      (5 marks)

(d) Sketch the Manchester encoding and the differential Manchester encoding for the bit stream : 0001010111. (Assume a 0 is represented by a low level and a 1 by a high level)

                                                                      (3 marks)

(e) Consider two host computers A and F connected via four switching nodes B, C, D, and E, in a store-and-forward network
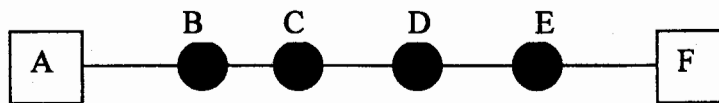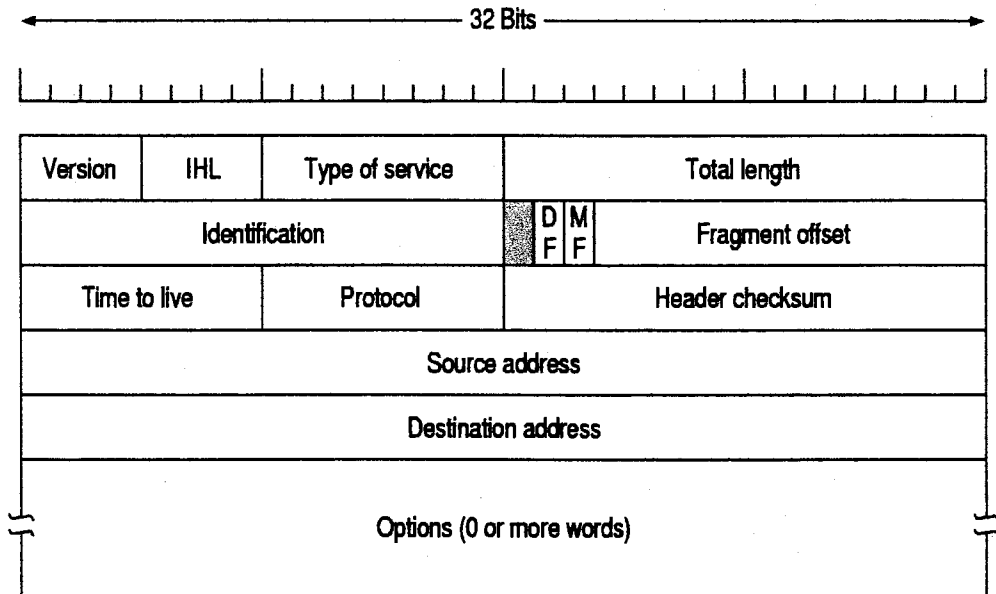

Ignoring processing times in the hosts and switching nodes, and assuming transmission rates of 10 kbps, calculate the time to send a 5 kbit message from A to F

   (i) if the whole message is transmitted as a single block   (2 marks)
   (ii) if the message is segmented into 1 kbit packets which are transmitted one after another

                                                                      (4 marks)

QUESTION THREE

(a) Discuss the IPv4 datagram header fields given in the frame below

(10 marks)

```
|<------------------------- 32 Bits ------------------------->|
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
```

Version	IHL	Type of service			Total length	
Identification			DF	MF	Fragment offset	
Time to live		Protocol		Header checksum		
Source address						
Destination address						
Options (0 or more words)						

(b) A 4000 byte IP datagram (with DF bit set to 0) from an FDDI (fibre distributed data interface) ring is received by a gateway router to an Ethernet LAN. Explain what the router does to the datagram in order to transmit it across that Ethernet LAN. In your answer, give the fragmentation-related header field values of the IP datagrams sent onto the LAN. Assume that each frame, apart from the last one, is as full as possible. You may also assume that the datagram header has no options.

Hint: IP header is 20 bytes (with no options) and maximum size of an Ethernet data field is 1500 bytes

(8 marks)

(C) With the aid of a sketch, briefly discuss the principle of operation of the Go – back N protocol

(7 marks)

QUESTION FOUR

(a) Using **CIDR** (Classless Inter-Domain Routing), an ISP called ISP_A is allocated the prefix 194.24.0.0/16. Determine the class of the address and allocate prefixes to four of its customers requiring 2048, 1024, 1024 and 4096 host addresses. Also give the address ranges and the respective subnet masks

(10 marks)

(b) By using Dijksra's routing algorithm to the network of routers shown below, find the minimum distances and routes between node C and all other nodes. Also, sketch the graph of the routes.

(12 marks)
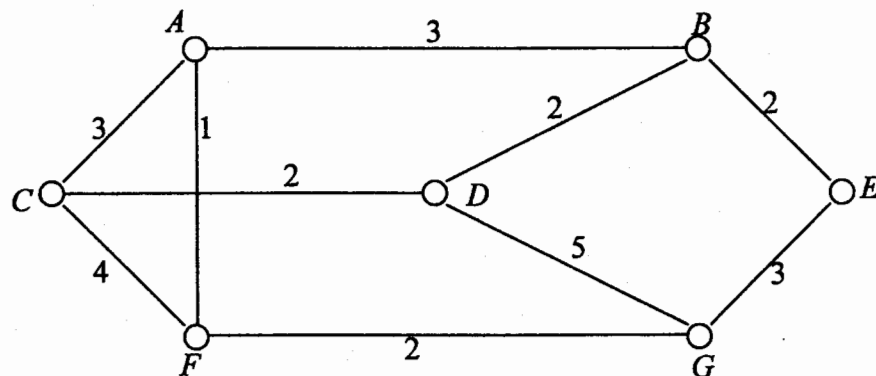
(c) Consider the use of 1024 bit packets on a 64 kbit/s satellite channel, where the round trip to and from the satellite is 250 ms. Ignoring the processing time and ACK bits, calculate the time utilization to send a packet using **stop & wait protocol**

(3 marks)

QUESTION FIVE

(a) Compare and contrast connectionless communication and connection-oriented communication

(8 marks)

(b) Imagine that you train your dog, Jupiter, to carry a box of two floppy disks. These floppy disks each contain 250,000 bytes. Jupitor can travel to your side, wherever you may be, at 18 km/hr. For what range of distance does Jupiter have a higher rate than a 300 bps telephone line

(6 marks)

(c) Consider an error-detecting **CRC** with the generator 10011. The CRC bits follow the data bits in any transmission. The string of bits 111011000100 is received. Is it acceptable, and if so what is the data bit sequence.

(5 marks)

(d) Give three (3) main requirements for having seven (7) layers in the OSI reference model

(6 marks)