UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

DEPARTMENT OF ELECTRONIC ENGINEERING

MAIN EXAMINATION 2006

TITLE OF PAPER: COMPUTER NETWORKS AND OSI

COURSE NUMBER: ECO520

TIME ALLOWED: THREE HOURS

INSTRUCTIONS: ANSWER QUESTION **1** AND **ANY THREE** OF THE OTHER FOUR QUESTIONS.

EACH QUESTION CARRIES **25 MARKS**.

DO NOT OPEN THE PAPER UNTIL PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR.

QUESTION 1 (Compulsory)

a) A person on a motorcycle travelling at 50 Km/hr can carry 5 CDs, each CD containing **700 MB** of data. For what range of distances would it be faster to use the person on the motorcycle to transfer the information on 5 CDs, than to use a **1 Mbps** data line to transfer the data?

[5]

b) Describe how stations implementing the IEEE 802.3 (Ethernet) specification implement the medium access control protocol.

[5]

c) List the layers of the ISO Open Systems Interconnection architecture and briefly describe what each layer does.

[10]

d) Define channel bandwidth and channel capacity. State Shannon's theorem for channel capacity.

[5]

QUESTION 2

a) Give two situations where optic fibre cabling would be preferable to copper cabling.

[2]

b) For the bit stream **0000101010000110**, sketch the waveform for each of **NZRI, Manchester** and **HDB3** encodings. Assume the signal level preceding the first bit given above was high for NRZI, the preceding bit before the first bit of given bit stream ended at a high level for Manchester encoding and the most recent substitution occurred just before the first bit of the given bit stream, and the most recent non-zero voltage level was positive for HDB3 encoding.

[10]

c) Two hosts, A and B are connected by a 7500 km optic fibre cable. The data rate over the cable is 512 Kbps and the propagation speed is 2×10^5 km/s. Host A sends a frame to host B, and the size of the frame is such that the first bit sent by A reaches host B just as the last bit of the frame is being transmitted by host A. Calculate the size of the frame.

[5]

d) Given that a telephone connection provides a usable bandwidth of 3.5 KHz, what is the minimum signal-to-noise ratio in dB required to support transmission rates of 56 Kbps?

[5]

e) In order for a satellite link to have full duplex communications, what is required?

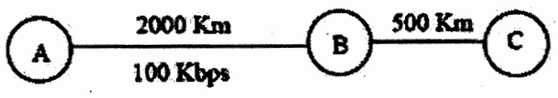
[3]

QUESTION 3

a) Given the message **1011010011** and the generator polynomial $G(x) = x^3 + 1$, determine the transmitted codeword T(x).

[4]

b)



In the transmission system above, frames are sent from node A to node C via node B. The propagation delay is 8 μs/Km on each link, with each link being full duplex. Data frames are 1000 bits long and acknowledgements are of negligible length. Between nodes A and B, a sliding window protocol with window size of 3 is used, while between B and C stop-and-wait protocol is used.
Calculate the minimum data rate required between nodes B and C to ensure that the average rate at which frames arrive and leave node B is the same i.e. frames are not buffered at B.

[7]

c) A channel has a bit rate of 56 Kbps and a propagation delay of 120 ms. For what range of data frame sizes does stop-and-wait give an efficiency of at least 60 %?

[5]

d) Explain the functions of the preamble and Cyclic Redundancy Check within an Ethernet frame.

[5]

e) List and briefly explain the fields in an ATM cell.

[4]

QUESTION 4

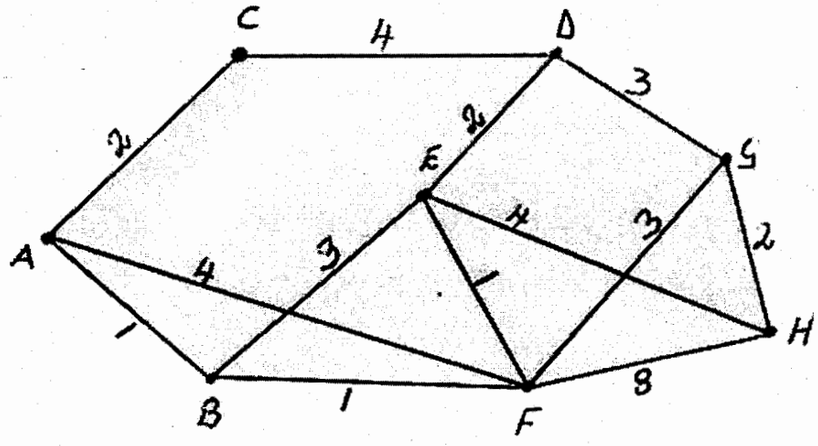
a) Consider the use of 5000 bit frames on a 1 Mbps satellite channel, where the satellite relay station is located 35000 Km above the earth's surface. The propagation speed of electromagnetic waves in air/vacuum is 3×10^8 m/s. What is the maximum link utilization for:

a) Stop-and-wait flow control protocol
b) Sliding window flow control protocol, with a window size of 7

Assume that acknowledgement frames are of negligible size

[8]

b) Apply Dijkstra's routing algorithm to the network of routers shown below



[7]

c) With the help of diagrams, describe the following routing strategies:
(i) Fixed routing
(ii) Random routing

[6]

d) The IP network address **196.24.64.32** has a broadcast address of 196.24.64.63. What is the network mask of the network?

[4]

QUESTION 5

a) How is the IPv4 header checksum calculated?

[2]

b) What is a socket in TCP/IP?

[3]

c) Into how may classes can an IP address fall into, and how do you determine which class it belongs to?

[5]

d) Describe how machine A with IP address 192.168.4.3 sends a packet to machine B with IP address 192.168.4.13, and how machine A sends a packet to machine C with IP address 192.168.5.13

[6]

e) Draw the diagram of an HDLC frame and describe the function of each field.

[6]

f) What are the 3 frames supported by HDLC?

[3]