UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE & ENGINEERING

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

MAIN EXAMINATION

May 2017

TITLE OF PAPER: COMPUTER NETWORKS

COURSE CODE: EE572

DURATION: 3 HOURS

INSTRUCTIONS:

1. There are five (5) questions in this paper. Answer any four (4) questions.
2. Each question carries equal marks.
3. Use correct notation and show all your steps clearly in any program analysis.
4. All programs should be sufficiently commented and indented for clarity.
5. Start each question in a new page.

This paper should not be opened until permission has been given by the invigilator.

This paper contains five (5) pages including this page.

Question 1

a. The OSI reference model is a standard model for communication in computer networks: draw the model and provide a detailed explanation of the services provided by each layer. [10]

b. Give at least 2 network topologies and discuss their advantages and disadvantages. [5]

c. Which layers of the internet reference model do the following devices process? [3]
    - Router
    - Switch
    - Host process

d. Briefly discuss the advantages of fiber optics over copper as a transmission medium. Explain the downside of using fiber optics over copper. [4]

e. Explain the difference between error correction and detection. Give examples where each of the approaches would be suitable. [3]

Question 2

a. If a binary signal is sent over a 3 Khz channel whose signal to noise ratio is 20dB what is the maximum achievable data rate? [3]

b. Calculate the latency of a packet from the first bit sent to the last bit received for a 100 Mbps Ethernet link with a switch in the path and the packet size being 12000 bits. Assume that each link has a propagation delay of 10 us and the switch begins retransmitting immediately after it has finished receiving the packet. [3]

c. Sketch the NRZI (assume NRZI starts low) and Manchester encoding for the following bit sequence:
    100111110010001. [3]

d. What are the benefits of using the 4B/5B encoding scheme over Manchester encoding? [3]

e. A decoder receives a codeword 1000110. Using the generator polynomial $X^3 + X + 1$ calculate the CRC and state what happened to the received codeword after computation. [6]

f. Describe the technique of bit stuffing. What framing problem does is seek to address? [3]

g. Given that a message is represented by the bit pattern shown below, answer the following:
    1010 0111 0101 1001

    i. Define the matrix for two dimensional even parity scheme. [2]

ii. Suppose a bit flip occurs whilst the message is in transit, explain how the scheme resolves such an error. [2]

Question 3

a. The CSMA/CD protocol cannot work in wireless LANs due to two problems:

(a)   (b)
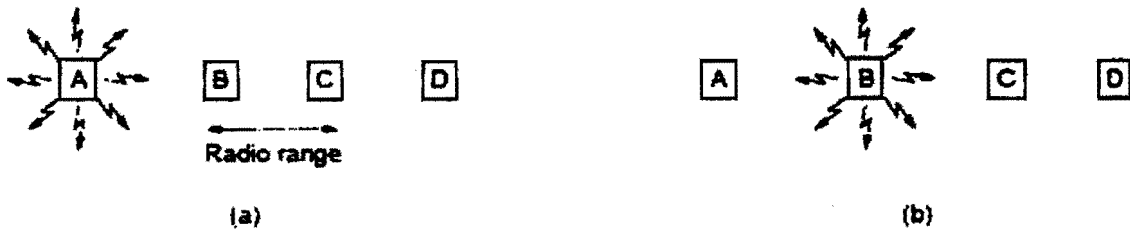
i.   Hidden station problem.   [3]
ii. Exposed station problem.   [3]

Briefly describe each of the problems using illustration where necessary.

b. The CSMA/CA, also referred to as multiple access with collision avoidance (MACA) is used by wireless LANs since the sensing part is based on sensing the activities around the receiver. Given the scenario shown in Figure 2a and 2b explain briefly how the protocol works in wireless LANs in order to avoid collisions. [4]
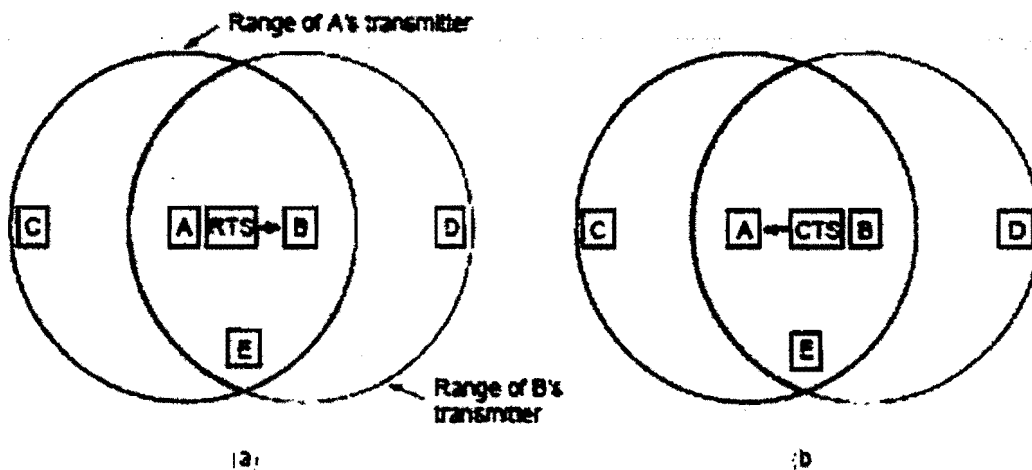

Figure 2.

3

c. What are the functions performed by a router? Why is it necessary for a router to know all possible routes within a network? [2]

d. Give two example computer applications for which connection-oriented service is appropriate. [2]

e. A company has just been assigned the network address 130.0.0.0. How many subnets and hosts per subnet can be created with a subnet mask of 255.255.128.0? [4]

f. In a block address, we know the IP address of one host is 182.44.82.16/26. What is the first address (i.e. network address) and last address in this block? [4]

g. Describe the count to infinity problem in distance vector routing. [3]

Question 4

a. Discuss the go-back-N and selective repeat ARQ error control techniques. State with reason to support which one of the techniques can be suitable for a high traffic environment such as a bank. [6]

b. Consider the network shown in the figure below. Using Dijkstra's shortest path algorithm, compute the shortest path from A to H. Show all the nodes involved. [6]
[add figure]

c. The IPV4 address space is considered too small to accommodate future internet growth: give three reasons for this notion. [3]

d. Define the following terms: [6]
- Subnet
- Prefix
- BGP route

e. Explain how a TCP socket is fully identified. [2]

f. In CSMA schemes, all nodes perform carrier sensing before transmission. Explain why collisions still occur? [2]

Question 5.

a. Discuss the differences between domain name service (DNS) and hypertext transfer protocol (HTTP). [4]

b. Describe the TCP three way hand-shake. [4]

c. Suppose the message shown below is transmitted together with a 1s complement checksum for error detection at the receiver:

    i. Compute the checksum of the message. [4]
    ii. How will the receiver detect errors with this method? [2]

       01010011 01100110 01110100

d. Explain why an application developer might choose to run an application over UDP rather than TCP protocol. [3]

e. Consider a packet switched network using 8 bit host addresses. Suppose a router uses longest prefix matching and has the following forwarding table:

Prefix Match	Interface
11	0
101	1
100	2
Otherwise	3

For each of the four interfaces, give the associated range of destination host addresses and the number of addresses in the range. [8]

End of paper