UNIVERSITY OF ESWATINI

FACULTY OF SCIENCE & ENGINEERING

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

MAIN EXAMINATION

MAY 2019

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 seven (7) pages including this page.

Question 1

a. What is the rationale behind the use of layered protocols in communication systems? [2]

b. Services, interfaces and protocols are key concepts in reference models. Define these terms.

i. Service [2]
ii. Interface [2]
iii. Protocol [2]

c. Explain the following terms in the context of computer networks; [8]

i. Protocol stack
ii. Interoperability
iii. Distributed system
iv. Protocol graph

d. In the class it was mentioned that the internet layer is the 'glue' that that holds the internet together, why do you think this is so? [2]

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

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

Question 2

a. 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]

b. Sketch the NRZI (assume NRZI starts low) and Manchester encoding for the following bit sequence:

100111110010001. [3]

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

d. 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]

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

f. Suppose you want to send some data using the BISYNC framing protocol and the last 2 bytes of your data are DLE and ETX. What sequence of bytes would be transmitted

immediately prior to the CRC? [2]

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

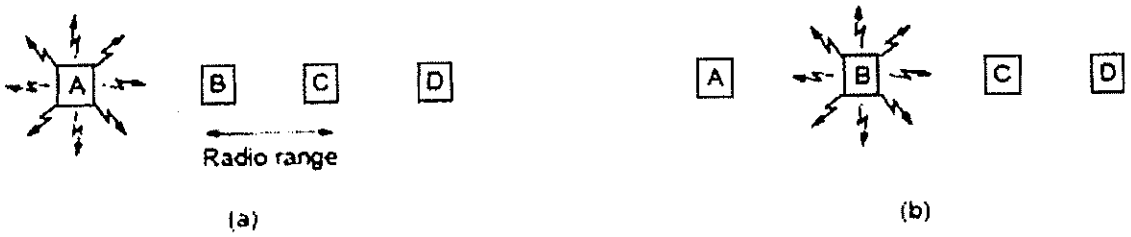
1010 0111 0101 1001

i. Determine the sequence of bits that are sent when a two dimensional even parity scheme is used. [3]

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:



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]

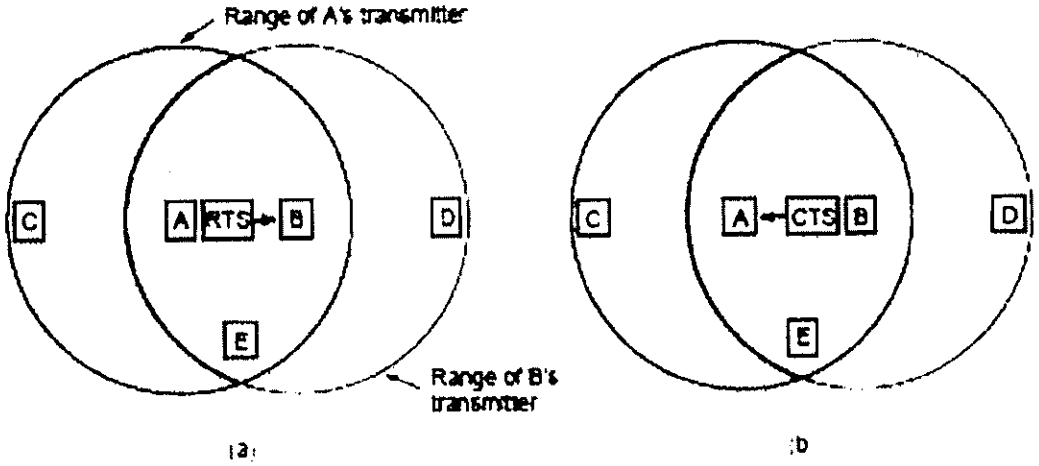


Figure Q.3b

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. Let's say you buy a wireless router/ADSL modem and connect it to your telephone socket. Also suppose that your ISP dynamically assigns one IP address to your connecting device (i.e. your router/modem). Also suppose that you have five PCs at home that use 802.11 to wirelessly connect to your wireless router. How will IP addresses be assigned to five PCs? Will the wireless router use NAT? Why or why not? [3]

b. Suppose datagrams are limited to 1,500 bytes (including header) between source Host A and destination Host B. Assuming a 20 - byte IP header and a 20 - byte TCP header, how many datagrams would be required to send an MP3 consisting of 4 million bytes. [4]

c. The IPV4 address space is considered too small to accommodate future internet growth: give 4 reasons for this notion. [4]

d. Define the following terms: [4]

- Subnet
- Prefix

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

f. What is the rationale of running the spanning tree protocol in switches? Briefly explain how the spanning tree protocol works. [5]

g. Why is an ARP query sent within a broadcast frame? Why is an ARP response sent within a frame with a specific destination MAC address? [3]

Question 5

a. Consider the topology shown in **Figure Q.5a**.

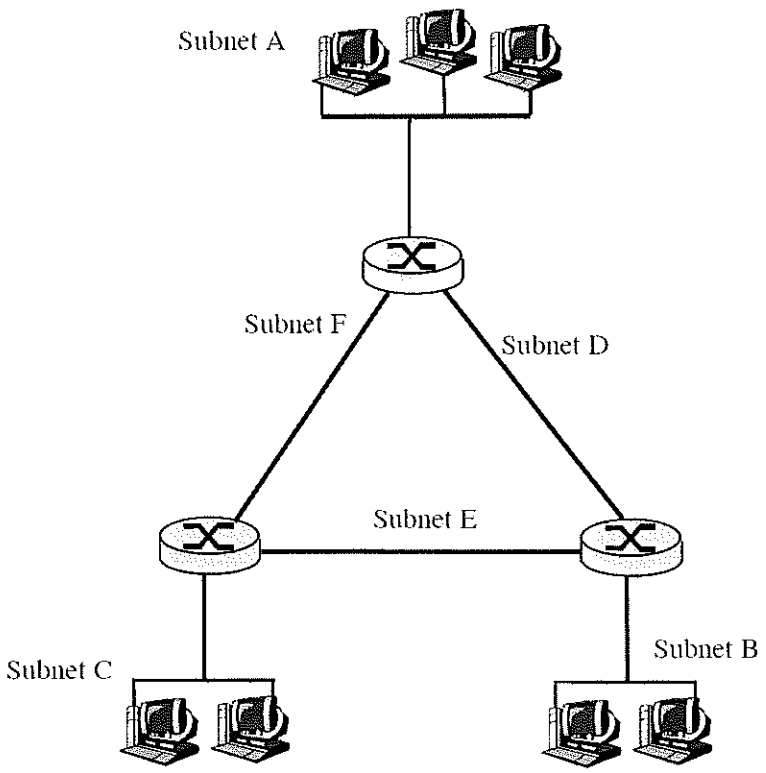


Figure Q.5a

i. Assign network addresses to each of these 6 subnets, with the following constraints; [12]

   1. All addresses must be allocated from 214.97.254.0/23
   2. Subnet A must have enough addresses to support at least 250 PCs
   3. Subnet B must have enough addresses to support at least 120 PCs
   4. Subnet C must have enough addresses to support at least 120 PCs
   5. Subnet D, E, and F must support at least 2 interfaces

ii. Using the address assignments obtained in **Q.5a(i)**, provide the forwarding tables for each router using longest prefix matching. [9]

b. Given that a forwarding table shown in **Figure Q.5b**. To which interface will a packet with a destination address of 128.59.29.18 be forwarded? Explain how you reached to your answer. [4]

Prefix	Interface
128.59.28.0/22	0
128.59.28.0/23	1
128.59.28.0/24	2

Figure Q.5b

End of paper