

UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE & ENGINEERING

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

MAIN EXAMINATION

May 2018

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 four (4) pages including this page.

Question 1

- a. What is the rationale for using layered protocols in networks? What could a possible setback of using this approach? [3]
- b. The OSI reference model is a standard model for communication in computer networks.
 - i. In general, what is the purpose of reference models in communication networks? [2]
 - ii. What are the responsibilities of layers 2, 4, and 7 of the OSI model? [6]
- b. What do encapsulation and de-encapsulation mean? Why are they required in a layered protocol stack? [3]
- c. Briefly discuss the advantages of mesh over ring topology. What is the downside of using mesh topology over ring? [5]
- d. What addresses are used in the following layers? [3]
 - Data link layer
 - Network layer
 - Transport layer
- 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. A user can directly connect to a server through either long-range wireless or twisted-pair cable for transmitting a 1500 bytes file. The transmission rates of the wireless and wired media are 2 and 100Mbps, respectively. Assume the propagation speed is 3×10^8 m/s for wireless and 2×10^8 for twisted pair. If the user is located 2 km away from the server, what is the latency when using each of the two technologies? [4]
- c. Sketch the NRZI and Manchester encoding for the following bit sequence:
100111110010001. [4]
- d. What are the benefits of using the 4B/5B encoding scheme over Manchester encoding? [3]
- e. For the generator polynomial $G = 110011$ and the data bits (message) $M = 11100011$ find the CRC bits and the transmitted code-word. [7]
- f. 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. Why does collision occur in CSMA if all nodes perform carrier sensing before transmission? [2]
- b. What is the address space size of the following? [2]
 - i. IPV4 address
 - ii. MAC address
- c. Describe the hidden station and exposed station problem found in wireless networks [4]
- d. What are the functions performed by a router? Why is it necessary for a router to know all possible routes within a network? [2]
- e. A company has just been assigned the prefix 130.0.0.0/16. 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]
- h. State the basic differences between Dijkstra's and distance vector routing algorithms. [4]

Question 4

- a. The IPV4 address space is considered too small to accommodate future internet growth: give three reasons for this notion. [3]
- b. Briefly explain the principle of operation of ICMP. [3]
- c. Briefly describe how Network Address Translation (NAT) works. You may illustrate the operation using a diagram. [4]
- d. Why is packet fragmentation not a problem in IPV6? How is this possible? [3]
- e. Discuss the challenges and solutions related to the interoperability of IPV6 and IPV4. [6]
- f. Define the following terms: [4]
 - Split horizon
 - Poison reverse

- g. Explain how traceroute repurposes the time to live field in the IP packet header? [2]

Question 5.

- a. Briefly describe how the address resolution protocol (ARP) work. [4]
- b. Consider sending a 1,600 byte datagram into a link that has a maximum transmission unit (MTU) of 500 bytes. Suppose the original datagram is stamped with the identification number 291.
- How many fragments are generated? [2]
 - What are the values in the various fields in the IP packets generated related to fragmentation? [6]
- c. Suppose the message shown below is transmitted together with a 1s complement checksum for error detection at the receiver:
- Compute the checksum of the message. [4]
 - How will the receiver detect errors with this method? [1]

01010011 01100110 01110100

- d. 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