Autumn Examinations 2021-2022

Exam Code(s)	2BCT, 3BS, 3BM
Exam(s)	BSc in Computer Science & Information Technology
	BSc General, BSc Mathematical Science
Module Code(s)	CT2108
Module(s)	Networks and Data Communications 1
Paper No.	1
External Examiner(s)	Dr. R. Trestian
Internal Examiner(s)	Prof. M. Madden
	*Dr. D. Chambers

Instructions: Answer any 4 questions.
 All questions carry equal marks.

Duration 2 hours

No. of Pages 4

Department(s) School of Computer Science

Requirements:

Release in Exam Venue	Yes	X	No	
MCQ Answersheet	Yes		No	X
Handout	None			
Statistical / Log Tables	Yes			
Cambridge Tables	None			
Graph Paper	None			
Log Graph Paper	None			
Other Materials	None			
Graphic material in colour	Yes		No	X

Question 1

a) Compute the wavelength of a radio signal having a frequency of 30GHz. In what part of the electromagnetic spectrum does this signal belong i.e. would it correctly be described as UHF, Microwave or Infrared?   5 MARKS

b) What is the main advantage of using a Digital Communications Signal instead of an Analog Signal? Suppose we have a communications channel with 40MHz of bandwidth. How many bits/sec can be sent over one of these channels if 1024-level digital signals are used? Assume a noiseless channel.
10 MARKS

c) The channels used for fixed point to point microwave links are typically 28MHz wide in terms of bandwidth. What is the minimum signal-to-noise ratio (in decibels) required to transmit a 280Mbps data stream through one of these channels? Also, what is the minimum number of signal levels required in the transmitted digital signal to achieve that data rate?   10 MARKS

Question 2

a) What is modulation? Briefly describe three types of modulation, giving practical examples.   5 MARKS

b) Digital signals transmitted via copper wires can sometimes be exposed to radiated electrical noise that can cause interference and potential data loss in the received signal, especially if the distance involved is over 10m. Suggest a suitable physical transmission scheme for sending digital signals over copper wires that provides some level of immunity against this type of interference.
10 MARKS

c) Explain clearly, using an example of each type, the difference between *Asynchronous* and *Synchronous* transmission of data. Which type requires the least amount of bandwidth? Illustrate, using a suitable example, how *Manchester Encoding* can be used to allow a data receiver to recover the clocking information from transitions in the arriving data.
10 MARKS

Question 3

a) Compare briefly the purpose and structure of the OSI Reference Model with the model used in the Internet. Which of the OSI layers handles each of the following tasks?
   - Providing error free end-end communications across the network.
   - Determining the header format for the FTP protocol.
   - Determining which route through the network to use.
                                                              5 MARKS

b) How is it possible to provide high speed internet access over normal telephone lines? Provide details on a suitable encoding scheme that could be used to provide such a service e.g. ADSL or VDSL. What is the main limiting factor on the maximum data rate that can be achieved using one of these services?
                                                              10 MARKS

c) Most existing wired Local Area Networks are now based on Cat-5 UTP type cabling. Suggest a suitable modulation and encoding scheme that facilitates fully duplex 100Mbps data transmission using one cable pair in each direction. The physical signal that is transmitted over the cable should have a maximum frequency component of about 31.25Mhz. Explain the solution proposed in your answer and why it would work.   10 MARKS

Question 4

a) What are the main enhancements provided in IPv6 over IPv4 and what impact is this protocol likely to have in the way we use the Internet? Why has the new protocol not included protocol header support for IP fragments? How many IPv6 addresses are typically being allocated to each customer by ISPs? Give an example of what an IPv6 address will look like.   12 MARKS

b) Assume that you have been asked to design the congestion control mechanism for a reliable Transport Layer Protocol. The proposed mechanism may assume that all ACK timeouts are due to congestion and it should therefore monitor timeouts to detect congestion. It should also be capable of dynamically adjusting the transmit window size if congestion is detected. It may also incorporate appropriate threshold values to control the rate at which the transmission speed is changed over time. Explain the solution proposed in your answer and why it would work.   13 MARKS

Question 5

a) Explain the purpose and operation of the Internet Control Message Protocol (ICMP). What type of messages may be sent using ICMP and when are these messages typically used? Why does an ICMP packet not have source and destination port numbers?   8 MARKS

b) Assume that you are working for a corporation that is using the private IP address range 172.16.0.0/16 for its internal network. The company management wants to be able to accommodate 64 departments where each department has its own routed subnet with at least 1000 hosts per department subnet. You are requested to design the network layout. Answer the following questions and fully explain the logic behind each answer:

- What subnet mask will need to be used?   5 MARKS

- What are the valid host addresses on the first and second subnets?
  4 MARKS

- What other private IP ranges could the company use if needed?
  4 MARKS

- When is it appropriate to use IP private addressing versus public addressing?   4 MARKS