NUI Galway
OÉ Gaillimh

Semester 2 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 6GHz. 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 are the key differences between a Digital Signal and 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 64-level digital signals are used? Assume a noiseless channel. 10 MARKS

c) DTT (Digital Terrestrial TV) channels are generally about 8MHz wide in terms of bandwidth. What is the minimum signal-to-noise ratio (in decibels) required to transmit a 96Mbps data stream through one of these channels? Also, what minimum number of signal levels is required in the transmitted digital signal to achieve that data rate? 10 MARKS

Question 2

a) If the bit string 0111101111111111110 is "bit stuffed" for transmission using a bit-oriented data link protocol, what is the output bit string? What is the purpose of "bit stuffing" in this context? 6 MARKS

b) What is the significance of the Hamming Distance between two codewords used to transmit data? Give an example of two 8-bit codewords and calculate their Hamming Distance. 7 MARKS

c) Describe at least two advantages of using Fibre Optic cable over copper based cables like e.g. Twisted Pair and Coaxial Cable. What diameter is the inner core of a single mode fibre optic cable? 6 MARKS

d) What is meant by the term Modulation? Give examples of three types of Modulation. How might the following stream of data be transmitted using a two bit system of Phase Shift Keying: 1111010011011101
6 MARKS

Question 3

a) Explain briefly each of the fields in the header of a standard Ethernet frame, for both the original (DIX) frame format and the IEEE 802.3 standard. 7 MARKS

b) Discuss the operation of 100mbps Fast Ethernet (802.3u). Outline what media types are supported and explain how the higher data rate is achieved over CAT-5 unshielded twisted pair (UTP) cables. 8 MARKS

c) How is it possible to provide high speed Internet access over normal telephone lines? Provide details on a suitable transmission 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? What is the maximum bandwidth that is typically available for a VDSL modem? 10 MARKS

Question 4

a) What are the main enhancements provided in IPv6 over IPv4? Why has the new protocol not included protocol header support for IP fragments? Give an example of what an IPv6 address will look like. 5 MARKS

b) Describe the main differences between the UDP and TCP transport layer protocols, using their header formats as the basis for the comparison. The largest (max) payload of a TCP segment is 65,515 bytes. Why was this particular number chosen? 10 MARKS

c) Explain, using a simple example, how both Flow Control and Window Management operate in TCP. How does the protocol solve the potential efficiency problems caused by the sending application delivering data to TCP one byte at a time or the receiving application reading data one byte at a time? 10 MARKS

Question 5

a) IPv4 is running out of IP addresses. Apart from moving to IPv6, what are the two main solutions that have been used to cope with and alleviate the address shortage problem? Describe each of these solutions using an appropriate example. 10 MARKS

b) Assume that you are working for a corporation that is using the IP address range 172.16.0.0/16 for its internal network. The company management wants to be able to accommodate 16 departments where each department has its own routed subnet with at least 4000 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? 4 MARKS
- What are the valid host addresses on the second and third subnets? 4 MARKS
- What other private IP ranges could the company use if needed? 3 MARKS
- When is it appropriate to use IP private addressing versus public addressing? 4 MARKS