Semester 2 Examinations 2018 / 2019

Exam Code(s)	2BCT, 3BS, 3BM
Exam(s)	BSc 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. J. Howe
Internal Examiner(s)	Prof. M. Madden
	*Dr. D. Chambers

Instructions:	Answer any 4 out of the 5 questions.
	All questions carry equal marks.

Duration	2 hours
No. of Pages	4
Discipline	Information Technology
Course Co-ordinator	Dr D Chambers

Requirements	Log Tables to be provided if requested

Question 1

a) Compute the wavelength of a radio signal having a frequency of 3GHz. 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 56MHz of bandwidth. How many bits/sec can be sent over one of these channels if 256-level digital signals are used? Assume a noiseless channel.

10 MARKS

c) Standard WiFi channels are 20MHz wide in terms of bandwidth. What is the minimum signal-to-noise ratio (in decibels) required to transmit a 240Mbps 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 how analog to digital conversion works. In this context, why has the PCM sampling time, as used in digital speech encoding for the telephone network, been set at $125\mu S$? What is the resulting data rate required to transmit a single digitised voice channel using the standard PCM encoding scheme?

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.

   <div align="right">5 MARKS</div>

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?

   <div align="right">10 MARKS</div>

c) The minimum frame size allowed by the original Ethernet Standard (IEEE 802.3) is 64 bytes (from destination address to checksum, including both). Explain the reasons behind this limitation and also explain how Ethernet handles retransmission once a collision has occurred.   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 briefly the purpose and operation of the Address Resolution Protocol. What optimisations are possible in a typical implementation of this protocol? How would you list the current contents of the ARP table on a Windows PC?

<div align="right">5 MARKS</div>

b) Assume that you are working for a corporation that is using the private IP address range 192.168.0.0/16 for its internal network. The company management wants to be able to accommodate 32 departments where each department has its own routed subnet with at least 2000 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?

<div align="right">5 MARKS</div>

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

<div align="right">5 MARKS</div>

- When is it appropriate to use IP private addressing versus public addressing?   5 MARKS