



OLLSCOIL NA GAILLIMHE
UNIVERSITY OF GALWAY

Semester 2 Examinations 2022-2023

Course Instance 2BCT, 3BS, 3BM, 1OA
Code(s)
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

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Internal Examiner(s) Prof. M. Madden
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Instructions: Answer any 4 questions.
All questions carry equal marks.

Duration 2 hours
No. of Pages 4
Department(s) School of Computer Science
Course Co-ordinator(s) Dr Colm O’Riordan

Requirements:

Release in Exam Venue Yes ☒ No ☐

MCQ Answersheet Yes ☐ No ☒

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 ☒

Question 1

- a) Compute the wavelength of a radio signal having a frequency of 300MHz. 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 advantages of using a Digital Signal compared to an Analog Signal? Suppose we have a communications channel with 50MHz of bandwidth. How many bits/sec can be sent over one of these channels if a 1024-level digital signal is used? Assume that this is 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 200Mbps 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) Describe some of the advantages of using Fibre Optic cable over copper based cables like e.g. Twisted Pair and Coaxial Cable. What technique is used to combine the signals from multiple individual fibre optic cables onto a single long-haul shared fibre? 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 μ 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 HTTP protocol.
 - Determining which route through the network to use.
- 5 MARKS
- b) 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
- 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) Explain in your own words the main differences between the UDP and TCP transport layer protocols, use their header formats as the basis for the comparison. The maximum segment size of a TCP segment that traverses an Ethernet network is typically limited to 1460 bytes, how does this limit arise?
- 10 MARKS
- c) Describe, 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) 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?
6 MARKS
- b) Assume that you are working for a corporation that is using the IP address range 192.168.0.0/16 for its internal network. The company management wants to be able to accommodate 8 departments where each department has its own routed subnet with at least 8000 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 and why? 4 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
- c) Describe the purpose and operation of Network Address Translation (NAT). Would NAT be required for internet access in a situation where we are using the IP address range 192.168.1.0/24 on our office Local Area Network?
7 MARKS