**CSC1022 Architecture and Networks**

**1st November 2021**

**9.00 am – 11.00 am (Belfast UK time zone)**

**Instructions to Candidates**

Please read all sections of the instructions before you start answering questions.

1. **Format of the test**

This is an OPEN BOOK test. You may use your own lecture notes, the recommended texts for this module, and other material presented during the lectures on networking for CSC1022. You do NOT NEED to reference these materials.

You cannot cut and paste anything whatsoever from any OTHER source whatsoever unless you reference such work in your answer.

This resit test is worth 50% of the marks for the CSC1022 module.

The time available is 2 hours. This is 1 hour 15 minutes for the test plus a 45 minute extension for remote working.

The examiners will allow some extra minutes for upload to compensate for problems with Internet connections. Please note that we have a record of time of upload. You do not need to contact Dr. Gillan or Mr Sah to inform them of delays unless these become excessively long.

If you have an ISSA approved by QUB, **you may add your allowance to the 1 hour 15 minutes for the test**. For example, if you have a +25% allowance, you can take an EXTRA 19 minutes (25% of 1 hours 15 mins) to complete the test. That means your total allocation is 2 hours 19 minutes.

You must present all working out steps in mathematical questions. If no working is shown, no marks will be awarded. You may give the answer first and attach the working out, or you may show the working out and present the answer at the end. In either case, PELASE MARK clearly what you are presenting.

1. **Upload instructions**

You download this file from Canvas to your local computer. You should create a folder for your answers and place all answers in it. You must NAME THE folder with your student number and NOTHING else. For example

123456789

All files in the folder should also begin with your student number and name.

12345678\_John\_Doe

You may enter your answers below each question in the Word documents, or you may split the documents into separate questions. Clearly mark the point where your answer begins. We recommend use of Courier font for mathematical information if you are using a Word processor to prepare your answers.

If you use separate files then name them appropriately for the question which the answer, for example

12345678\_John\_Doe\_Question\_1\_part\_i.docx

Some students may wish to handwrite all their answers. In that case, you may wish to prepare one or more PDFs or a set of screen shots in JPG or GIF format.

When you have completed answering the questions, you must ZIP the folder and then you must upload the ZIPPED file to Canvas. There is a button under the Canvas QUIZ Question 1, for you to perform the upload.

1. **Submission of the work**

Please note the following declaration.

By submitting the work, I declare that:

1. I have read and understood the University regulations relating to academic offences, including collusion and plagiarism:

<http://www.qub.ac.uk/directorates/AcademicStudentAffairs/AcademicAffairs/GeneralRegulations/Procedures/ProceduresforDealingwithAcademicOffences/>

1. The submission is my own original work and no part of it has been submitted for any other assignments either by me or by anyone else, except as otherwise permitted.
2. All sources used, published or unpublished, have been acknowledged if appropriate;
3. I give my consent for the work to be scanned using a plagiarism detection software
4. **Issues arising during the test**

If you need to raise an issue during the test, you should e-mail [c.gillan@qub.ac.uk](mailto:c.gillan@qub.ac.uk) at that time or as soon as possible afterwards.

**[ End instructions ]**

**Part A Networking Questions – Answer ALL questions**

**All questions carry equal marks**

***Q1***. Explain the OSI layered model of data networking. What is the principal advantage of having a well-defined model? Are there any disadvantages to having this model? Your answer should be no longer than 300 words.

**[Marks 10]**

**Q2**. Queen’s University has decided to build a new facility that will have three floors. The building will be allocated the IPv4 network address and netmask 143.117.192.0 /23. (QUB owns all IPv4 addresses in the range 143.117.0.0 to 143.117.255.255) The chief network architect has decided that each floor should have its own subnet. You have been asked to carry out the calculations on the IPv4 address and to implement any limitations defined in the IETF RFCs for such addresses.

Calculate all of the following, explaining your answers clearly.

(i) What is the smallest number of bits that you must add to the /26 mask in order to be able to create three distinct subnets for the building.

**[ Marks 1 ]**

(ii) Complete the following table, using one row for each subnet, giving your answers in dotted decimal format

|  |  |  |
| --- | --- | --- |
| **Full subnetwork address (not the mask)** | **Lowest IPv4 address in the subnet** | **Highest IPv4 address in the subnet** |
|  |  |  |
|  |  |  |
|  |  |  |

**[ Marks 9 ]**

**Q3.** Write a short note, maximum 500 words, in which you compare and contrast the functionality of the TCP and UDP protocols at layer 4 of the IPv4 protocol suite. What are the advantages and disadvantages of selecting TCP as the layer 4 transport protocol for your application instead of UDP ?

**[ Marks 10 ]**

**Q4.** Answer the following three parts of this question.

1. Why does the DYNAMIC HOST CONFIGURATION PROTOCOL in an IPv4 network present a cyber security risk ?

**[Marks 3]**

1. Consider a network with N nodes. Assume that each node is connected to all other nodes, (but as studied in lectures does not have a looped connection to itself) and that all connections (edges) are bi-directional and have equal weight. Show, clearly, how you can derive a formula for the number of non-zero values in the full adjacency matrix for this network?

**[Marks 3]**

1. In the logic circuit in Figure 1, *x1, x2* and *x3* are binary inputs. This means that they can only have the values 0 or 1.

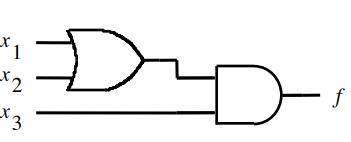


Figure 1: Logic circuit for Question 4 (iii)

List all of the combinations of the binary inputs that cause the output *f* to have the value 0.

**[ Marks 4 ]**

**Q5.** In computations in the field of data analytics, it is common to use data types that follow the pattern of the IEEE 754 32-bit floating point representation but which have a smaller number of bits. These representations can lead to faster program execution time, to lower energy consumption and to the use of considerably less memory. Some authors use a custom 16-bit representation, known as bfloat16, with the following bit widths:

Sign bit – 1 bit

Exponent – 8 bits and using a bias of 127 (decimal)

Mantissa - 7 bits

Find the representation of 1.2161 (decimal) using bfloat16.

What is the closest floating point value smaller in magnitude than1.2161 that can be represented in bfloat16.

**[ Marks 10 ]**

**[ End of Test ]**