Beijing-Dublin International College

SEMESTER II FINAL EXAMINATION – 2018/2019

UCD School of Electrical and Electronic Engineering

EEEN1002J Introduction to Electronic Systems

Prof. Peter Kennedy
Prof. Tomas Ward
Dr John Healy*

Time Allowed: 120 minutes

Instructions for Candidates

Answer **ANY THREE** questions.

BJUT Student ID: _____ **UCD Student ID:** _____

I have read and clearly understand the Examination Rules of both Beijing University of Technology and University College Dublin. I am aware of the Punishment for Violating the Rules of Beijing University of Technology and/or University College Dublin. I hereby promise to abide by the relevant rules and regulations by not giving or receiving any help during the exam. If caught violating the rules, I accept the punishment thereof.

Honesty Pledge： _____ **(Signature)**

Instructions for Invigilators

Non-programmable calculators and an English-Chinese/Chinese-English dictionary are permitted.

No rough-work paper is to be provided for candidates.

Obtained score

Question 1:

(a) In the past, various civilisations and people attempted to build mechanical computers, from the Antikythera device to Babbage's analytical engine. Write a short note about these precursors to modern computers.

(25 marks)

(b) Discuss the impact of the transistor and of integrated circuits on the development of computing.

(25 marks)

(c) Consider the Boolean diagram below.

a. Name the type of circuit elements in the diagram.
b. Write a Boolean expression for the circuit.
c. Copy the diagram into your answer book. If a = 1, b = 0, write the output of each gate on the diagram.

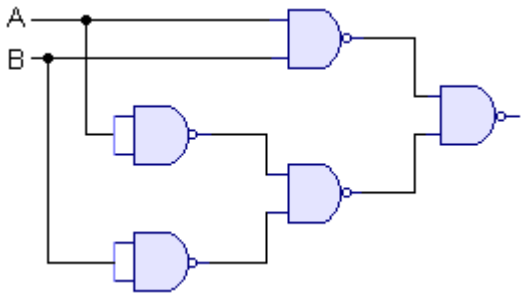

Fig. 1. Diagram for Question 1(c).

(25 marks)

(d) Digital cameras have become ubiquitous.

a. Explain how a digital camera records an image.
b. What is saturation (or clipping)?
c. What is the main difference between a .bmp file and a .jpg file?

(25 marks)

Obtained score

Question 2:

(a) Describe the development of audio-only communication from telephones to radio transmissions to mobile phones.

(25 marks)

(b) What is the OSI 7 layer model? Does the internet conform to this model? Explain your answer – a simple yes or no will not receive any marks.

(25 marks)

(c) Consider a communication system that consists of a laptop computer communicating with a wifi hub.

i. Is the system simplex, half-duplex, or duplex?

ii. Is there a shared medium? If so, what is it and who is it shared with?

iii. Considering the local network of the hub and any laptops connected to it, is this an example of a star or a mesh network topology?

In each case, explain your answer. A significant portion of the marks will be awarded for simply defining the terms.

(25 marks)

(d) A connection-oriented communication system acknowledges that it has received a frame. Sometimes that acknowledgement is lost in transmission. Explain with the aid of a diagram what our two main options are to handle that situation.

(25 marks)

Obtained score

Question 3:

(a) What is the Internet of Things? Describe the factors behind its emergence.

(25 marks)

(b) In a homework assignment in week 9, you studied news coverage of an IoT related topic. What was that topic? Write a short note about it.

(25 marks)

(c) In encryption, what do the following terms mean?

a. A character-oriented cipher.
b. A one-time pad.
c. A symmetric cipher.
d. The key distribution problem.

How was the key distribution problem solved?

(25 marks)

(d) Given the sequence 01010101 which has been encrypted by means of a one time pad using the key 01011010, recover the original message. If the key was 10100101 instead, what would the recovered message be? If we don't know the key, how can we guess which key is more likely to be correct?

(25 marks)

Obtained score

Question 4:

(a) Answer the following.

i. What is charge?

ii. Define current in terms of charge.

iii. What is the S.I. unit of charge?

iv. Draw an arbitrary two terminal circuit element in your answer book. Indicate how to indicate the voltage dropped across it and the current flowing through it.

(25 marks)

(b) Copy the circuit in Fig. 2 into your answer book.

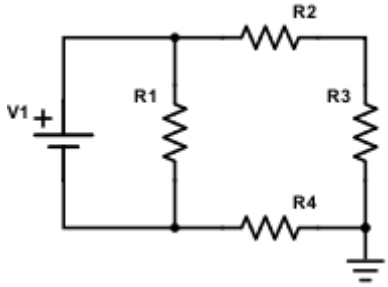

Fig. 2. Circuit for Question 4(b).

i. Mark all of the nodes, and label the branch voltages and currents.

ii. Choose a loop in the circuit above. Write an equation for that loop using Kirchoff's voltage law.

iii. Choose a node in the circuit above. Write an equation for that node using Kirchoff's current law.

(25 marks)

(c) What voltage appears between nodes A and B in each of the circuits below? Justify your answers – the correct numbers alone will receive only partial credit.

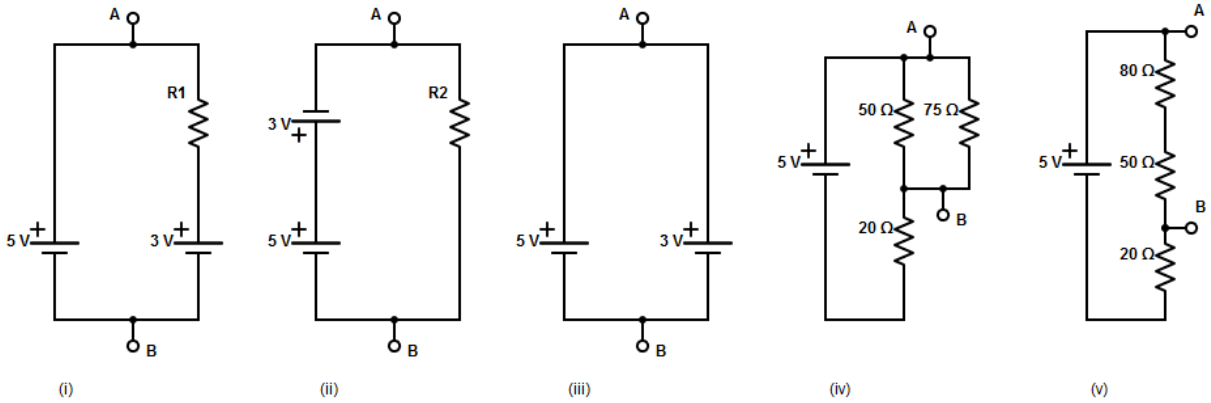

Fig. 3. Circuits for Question 4(c).

(25 marks)

(d) In a laboratory this year, you built a light sensor using a light dependent resistor (LDR), a resistor, and two parts of an Arduino microcontroller board: a 5V source, and a digital voltage meter that could measure voltages between 0 and 5 V. If the resistor is 10 kΩ, and under a certain lighting condition the LDR has resistance 7.5 kΩ:

i. What is the node voltage at the Arduino's input pin?

ii. What 8-bit number does the Arduino read from this pin?

iii. What is the smallest change in the LDR's resistance that the Arduino can detect?

(25 marks)