UNIVERSITY EXAMINATIONS
EXAMINATION FOR JANUARY/APRIL 2023/2024 CERTIFICATE IN INFORMATION TECHNOLOGY

COURSE CODE: **RCT 003** COURSE TITLE: **INTRODUCTION TO DIGITAL ELECTRONICS.**

DATE -- / -- / 2024 TIME: 2 HOURS

GENERAL INSTRUCTIONS:

Students are NOT permitted to write on the examination question paper during examination time.

This is a closed book examination. Text book/Reference books/notes are not permitted.

SPECIAL INSTRUCTIONS:

This examination paper consists Questions in Section A followed by section B.

Answer **Question 1 and any Other Two** questions.

QUESTIONS in ALL Sections should be answered in answer booklet(s).

1. **PLEASE start the answer to EACH question on a NEW PAGE.**
2. **Keep your phone(s) switched off at the front of the examination room.**
3. **Keep ALL bags and caps at the front of the examination room and DO NOT refer to ANY unauthorized material during the course of the examination.**
4. **ALWAYS show your working.**
5. **Marks indicated in parenthesis i.e. ( ) will be awarded for clear and logical answers.**
6. **Write your REGISTRATION No. clearly on the answer booklet(s).**
7. **For the Questions, write the number of the question on the answer booklet cover page in the order you answered them.**
8. **DO NOT use your PHONE as a CALCULATOR.**
9. **YOU are ONLY ALLOWED to leave the exam room 1 hour to the end of the Exam.**
10. **DO NOT write on the QUESTION PAPER. Use the back of your BOOKLET for any calculations or rough work.**
11. **Scientific CALCULATOR will be required.**

SECTION A (COMPULSORY)

Question (1) - (30Marks)

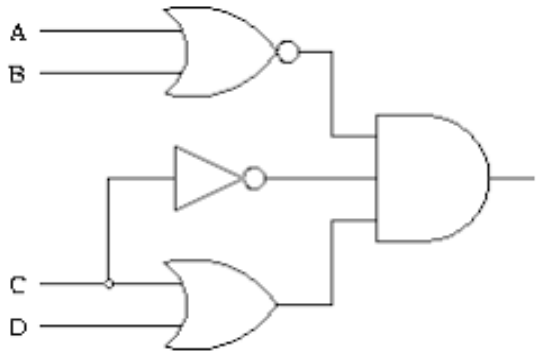
a) Describe the following terms as used in digital logics. **(12 Marks)**

i. A.D.C.
ii. D.A.C.
iii. Encoders.
iv. Decoders.
v. Multiplexer.
vi. De-multiplexer.

b) Describe **FOUR** Number systems popularly used in computer systems and digital systems. **(4 Marks)**

c) Compare the binary numbers system and gray code. **(3 Marks)**

d) Express the circuit below as a Boolean function. **(4 Marks)**



e) Considering the Boolean function shown below, draw an equivalent Logic circuit diagram. **(5 Marks)**

$$\mathbf{Y} = \overline{[(A\overline{B} + C)D] \oplus [(\overline{CD} + B) + A]}$$

f) **Name** and **<u>draw</u>** any two Universal Logic gates. **(2 Marks)**

SECTION B (Answer Any Two Questions)

Question (2) - (15Marks)

a) State the **De-Morgan's** theorems. **(1 Marks)**

b) Using suitable truth tables **<u>or</u>** Boolean algebra, **prove** the De-Morgan's theorems. **(4 Marks)**

c) Design a **half adder** from the **first principle** of digital circuit designing. **(4 Marks)**

d) Convert the following binary numbers, into Decimal Number. **(3 Marks)**

$\mathbf{11001101.1010101_2}$ ***<u>Show all the working.</u>***

e) Convert the following Decimal numbers, into Binary Number. **(3 Marks)**

$\mathbf{246.579_{10}}$ ***<u>Show all the working.</u>***

Question (3) - (15 Marks)

a) Considering the Boolean function shown below, simplify it and hence implement the simplified logic circuit. **(5 Marks)**

$$\mathbf{Y} = \overline{\overline{A}\overline{B}C} + \overline{(A + B + C)} + \overline{\overline{A}\overline{B}\overline{C}D}$$

b) Evaluate the following calculations / numbers Conversions, into the indicate formats.
NB: ***Show all the working, marks awarded on only working, <u>not answers</u>.*** **(10 Marks)**

i. $\mathbf{1010101011001100_{bin}}$ into **hexadecimal** number.
ii. $\mathbf{11111111_{bin}}$ into **gray** code.
iii. $\mathbf{1101010100_{bin}}$ into **decimal** number.
iv. $\mathbf{F1E2D3_{hex}}$ into **octal** number.
v. $\mathbf{10101_{dec}}$ into **binary** number.

Question (4) - (15 Marks)

a) Simplify the Boolean function below, using any technique of your choice. **(4 Marks)**

$$\mathbf{Y} = \overline{A}BC + A\overline{BC} + \overline{ABC} + A\overline{B}C + ABC$$

b) Design a **FOUR** Bits Binary to Gray code converter.
Follow the following procedures.

i. Draw truth table, hence Form a **POS** or a **SOP**. **(4 Marks)**
ii. Map outputs onto a suitable Karnaugh Map. **(1 Marks)**
iii. Simplify the K- Map into the simplest function. **(2 Marks)**
iv. Draw / implement the logic circuit. **(2 Marks)**

c) Justify why designers simplify logic circuits before implementation. **(2 Marks)**

Question (5) - (15 Marks)

a) Define the team universal logic gates. **(1 Marks)**

b) Implement the following logic gates, using any universal logic gates.

i. **OR** - logic gate. **(2 Marks)**

ii. **AND** - logic gate. **(2 Marks)**

iii. **X- OR** - logic gate. **(3 Marks)**

c) Design, from the **first principle**, a four inputs logic circuit, such that the output will be high, only if three or more inputs are high. Simplify the logic circuit derived and implement the design. **(7 Marks)**

END