UGANDA MARTYRS UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF NATURAL SCIENCES

FINAL ASSESSMENT FOR DIPLOMA IN COMPUTER SCIENCE & IT YEAR 1

SEMESTER I, 2022/2023

DIPCS 1102: BASICS OF COMPUTING MATHEMATICS

DATE: DECEMBER, 2022

TIME: 9:30 am – 12:30 pm

Instructions

1. Attempt ANY FOUR questions

2. Ensure that your name and registration number is indicated on the cover page of your work.

3. Where applicable, leave your answer in fractional form or round it to 2dp

4. Only Non-Programmable calculators are allowed

Question 1

(a) Given the following sets:-

$A = \{ x : x \in N \leq 15 \}$; $P = \{x : x \in W < 8\}$; $R = \{y : y = 2n; n = 1, 2, 3, 4, 5\}$.

Determine:-

(i) $\overline{P}$

[2 marks]

(ii) $A - R$

[3 marks]

(iii) $P \Delta A$

[3 marks]

(b) In an examination, 40% of candidates passed in mathematics, 45% in Science and 55% in Health. 10% passed in Mathematics and Science, 20% in Science and Health and 15% in Health and Mathematics. No candidate failed in all the three subjects.

(i) Summarize the given information in using set language

[4 marks]

(ii) Illustrate the given information using Venn diagram

[4 marks]

(iii) Find the percentage of those who passed in the three subjects

[3 marks]

(iv) Find the percentage of those who passed in at least two subjects

[3 marks]

(v) Find the percentage of those who passed in one subject only

[3 marks]

Question 2

(a) Let A = "Aldo is Italian"; B = "Bob is English". Formalize the following Propositional Logic to English sentences:

(i) $\neg A \leftrightarrow B$..[2 marks]

(ii) $A \vee (\neg A \rightarrow B)$..[2 marks]

(iii) $(A \wedge B) \vee (\neg A \wedge \neg B)$..[2 marks]

(b) Define the following terms as applied in propositional logic

(i) Tautology   [1 mark]

(ii) Contradiction   [1 mark]

(iii) Contingency   [1 mark]

(d) Determine whether each of the following propositional logic statements is a contradiction, a tautology or a contingency

(i) $(P \rightarrow Q) \vee (Q \rightarrow P)$ [4 marks]

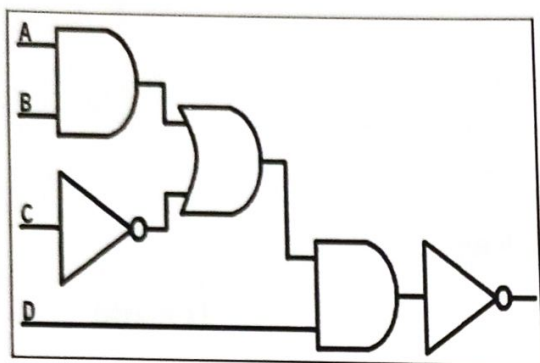(ii) $(P \vee Q) \wedge ((\neg P) \wedge \neg Q)$ [4 marks]

(iii) $(P \rightarrow Q) \wedge (Q \rightarrow R)$ [4 marks]

(iv) Show that $P \rightarrow Q$ and $\sim P \vee Q$ are logically equivalent   [4 marks]
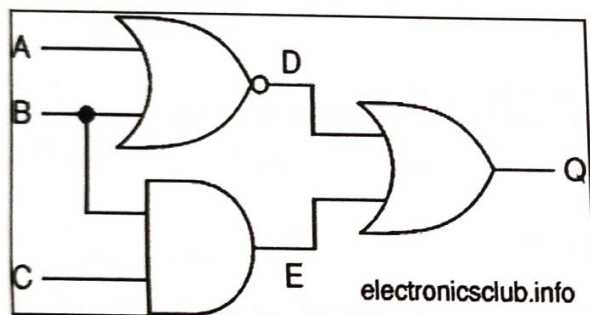
Question 3

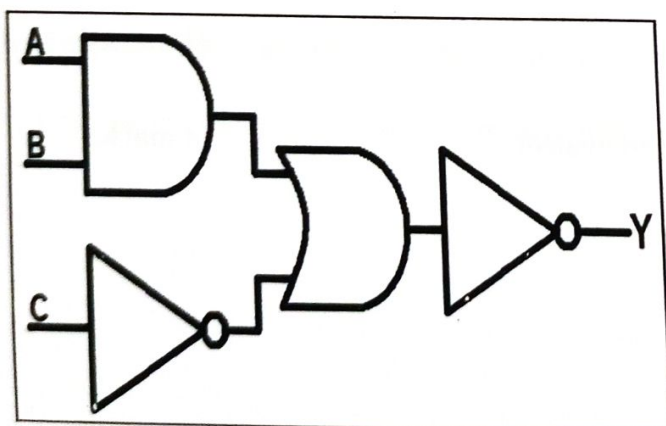(a) Obtain the expression of the output for each of the circuits given below
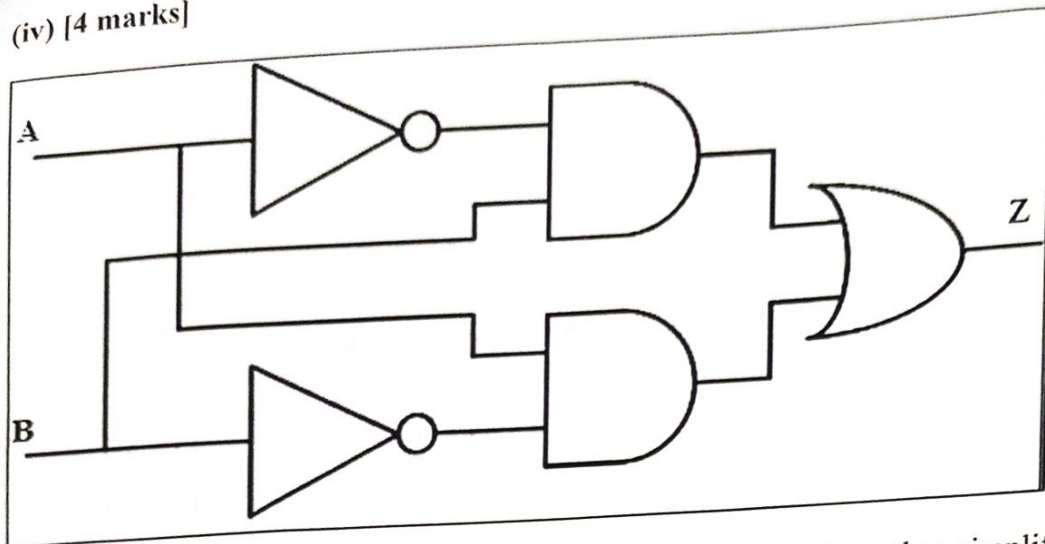
(i) [4 marks]

(ii) [4 marks]

(iii) [4 marks]

(iv) [4 marks]

(b) Draw the circuit diagrams for the following Boolean expressions; then simplify and draw simplified circuit diagrams

(i) $\overline{A\overline{(C+D)}}$ ··[3 marks]

(ii) $\overline{AB(C+D)}$ ··[3 marks]

(iii) $\overline{\left(\overline{X+Y+\overline{Z}}\right)}$ ··[3 marks]

Question 4

(a) Given that set A = {1, 2, 3} and that set B = {1, 2, 4}

(i) Determine a binary relation R from set A to set B   [3 marks]

(ii) Determine the number of relations in R   [2 marks]

(iii) Determine the sub relations form R given by:-

R_1 = {(a, b) : a < b}   [2 marks]

R_2 = {(a, b) a + b < 7}   [2 marks]

R_3 = {(a, b) : b − a = 2}   [2 marks]

(b) Determine the following combined sub relations:-

(i) $R_1 \cap R_2$ [2 marks]

(ii) $R_2 \cup R_3$ [2 marks]

(iii) $R_3 - R_2$ [2 marks]

(iv) $R_2 \triangle R_3$ [2 marks]

(c) Given a sub relation $R_3 = \{(1, 2), (2, 3), (2, 4), (2, 2), (3, 2), (4, 1), (1, 1), (3, 3)\}$ on a binary relation on set $Q = (1, 2, 3, 4)$. Determine giving a reason whether or not R is:-

(i) Reflexive   [2 marks]

(ii) Transitive   [2 marks]

(iii) Symmetric   [2 marks]

Question 5

(a) Using De-Morgan's laws to simplify the following expressions

(i) $\left(\overline{\overline{X + Y + \overline{Z}}}\right)$ ··[4 marks]

(ii) $\left(\overline{W + \overline{\overline{X}} + Y}\right).\overline{\overline{\overline{Z}}}$ ································[5 marks]

(iii) $\overline{AB + CD}$ ....[3 marks]

(iv) $\overline{A + \overline{\overline{BC}}}$ ....[3 marks]

(v) $\overline{\overline{A + BC} + \overline{\overline{\overline{AB}}}}$ ....[4 marks]

(iii) $\overline{\overline{A}.B.B.\overline{C}}$ ....[3 marks]

Determine the output Q of the expression $\overline{A} + BC + \overline{C} + \overline{D} = Q$ if:-

(i) A = 1, B = 0, C = 0 and D = 0   [2 marks]

(ii) A = 0, B = 1, C = 0 and D = 1   [2 marks]

END