The Open University of Sri Lanka
Faculty of Natural Sciences
B.Sc/ B. Ed Degree Programme

Department	**: Computer Science**
Level	**: 05**
Name of the Examination	**: Final Examination (1st Semester)**
Course Title and - Code	**: CSU 5304 – Mathematics for Computing**
Academic Year	**: 2021/2022**
Date	**: 13.10.2022**
Time	**: 9.30 am -11.30 am**
Duration	**: Two hours only**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **(06)** questions in **(05)** pages.
3. Answer any **(04)** questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. Draw fully labelled diagrams where necessary.
6. Involvement in any activity that is considered as an exam offense will lead to punishment.
7. Use blue or black ink to answer the questions.
8. Clearly state your index number in your answer script.

Answer Four Questions Only

(01)

i. Give the definition of a "***function***" in the context of mathematics.

ii. f(x) is a function defined by

$$f(x) = \begin{cases} 2x + 4; & x \leq 2 \\ 2x - 1; & x > 2 \end{cases}$$

Find the values of f (4), f (2) and f (0)

iii. h(x) and g(x) are two functions given by $h(x) = \frac{2x}{5} + 7$ and $g(x) = 10x^2 - 15$;

$\forall x \in \mathbb{R}$. Find the composite function $h_0g(x)$ and give your answer in the form of $ax^2 + b$; where a and b are integers.

iv. When composing a composite function, with only two functions, what is the important condition that should be satisfied by the first function?

v. Give <u>one</u> real life scenario, where you can use the concept of function.

(25 marks)

(02)

i. Write the general definition of "***Induction***" in brief.

ii. A similar concept is used in Mathematics, known as the **Principle of Mathematical Induction.** Write the main steps that you follow in a proof, when using the principle of Mathematical Induction.

iii. Use the above steps that you have given in question (02) part (ii) to prove the following.

$$3 + \sum_{i=1}^{n} (3 + 5\,i) = \frac{(n+1)(5n+6)}{2} \qquad \forall \quad n \geq 1$$

iv. After proving any identity, using the above principle and presenting the answer, what is the <u>important</u> statement that you should write?

v. What is the principle of ***Strong Induction***? (Give your answer in the point form)

(25 marks)

(03)

i. Why do you use sets in mathematics?

ii. Define the following terms regarding sets.

(a) Set and subset

(b) Power set

(c) Equal set

iii. List the elements of the following sets where P = {1,2,3,....20}

(a) A = {x: x∈P, 3<x<12}

B = {x: x∈P, x is even and x<15}

C = {x: x∈P, 4+x=3}

D={x: x∈P, x is a multiple of 5}

iv. A small college of 140 students, require its students to take at least one mathematics course and at least one science course. 60 students study mathematics, 45 students study science and 20 students study both mathematics and science. Use a Venn diagram or any other method in set theory to find the number of students who had completed:

(a) Exactly one of the two requirements

(b) At least one of the requirements

(c) Neither requirements

v. Write two daily life examples of sets.

(25 marks)

(04)

i. (a) Give the definition of a ***matrix***.

(b) What are the conditions that matrices should satisfy to perform the following operations?

- When adding two matrices
- When multiplying two matrices.
- Finding the inverse of a matrix
- Finding the determinant of a matrix

ii. How would you recognize any order of a square matrix as a :

(a) Diagonal matrix?

(b) Identity matrix?

(c) Upper triangular matrix?

iii. (a) Find the inverse of the matrix M_{2x2} in terms of k.

$$M_{2\times2} = \begin{bmatrix} k & k+1 \\ k+1 & k+2 \end{bmatrix}$$

$2x2$

(b) Write the condition that you use to check a given square matrix of any order is singular.

(c) $$A_{3\times3} = \begin{bmatrix} -4 & -4 & 4 \\ -1 & 0 & 1 \\ -7 & -6 & 7 \end{bmatrix}$$

$3x3$

Given that I_{3x3} is an identity matrix. Determine the values of the constant λ, such that $(A + \lambda I)$ is singular.

iv. (a) Why are matrices useful in computer science?

(c) Are matrices useful in programming? Justify your answer.

(25 marks)

(05)

(i) (a) Suppose there are two statements p and q. Such that p → q. Write the logical implications of **inverse** and **contrapositive** in terms of p and q.

(b) Define the term proposition in the context of logic. **"If a compound proposition is tautology"** What do you mean by the above statement?

(c) Show that (p → q) → (¬p v q) is tautology by using a truth table.

(ii) Write in English the converse and the negation of each statement given below.

(a) If it is not raining and not windy, then I will go for running or cycling.

(b) A day that is sunny and not too windy is a good day for walking.

(iii) (a) What do you mean by "Predicate" logic? What are the limitations of predicate or propositional logic?

(b) Using quantification symbols, write the following:

- Mary loves everyone. [Assuming domain contains only humans.]
- Every student smiles.
- Someone walks and talks.

(iv) Transform each of the following statements in to logical expressions, using predicates quantifiers and logical connectives.

C(x) : x is a CSU 5304 student

L(x): x loves music

The universe of discourse for the variable x is all students.

(a) Every student loves music.
(b) Some students love music.
(c) Every CSU5304 student loves music.
(d) Some CSU5304 students love music.

(v) Why do we need predicate logic?

(25 marks)

(06)

(i) (a) Names of basic logic gates are given below. Draw the logic gate symbols for each name.

AND, NOT, NAND, NOR

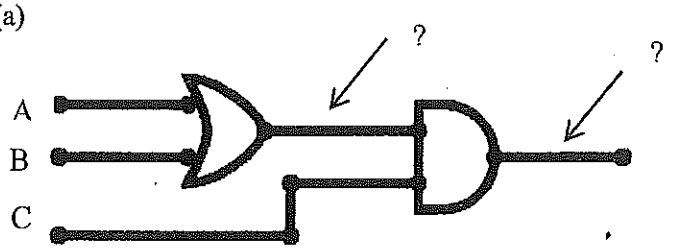
(b) Complete the truth table for NOR gate.

A	B	Out put
0	0	?
0	1	?
1	0	?
1	1	?

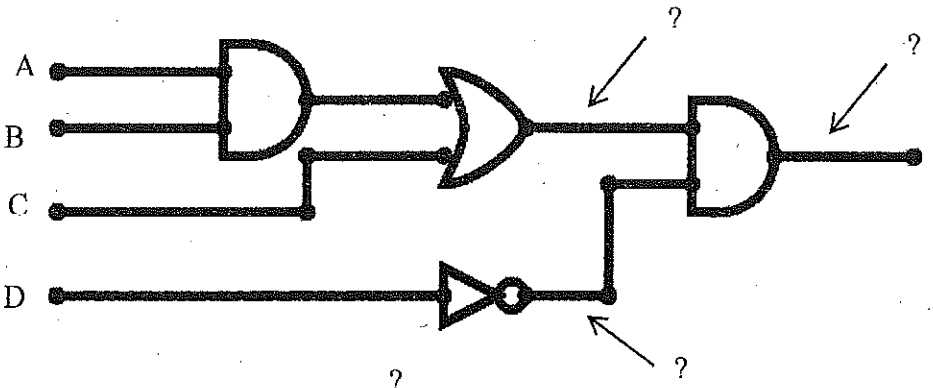
Table for NOR gate

(ii) Convert the following logic gate circuits in to Boolean expressions, by writing Boolean sub expressions next to each gate output in the diagram indicated by a question mark (?)

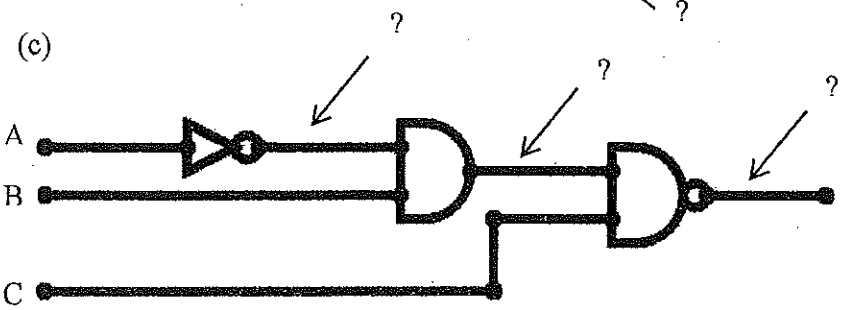
(a)



(b)



(c)



(iii) Suppose an engineer hands you a paper with the following Boolean expression on it, and tells you to build a gate circuit to perform the function, given below.

$$A\bar{B} + \bar{C}(A + B)$$

(iv) (a) Who invented Boolean Algebra?

(b) Provide names of four number systems.

(c) What is the use of combination logic?

(d) Write the complement of the binary number 1010. (25 marks)