BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

- OCT 2024

COMPUTER SCIENCE DEPARTMENT

BSc HONORS INFORMATION TECHNOLOGY/COMPUTER SCIENCE/SOFTWARE ENGINEERING/NETWORKING ENGINEERING

DISCRETE MATHEMATICS -CS205/CSH105/NWE107/SWE117

2 HOURS 30 MINUTES

INSTRUCTION TO CANDIDATES
This paper carries **five (5)** questions. Answer **ALL.**

Marks are indicated in brackets at the end of each question. Total marks are 100

Question 1

a) If two students at Main Campus and Town Campus receive an e-mail from their parents every 45 and 33 hours respectively, calculate,

i. the number of hours it will take them to receive an e-mail at the same time. **[4]**

ii. the number of e-mails received by each university. **[5]**

b) Prove the following statement:

i. For any integer x, the value of $f(x) = x^3 + x + 1$ is an odd integer. **[9]**

ii. The product of two odd numbers is odd. **[2]**

Question 2

a) In a group of 265 adults, 200 like singing, 110 like dancing and 55 like painting. If 60 adults like both singing and dancing, 30 like both singing and painting and 10 like all activities.

i. Represent this information on a Venn diagram. **[6]**

ii. Three adults are selected at random, calculate the probability they all do the same activity. **[4]**

iii. If three adults from this group are selected at random, find the probability that they like all the activities. **[2]**

b) Solve for the recurrence relation: $a_n = 8a_{n-1} - 15a_{n-2}$, $n \geq 2$, with $a_0 = 1$ and

$a_1 = 9$. [5]

c) What is the solution to the recurrence relation $a_n = 20a_{n-1} - 100a_{n-2}$ with initial conditions $a_0 = 1$, $a_1 = 30$? [5]

Question 3

a) Given the two tree traversal methods.

Pre-order: /, *, D, E, +, F, G

In-order: D, *, E, /, F, +, G

i. Draw the binary tree using the above output data. [5]

ii. Hence write the output if your tree is traversed in post-order traversal. [3]

iii. Explain the meaning of brother nodes in a binary tree. [2]

b) A safety system uses three inputs to a logic circuit. An alarm, X, sounds if input A represents ON and input B represents OFF, or if input B represents ON and input C represents OFF.

Produce a logic circuit and a truth table to show the conditions which cause the output X to be 1. [10]

Question 4

a) David is just starting a new job. His salary is $15 000 per annum, with an annual increment of $500. If this did not change, how much would he earn:

i. on the 7th year? [2]

ii. in total over a period of 12 years? [4]

b) The first three consecutive terms of a geometric sequence are (x - 2), (x + 2) and (5x - 2).

i. Find the two possible values of x. [4]

ii. Hence list the numbers and their common ratio. [4]

c) Let R be the relation on the set Z of integers defined by the rule: aRb if a + b is divisible by 2 (that is, a + b =2n for some integer n). Prove that R is an equivalence relation. [6]

Question 5

a) With the aid of a directed graph of atleast four nodes, explain the following methods used in a graph data structure.

   i. Adjacency matrix. **[5]**

   ii. Adjacency list. **[5]**

b) Explain any **four** applications of a graph data structure showing clearly how links and nodes are represented. **[8]**

c) Translate the symbolic statement $\sim p \wedge \sim q$ into plain English if:

   p = "Weston is the brightest student"

   q = "Weston is the busiest person" **[2]**

**********GOOD LUCK**********