BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

COMPUTER SCIENCE DEPARTMENT

MAR 2024

BSc HONORS COMPUTER SCIENCE

BSc HONORS INFORMATION TECHNOLOGY

DISCRETE MATHEMATICS –CS205/CSH105/NWE107

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) A manufacturer of TV sets produced 600 sets in the third year and 700 sets in the seventh year. Assuming that the production increases uniformly by a fixed number every year, find the:

   i. production in the 1st year [3]

   ii. production in the 10th year [2]

   iii. total production in first 7 years [3]

b) If a man deposits $200 at the beginning of each year in a bank that pays 4 percent compounded annually, how much will be to his credit at the end of 6 years? [4]

c) Prove using mathematical induction method that $3^{2n} - 1$ is divisible by 8 for each integer greater than zero. [8]

Question 2

a) There are 200 boys in Grade 12 at Marist Brothers High School. Their participation in sport can be broken down as follows:

   107 play rugby

   90 play soccer

63 play cricket

35 play rugby and soccer

23 play rugby and cricket

15 play rugby, soccer and cricket

190 boys play rugby, soccer or cricket

Draw a Venn diagram to illustrate the given information and use it to answer the following questions: **[6]**

i. How many boys play soccer and cricket, but not rugby? **[2]**

ii. What is the probability that 3 randomly chosen Grade 12 boys at Marist Brothers High School will take part in only one sport? Give your answer correct to 3 decimal places. **[4]**

b) If two factories A and B manufacture a mowing machine every 210 and 858 hours respectively,

i. Calculate number of hours it will take for them to manufacture a mowing machine at the same time. **[4]**

ii. Calculate the number of mowing machines manufactured by each factory. **[4]**

Question 3

a) Given the two tree traversal methods.

Pre-order: F, B, A, D, C, E, G, I, H

In-order: A, B, C, D, E, F, G, H, I

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]**

b) Solve for the recurrence relation: $a_n - 2a_{n-1} - 3a_{n-2} = 0$, $n \geq 2$, with $a_0 = 3$ and $a_1 = 1$. **[5]**

c) What is the solution to the recurrence relation $a_n = 8a_{n-1} - 16a_{n-2}$ with initial conditions $a_0 = 1$, $a_1 = 7$? **[3]**

d) With the help of a simple diagram, distinguish a binary search tree and binary tree. **[4]**

Question 4

a) Let R be the relation on the set Z of integers defined by the rule: xRy if $x - y$ is divisible by 20 (that is, $x - y = 20n$ for some integer n). Show that R is an equivalence relation, and describe the equivalence classes. **[10]**

b) Explain any **three** applications of graph data structure showing clearly how links and nodes are represented. **[6]**

c) Let S = {n :N | 1 ≤ n ≤ 10}. Show that any subset T of S with more than 5 elements contains two numbers that add up to 11. **[4]**

Question 5

a) The following diagram in fig.1, shows a graph.

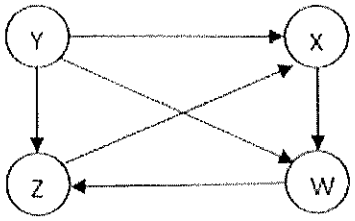

Fig.1

i. Draw the adjacency matrix to represent the graph. **[4]**

ii. Represent the graph using an adjacency list. **[4]**

b) Translate the following symbolic statement forms into plain English:

Let h = "Donald is healthy"

w = "Donald is wealthy"

s = "Donald is wise"

i. $(h \wedge w) \wedge (\sim s)$ **[3]**

ii. $\sim w \wedge (h \wedge s)$ **[3]**

iii. $\sim h \wedge \sim w \wedge \sim s$ **[3]**

c) State the converse, inverse and contrapositive of $P \rightarrow Q$. **[3]**

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