BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE EDUCATION

DEPARTMENT OF EDUCATIONAL TECHNOLOGY

BACHELOR OF SCIENCE EDUCATION IN COMPUTER SCIENCE

MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE CS103/EDT103

TIME: 3 HOURS

INSTRUCTIONS

AUG 2024

Answer **ALL the questions.** Each question carries **20** marks.

The question paper has **5** questions

Question 1

a. Obtain the principal disjunctive and conjunctive normal forms of the formula

$$(\sim P \vee \sim Q) \rightarrow (P \leftrightarrow \sim Q)$$ **[6]**

b. Prove or disprove the validity of the following arguments **[6]**
All men are mortal.
Socrates is a man.
Therefore, Socrates is mortal

c. **Simplify** $\neg(\neg p \wedge q) \wedge (p \vee q)$ **[8]**

Question 2

a. What do you understand by that a statement can be tautology, contradiction, or at least satisfiable? **[6]**

b. Let $X = \{1, 2, 3, 4\}$ and $R = \{(x, y) | x > y\}$. Draw the graph of R and also give its matrix. **[8]**

c. Let the compatibility relation on a set $\{x1, x2, ..., x6\}$ be given by the matrix:

x_2	1				
x_3	1	1			
x_4	0	0	1		
x_5	0	0	1	1	
x_6	1	0	1	0	1

X1 X2 X3 X4 X5

Draw the graph and find the maximal compatibility blocks of the relation. **[6]**

Question 3

a. Symbolize the following argument and check for its validity:
Lions are dangerous animals.
There are lions.
There are dangerous animals. **[10]**

b. How many non-negative integral solutions are there to

$$x_1 + x_2 + x_3 + x_4 + x_5 = 20$$
$$\text{where } x_1 \geq 3,\ x_2 \geq 2,\ x_3 \geq 4,\ x_4 \geq 6 \text{ and } x_5 \geq 0\ ?$$

[10]

Question 4

a. Calculate $A(X) = \sum a_r$, $X^r = 0 .. \infty = 1 / (X^2 - 5X + 6)$. **[10]**

b. In how many ways can 12 of the 14 men be partitioned into 3 teams of 4 each? **[5]**

a. What is the number of vertices in an undirected connected graph with 27 edges, 6 vertices of degree 2, 3 vertices of degree 4 and remaining vertices of degree 3? **[5]**

Question 5

a. Using mathematical induction, prove that the following statement is true for all positive integers n.

$$1^2 + 3^2 + 5^2 + \ldots + n^2 = \frac{n(n+1)(2n+1)}{6} \text{ for } n \geq 1$$ **[15]**

b. Find the number of positive integers less than or equals to 91 and relatively prime to 91 using Euler ϕ - function. **[5]**

THE END