# BINDURA UNIVERSITY OF SCIENCE EDUCATION

## FACULTY OF SCIENCE EDUCATION

AUG 2023

## DEPARTMENT OF EDUCATIONAL TECHNOLOGY

## BACHELOR OF SCIENCE EDUCATION IN COMPUTER SCIENCE

**EDT103: MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE**

**TIME: 3 HOURS**

**INSTRUCTIONS**

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

The question paper has **5** questions

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**Question 1**

a. Obtain the principal disjunctive and conjunctive normal forms of the formula
$(Q \rightarrow P) \wedge (\sim P \wedge Q)$ **[8]**

b. Prove or disprove the validity of the following arguments **[6]**
Every husband argues with his wife.
$x$ is a husband.
Therefore, $x$ argues with his wife.

c. Prove the following logical equivalence **[6]**

$$p \oplus q \equiv (p \vee q) \wedge \neg (p \wedge q)$$

**Question 2**

a. Explain in brief about duality Law? **[5]**

b. Example: Let $A = \{1, 2, 3, 4\}$. Find the relation $R$ on $A$ determined by the matrix

$$M_R = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 \end{pmatrix}$$ **[5]**

c. Let $X = \{1, 2, 3, ..., 7\}$ and $R = \{(x, y) | x - y \text{ is divisible by } 3\}$. Show that R is an equivalence relation. **[10]**

**Question 3**

**a.** If the function $f$ is defined by $f(x)=x^2+1$ on the set $\{-2, -1, 0, 1, 2\}$, find the range of $f$. **[8]**

b. In how many ways can 5 similar books be placed on 3 different shelves so that each shelf contains at least one book? **[5]**

**c.** Five balls marked with B1,B2,B3,B4,B5 are to be kept in 5 cells marked with C1,C2,C3,C4,C5. How many ways this can be done so that ball Bi is not kept in cell Ci (i = 1,2,…,5). **[7]**

**Question 4**

a. A certain computer center employs 100 computer programmers. Of these 47 can program in FORTRAN , 35 in Pascal and 23 can program in both languages. How many can program in neither of these 2 languages? **[10]**

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

c. Let G be a simple graph with n vertices. Then show that the number of edges in G is less than or equal to $\{n.(n-1)\} / 2$. **[5]**

**Question 5**

a. Using mathematical induction, prove that the following statement is true for all positive integers n. **[15]**

b. $1^2 + 3^2 + 5^2 + ... + (2n-1)^2 = \dfrac{n(2n-1)(2n+1)}{3}$ for $n \geq 1$

b) Find the greatest common divisors of the following pairs of 510 and 374 **[5]**

**THE END**