FD-2851

BCA (Part-I) Examination, 2022

DISCRETE MATHEMATICS

Paper - I

Time : Three Hours] [*Maximum Marks* : 80

[*Minimum Pass Marks* : 27

Note : Answer any **two** parts from each question. All questions carry equal marks.

Unit-I

1. (*a*) (*I*) If $p \equiv$ Ramesh is a player $q \equiv$ Mohan is wise, then write the following symbols in sentence :

(*i*) $\sim p v \sim q$

(*ii*) $\sim (p \wedge q)$

(*II*) Write the following sentences in symbols :

(*i*) Until Sheela will not come I shall not go to college.

(*ii*) When Sheela will come then I shall go to colleage.

(*III*) Write True or False of the following statements :

(*i*) $\{2, 3\} \subset \{2, 4, 6\}$

(*ii*) $5 \in \{1, 3, 5\}$

(*IV*) Are the following propositions ?

(*i*) Some roses are black.

(*ii*) May you live long.

(*b*) Prove that $(p \Leftrightarrow q) \wedge (q \Leftrightarrow r) \Rightarrow (p \Leftrightarrow r)$ is a Tautology.

(*c*) (*I*) If $Q(x) = x$ is a rational number.

$R(x) = x$ is a real number.

then translate the following sentences into symbols :

(*i*) R is a real number.

(*ii*) Every rational number is a real number.

(*II*) Negate each of the following statements :

(*i*) $\forall x \, (|x| = x)$

(*ii*) $\exists x \, (x + 2 = x)$

(*III*) Write the following predicate into symbols and also write its negative in symbols. "Every rational number is a real number."

Unit-II

2. (*a*) (*I*) In a Boolean algebra B, the identity elements are complementary to each other i. e., for $0, 1 \in B$, then show that :

(*i*) $0' = 1$

(*ii*) $1' = 0$

(*II*) In a Boolean algebra, show that if $a + b = a + c$ and $ab = ac$, then $b = c$.

(*b*) (*I*) Show that the order relation $\leq$ is partial order relation in a Boolean algebra.

(*II*) In a Boolean algebra B, if $x \leq y$ and $y \leq x$, then prove that $x = y$.

(*c*) (*I*) Construct a circuit for the Boolean function

$$F(a, b, c) = a \cdot b \cdot c + a' \cdot b \cdot c$$

Simplify it and draw the figure.

(*II*) Draw the logic circuit with inputs a, b, c and output X where

$$X = abc + a'c' + b'c'$$

Unit-III

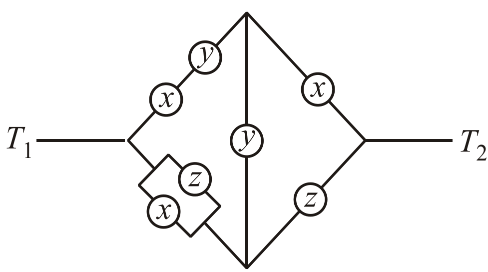
3. (*a*) (*I*) Express the following function in disjunctive normal form in the smallest possible number of variables :

$$f(x, y, z) = xy' + xz + xy$$

(*II*) Express the following function in conjunctive normal form :

$$f(x, y, z) = (xy' + xz)' + x'$$

(*b*) (*I*) Simplify the following circuit.



(*II*) Design a 3-terminal circuit which gives the real forms to the following functions :

$$f = xzw + y'zw$$

$$g = xzw + y'zw + x'y'z$$

(*c*) (*I*) Draw the binomial net for the following flow functions :

$$x \cdot y \cdot z + x' \cdot y \cdot z + xy'z + x'y'z'$$

(*II*) Design a tree-net in three variables for the flow function :

$$xyz + x'yz + xy'z + x'y'z$$

Unit-IV

4. (*a*) (*I*) If $A = \{1, 2, 3\}$, $B = \{2, 4\}$ and $C = \{3, 5\}$, then find $A \times (B - C)$.

(*II*) If $A = \{1, 2\}$, $B = \{2, 3\}$ and $C = \{3, 5\}$, then find

$$(A \times B) \cap (A \times C).$$

(*b*) (*I*) Let $A = \{1, 2, 3, 4\}$ and $B = \{a, b, c\}$ and let

$$R = \{(1, a), (2, a), (2, b), (3, a), (3, b)\}$$

be a relation from A to B, then find R^{-1}, $d(R)$, $r(R)$, $d(R^{-1})$ and $r(R^{-1})$

(*II*) Is the relation 'is less than' transitive in the set of natural numbers ?

(*c*) (*I*) Prove that the following sets are countable :

(*i*) the set I of all integers ;

(*ii*) the set E of all positive integers.

(*II*) If $A = \{1, 3, 5\}$, $B = \{a, b, c\}$ and $1 \leftrightarrow a$, $3 \leftrightarrow b$, $5 \leftrightarrow c$, show that it is one-one onto mapping.

Unit-V

5. (*a*) (*I*) Show that the vertices of odd degree (odd vertices) in a graph is always even.

(*II*) Draw the equivalent labelled graphs for G_1 and G_2 if

$$G_1 = \{\{v_1, v_2, v_3\}\ \{v_1, v_2\}\ \{v_1, v_3\}\ \{v_2, v_3\}\}$$

$$G_2 = \{\{w_1, w_2, w_3\}\ \{w_1, w_2\}\ \{w_1, w_3\}\ \{w_2, w_3\}\}$$

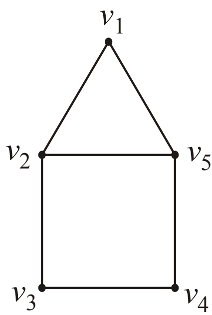
(*b*) (*I*) Draw the graphs represented by the following adjacency matrices :

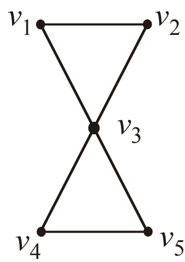
$$\begin{bmatrix} 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \end{bmatrix}$$

(*II*) Express the following algebraic expressions in binary trees :

$$(x - y) + ((y + z) + w)$$

(*c*) (*I*) Which of the following graphs have a Hamiltonian circuit ?





(*II*) A graph with at least one edge is 2-chromatic if and only if it has no circuits of old length.
