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M.Sc. IV Semester Examination 2020

Subject : Mathematics

Paper : 411(III) –Discrete Mathematical Structures

Max.Marks : 85 Min.Marks: 29

Note: Attempt all questions.

Section –'A'

(Short Answer Type Questions)

1. Attempt any five of the following questions. 5x5=25

(i) If I is the set of integers and the relation xRy$\Rightarrow$ x-y is an even integer, then prove that R is an equivalence relation, where x,y$\in$I.

(ii) Write axiom of Choice and Zorn's Lemma.

(iii) Explain contradiction and tautologies.

(iv) Explain proposition and logical operator.

(v) Define Distributive and Bounded lattice.

(vi) Show that two proposition $\sim(p\Rightarrow q)$ and $p\wedge\sim q$ are logically equivalent.

(vii) Define Boolean Algebra with example.

(viii) Change the function $x'yz + xyz + x'yz' + xyz'$ into disjunctive normal form of two variables.

(ix) What is generating function?

(x) Using mathematical induction, prove that

$$1 + 2 + 3 + \ldots\ldots\ldots + n = \frac{n(n+1)}{2}$$

For all n$\in$N.

Section –'B'

(Long Answer Type Questions)

Note: Attempt all questions. 12x5=60

2. (a) State and prove inclusion – exclusion principle. 8

(b) Define the following: 4

(i) Totally ordered set (ii) Partition of a set A.

Contd…

OR

Define equivalence relation and equivalence class. If R and S be equivalence relation in the set X, then prove that $R \cap S$ is an equivalence relation in X.

3. Prove that the connectives NAND and NOR are commutative but not associative. 12

OR

Define tautology. Verify that the following propositions are tautology:

(i) $\sim (p \vee q) \Leftrightarrow (\sim p) \wedge (\sim q)$

(ii) $\sim (p \wedge q) \Leftrightarrow (\sim p) \vee (\sim q)$

(iii) $(p \vee q) \vee r \Leftrightarrow p \vee (q \vee r)$

4. (a) Let $(L, \leq)$ be a lattice, then prove that for any a and b in L- 7

(i) $a \vee (a \wedge b) = a$

(ii) $a \wedge (a \vee b) = b$

(b) Prove that every distributive lattice is modular. 5

OR

(a) Show that De-Morgan's law holds in a complemented distributive lattice. 6

(b) Prove that in a distributive lattice $(<, \leq)$ if an element has a complement then this complement is unique. 6

5. Convert the function: $f(x,y,z) = (xy' + xz') + x'$ into disjunctive normal form. Also draw the switching circuit for the following Boolean function and replace it by a simpler one: 12

$$f(x,y,z) = xz + [y.(y'+z).(x' + xz')]$$

OR

Prove that every function without constant of Boolean Algebra is equal to a function in conjunctive normal form.

Contd…

6. Using mathematical induction, prove that the following:

(i) $\frac{1}{1.3} + \frac{1}{3.5} + \frac{1}{5.7} + \ldots\ldots.. + \frac{1}{(2n-1)(2n+1)} = \frac{n}{(2n+1)}$

(ii) $2 + 5 + 8 + \ldots\ldots\ldots\ldots\ldots + (3n-1) = \frac{n(3n+1)}{2}$

Where, $n \geq 1$.

OR

Solve the following recurrence relation:

$a_r + 5a_{r-1} + 6\,a_{r-2} = 3r^2 - 2r + 1$

Also find the generating function of the numeric function a_r, where

$a_r = 3a_{r-1} + 2,\ r \geq 1$ where $a_0 = 1$.
