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**BCA (11-13)/D-14**

**MATHEMATICAL FOUNDATION-I**

**Paper-BCA-115**

*Time allowed : 3 hours]*

*[Maximum marks : 80]*

*Note : Answer five questions in all, selecting one question from each section and. Question No. 1 is Compulsory. All questions carry equal marks.*

1. (a) Find the complement of each element of the lattice  $D_{35}$ .
- (b) Differentiate  $\frac{\sqrt{x+1} + \sqrt{x-1}}{\sqrt{x+1} - \sqrt{x-1}}$  w.r.t. x.
- (c) Find the differential equation of  $y = A \cos x + B \sin x$ .
- (d) Find the complementary fusion of

$$\frac{d^2y}{dx^2} - 6 \frac{dy}{dx} + 9y = e^{3x}.$$

**Section-I**

2. (a) Define Equivalence relation on a set. In the set of integers, let a relation R be defined as  $aRb$  if only if  $a, b$  is even. Prove that R is an equivalence relation.
- (b) To prove that  ${}^n P_r = {}^{n-1} P_r + r \cdot {}^{n-1} P_{r-1}$ .
3. (a) Determine whether the set  $\{1, 2, 4, 8, 16\}$  is a lattice with the relation of divisibility.

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- (b) Let S be a finite set. The power set of S i.e.  $P(S)$  is a lattice under the partial relation ' $\subseteq$ ' of set inclusion. Show that  $P(S)$  is a Boolean Algebra.

**Section-II**

4. (a) Define continuity of a function of a single variable using  $\epsilon-\delta$  definition, prove that

$$f(x) = \begin{cases} x \cos \frac{1}{x}, & \text{if } x \neq 0 \\ 0, & \text{if } x = 0 \end{cases} \quad \text{is continuous at } x = 0$$

- (b) Show that the function defined by

$$f(x) = |x| + |x-1| \quad \text{is continuous but not derivable at } x = 0 \text{ and } 1$$

5. (a) If  $y = \sqrt{x} + \frac{1}{\sqrt{x}}$ , show that  $2x \frac{dy}{dx} + y = 2\sqrt{x}$

$$(b) x^p y^q = (x+y)^{p+q}; \text{ prove that } \frac{dy}{dx} = \frac{y}{x}.$$

6. (a) Find the differential equation of family of all straight lines lying in xy-plane.

- (b) Solve the differential equation.

$$x^2 dy + y(x+y) dx = 0$$

7. Solve the differential equation  $\frac{dy}{dx} + 1 = e^{x-y}$

$$\text{Solve } (x y^2 + 2 x^2 y^3) dx + (x^2 y - x^3 y^2) dy = 0$$

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Section-IV

8. (a) Solve the differential equation

$$\frac{d^2y}{dx^2} - 4y = e^x + \sin 2x.$$

- (b) Solve the differential equation

$$x^2 \frac{d^2y}{dx^2} - 2y = x^2 + \frac{1}{x}.$$

9. (a) Solve  $\frac{d^2y}{dx^2} + 2y = x^2 e^x$ .

- (b) Solve  $\frac{d^2x}{dt^2} + \mu^2 x = \lambda \cos \mu t$ , given that  $x=0$ ,

$$\frac{dx}{dt} = 0 \text{ where } t=0.$$