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Mathematical Foundation of Computer Science–I

Paper : B.C.A. 103

Time : Three Hours] [Maximum Marks : 100

Note :– Attempt any **FIVE** questions, selecting at least ONE question from each unit.

UNIT–I

1. (a) Find the differential equation of the family of curves $x^2 + y^2 + 2ax + 2by + c = 0$, where a and b are arbitrary constants. (10)

   (b) Solve the differential equation :

$$(a+e^{x/y})\,dx + e^{x/y}\left(1-\frac{x}{y}\right)dy = 0. \quad (10)$$

2. (a) Solve : $y(xy+1)\,dx + x(1+xy+x^2y^2)\,dy = 0$. (10)

   (b) Solve : $\frac{dy}{dx}+\frac{2}{x}y = 3x^2 y^{4/3}$, $x > 0$. (10)

3. (a) Solve : $xdx + ydy = a^2\left(\frac{xdy - ydx}{x^2+y^2}\right)$ (10)

   (b) Solve : $(3x^2y^4 + 2xy)\,dx + (2x^3y^3 - x^2)\,dy = 0$. (10)

4. (a) Solve the differential equation :

$$\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = x e^x \sin x. \quad (10)$$

   (b) Solve : $x^2\frac{d^2y}{dx^2} - 3x\frac{dy}{dx} + 5y = \text{Sin}(\log x)$. (10)

UNIT–II

5. (a) Define set and complement of a set. State and prove D'Morgan's Laws of two sets. (10)

(b) Partition {1, 2, 3, ··· 9} into the minsets generated by $B_1 = \{5, 6, 7\}$, $B_2 = \{2, 4, 5, 9\}$ and $B_3 = \{3, 4, 5, 6, 8, 9\}$. (10)

6. (a) If ${}^nC_r : {}^nC_{r+1} = 1 : 2$, find the values of n and r. (10)

(b) Define power set of a set. Find the number of subsets of set S containing n elements. (10)

7. (a) Prove that :

$(p \rightarrow q) \wedge (q \rightarrow r) \Rightarrow p \rightarrow r$ is a tautology. (10)

(b) Show that : $2^n > n \ \forall \ n \in N$. (10)

UNIT–III

8. (a) Define Group, Subgroup and Ring by giving examples. (10)

(b) Express $\begin{bmatrix} -1 & 7 & 1 \\ 2 & 3 & 4 \\ 5 & 0 & 5 \end{bmatrix}$ as the sum of a symmetric and a skew-symmetric matrix. (10)

9 (a) Prove that $\begin{bmatrix} 2 & 6 & 1 \\ 0 & 1 & -6 \\ 3 & 4 & 2 \end{bmatrix}$ satisfies its characteristic equation. Also find its inverse, if it exists. (10)

(b) Solve :

$x + 2y - z = 3$
$3x - y + 2z = 1$
$2x - 2y + 3z = 2$ by matrix method. (10)

10. (a) Define a field. Prove that every field is an integral domain. (10)

b If $A = \begin{bmatrix} 2 & 0 \\ 3 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & 1 \\ 3 & 4 \end{bmatrix}$, verify $(AB)^{-1} = B^{-1} A^{-1}$. (10)

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