Roll No. ....

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MATHEMATICAL FOUNDATION-I
BCA-113

Time : Three Hours]   [Maximum Marks : 80

Note : Attempt *Five* questions in all, selecting *one* question from each Section. Q. No. **1** is compulsory.

(Compulsory Question)

1. (a) Verify that $(A \cup B)' = A' \cup B'$, where A = {2, 3, 4, 5, 6}, B = {3, 6, 7, 8} are subsets of U = {1, 2, 3, 4, 5, 6, 7, 8}.   4

   (b) Find r, if $^{10}P_{r+1} : {}^{11}P_r = 30 : 11$.   3

   (c) Find $\frac{dy}{dx}$, when $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.   3

   (d) Show that $x^2 + 4y = 0$ is a solution of   3
   $$\left(\frac{dy}{dx}\right)^2 + x\frac{dy}{dx} - y = 0$$

   (e) Solve the differential equation :   3
   $$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + y = 0.$$

Unit I

2. (a) In a class of 1000 students, 625 students pass in Mathematics and 525 pass in English. How many students pass in Mathematics only and how many pass in English only ?   8

   (b) In a set of integers, let a relation R be defined as aRb if and only if $a-b$ is even. Prove thaet R is an equivalence Relation.   8

3. (a) Find the number of arrangements that can be made out of the letter of the word PERMUTATION. In how many of these 5 vowels are together ?   8

   (b) A polygon has 44 diagonals. Find the number of its sides.   8

Unit II

4. (a) Using $\in$-δ definition, prove that :   8
   $$\lim_{x \to a} \cos x = \cos a, \text{ where } a \in R.$$

   (b) Differentiate :
   $$\tan^{-1}\frac{\sqrt{1+x^2}-1}{x} \text{ w.r.t. } \sin^{-1}\frac{2x}{1+x^2}. \qquad 8$$

5. (a) If $x^p y^q = (x+y)^{p+q}$, prove that : 8

$$\frac{dy}{dx} = \frac{y}{x}$$

(b) If $y = e^{\tan^{-1} x}$, prove that : 8

$$(1+x^2) y_2 + (2x-1) y_1 = 0.$$

Unit III

6. (a) Find the differential equation of the family of the curves $y = Ae^{3x} + Be^{5x}$, where A and B are arbitrary constants. 8

(b) Solve the differential equation : 8

$$(1+x^2) \frac{dy}{dx} + 2xy - 4x^2 = 0$$

7. (a) Solve the differential equation : 8

$$(y \log x - 1) y dx = x dy$$

(b) Verify that the differential equation :

$$x dy + y dy = a^2 \frac{(x dy - y dx)}{x^2 + y^2}$$

is exact and solve it. 8

Unit IV

8. (a) Solve the differential equation : 8

$$\frac{d^3 y}{dx^3} + \frac{d^2 y}{dx^2} + \frac{dy}{dx} + y = \sin 2x$$

(b) Solve the differential equation : 8

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

9. (a) Solve the differential equation : 8

$$x^2 \frac{d^2 y}{dx^2} - 2x \frac{dy}{dx} - 4y = x^4$$

(b) Solve the differential equation : 8

$$(3x+2)^2 \frac{d^2 y}{dx^2} + 3(3x+2)\frac{dy}{dx} - 36y = 3x^2 + 4x + 1$$