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**B. Tech. (Civil Engg., Aeronautical & Aerospace Avionics) (Semester – 2nd)
MATHEMATICS-II (DIFFERENTIAL EQUATION)**

Subject Code: BMATH4201

Paper ID: [19110019]

Time: 03 Hours

Maximum Marks: 60

Instruction for candidates:

1. Section A is compulsory. It consists of 10 parts of two marks each.
2. Section B consist of 5 questions of 5 marks each. The student has to attempt any 4 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A

(2 marks each)

Q1. Attempt the following:

- a) Solve the equation $y' + 2xy = x^2 y^2$
- b) What is the Cauchy-Euler's Equation?
- c) solve $p^2 + q^2 = z$
- d) solve partial differential equation $r + 2s + t = 0$
- e) Write the general form of the diffusion equation in one dimension.
- f) Use separation of variables to solve the PDE $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$
- g) Find the Laplacian of the function $u(x, y) = x^2 - y^2$.
- h) What is the wave equation and write its standard form in one dimension?
- i) Define D'Alembert's solution to the wave equation.
- j) Find the integrating factor for $(e^y + xe^y)dx + xe^y dy = 0$

Section – B

(5 marks each)

Q2. Solve the differential equation by method of variation of parameters:

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

Q3. Solve the following differential equation

$$(y^4 + 2y)dx + (xy^3 + 2y^4 - 4x)dy = 0$$

Q4. Solve $2xz - px^2 - 2qxy + pq = 0$

Q5. Find the deflection of a vibrating string of unit length having fixed ends with initial velocity zero and initial deflection $f(x) = x - x^2$.

Q6. Solve the PDE $(D_x^3 - 4D_x^2 D_y + 4D_x D_y^2)z = 4\sin(2x+y)$.

Section – C

(10 marks each)

Q7. Drive the Laplace Equation in Spherical polar coordinates and discuss its applications in solving PDEs.

Q8. A rod of length L has its ends kept at 0°C and the initial temperature distribution is $u(x, 0) = T_0 \sin \frac{\pi x}{L}$. Find the temperature distribution $u(x, t)$ at time t.

Q9. Solve the wave equation $u_{tt} - c^2 u_{xx} = 0$ using separation of variables and explain the boundary conditions.