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B. Tech. (Civil, Aeronautical & Aerospace Avionics) (Semester – 2nd)

MATHEMATICS-II (DIFFERENTIAL EQUATIONS)

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. Form the differential equation by eliminating the constants: $y = e^x(A \cos x + B \sin x)$.
- b. What do you mean by exact differential equation?
- c. Find the integrating factor of differential equation: $(3xy^2 - y^3)dx + (2x^2y - xy^2)dy = 0$.
- d. Find the particular integral of the differential equation: $(D^3 - D^2 - D - 1)y = \sin 2x$.
- e. Form the partial differential equation for the function $z = ae^{-b^2y} \sin bx$.
- f. Solve the differential equation $2p + 3q = 1$, where $p = \frac{\partial z}{\partial x}$ and $q = \frac{\partial z}{\partial y}$.
- g. Classify the partial differential equation: $\frac{\partial^2 z}{\partial x^2} = x^2 \frac{\partial^2 z}{\partial y^2}, x \neq 0$.
- h. State Laplace equation in polar form.
- i. Write down two-dimensional wave equation.
- j. What do you mean by Initial conditions?

Section – B

(5 marks each)

Q2. Solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 4y = e^x \cos x$.

Q3. Solve $(2x + x^3)\frac{d^2y}{dx^2} - \frac{dy}{dx} - 6xy = 0$, in series.

Q4. Solve the following Lagrange's partial differential equation:
 $p + 3q = 5z - \tan(3x - y)$

Q5. Solve for general solution:

$$\frac{\partial^3 z}{\partial x^3} - 2\frac{\partial^3 z}{\partial x^2 \partial y} - 2\frac{\partial^3 z}{\partial x \partial y^2} + 2\frac{\partial^3 z}{\partial y^3} = e^{x+y}$$

Q6. Solve $z^2 = p q x y$, by Charpit's method.

Section – C

(10 marks each)

Q7. Obtain the solution of heat equation $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$, by the method of separation of variables.

Q8. A tightly stretched string of length l has its ends fastened at $x = 0$, $x = l$. The point where

$x = \frac{l}{3}$ is drawn aside a small distance h and released at time $t = 0$. At any subsequent time $t > 0$ the displacement $Y(x, t)$ of the string satisfies the one dimensional wave equation

$$\frac{\partial^2 Y}{\partial t^2} = c^2 \frac{\partial^2 Y}{\partial x^2}$$

Determine $Y(x, t)$ at any time $t > 0$.

Q9. Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$, subject to

$u(x, 0) = u(x, m) = 0$ where $0 \leq x \leq l$ and $u(0, y) = 0, u(l, y) = F(y)$ where $0 \leq y \leq m$