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Assignment # 03

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Sec# B

Dept# BE (C)

Topic# Applications of
Partial Differential
Equations.

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"Applications of Partial Differential Equations":-

In this we discuss briefly some of the most important PDEs that arise in various branches of science and engineering. We shall see that some equations can be used to describe a variety of different situations.

1) Wave Equation:-

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

$$a) \frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2} - g$$

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$$b.) \frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2} - a \frac{\partial u}{\partial t}$$

$$\frac{\partial^2 u}{\partial t^2} = c^2 \left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} \right)$$

$$\frac{\partial^2 u}{\partial t^2} = c^2 \left(\frac{\partial^2 u}{\partial r^2} + \frac{1}{r} \frac{\partial u}{\partial r} + \frac{1}{r^2} \frac{\partial^2 u}{\partial \theta^2} \right)$$

$$0 \leq r \leq R, \quad 0 \leq \theta \leq 2\pi$$

2.) Heat Conduction Equation:-

$$\frac{\partial u}{\partial t} = k \frac{\partial^2 u}{\partial x^2} \quad \begin{array}{l} 0 \leq x \leq L \\ t > 0 \end{array}$$

$$\frac{\partial u}{\partial t} = k \left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} \right)$$

3.) Transmission line Equation:-

$$\frac{\partial^2 i}{\partial x^2} = LC \frac{\partial^2 i}{\partial t^2} + (RC + GL) \frac{\partial i}{\partial t}$$

$$+ RGi$$

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$$\frac{\partial^2 i}{\partial x^2} = RC \frac{\partial i}{\partial t}$$

$$\frac{\partial^2 i}{\partial x^2} = LC \frac{\partial^2 i}{\partial t^2}$$

4.) Laplace's Equation:-

$$\frac{\partial u}{\partial t} = k \left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} \right)$$

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$$

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} = 0$$

5.) Poisson's Equation:-

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = f(x, y)$$

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6.) Helmholtz's Equation:-

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + K^2 u = 0$$

7.) Schrödinger's Equation:-

$$-\frac{h^2}{8\pi^2 m} \left(\frac{\partial^2 \psi}{\partial x^2} + \frac{\partial^2 \psi}{\partial y^2} + \frac{\partial^2 \psi}{\partial z^2} \right) = E\psi$$

8.) Transverse Vibrations Equation:-

$$a^2 \frac{\partial^4 u}{\partial x^4} + \frac{\partial^2 u}{\partial t^2} = 0$$