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SECTION: B

DEPT.: BE Civil

Assignment # 04.

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⇒ "Applications of Partial Differential equation" :-

⇒ In this, we will 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.) $$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2} - g.$$

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

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

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

2.) Heat Conduction Equation:

$$\frac{\partial u}{\partial t} = K \frac{\partial^2 u}{\partial x^2} \qquad \therefore 0 \le x \le L, \; t > 0$$

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

3.) Transmission Line Equation:-

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

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

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:-

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

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:-

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