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Section = B.

Application of Partial Differential equation:-

(iv) Laplace Equation:-

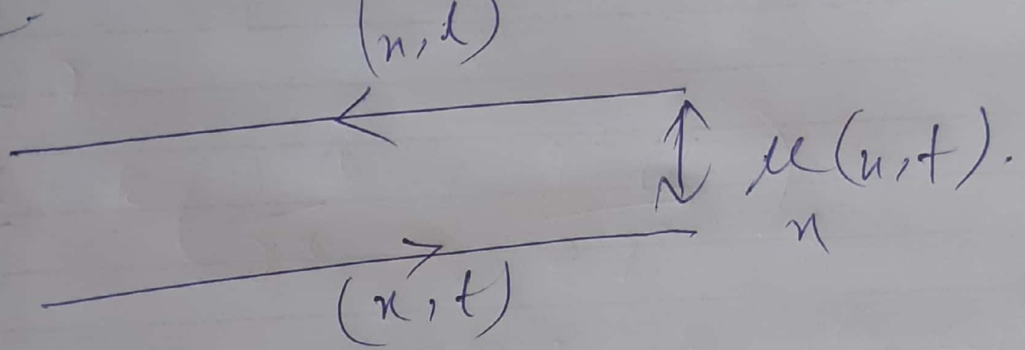
If you look back the two dimensional heat conduction equation.

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

Laplace equation is always a model for equilibrium situations.

(iii) Transmission line equation:-

In a long electrical cable or a telephone wire both the current and voltage depend upon position along the wire as well as the time.

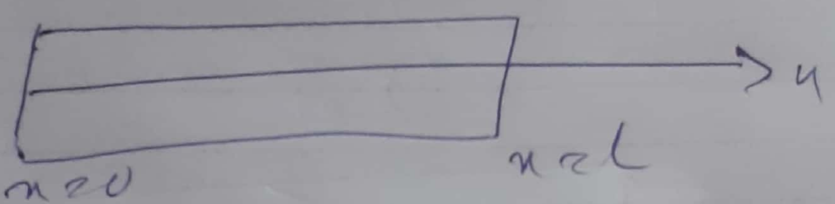


Using basic law of electrical circuit theory then the electrical current (x,t) satisfies -

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

(iii) Heat conduction equation:-

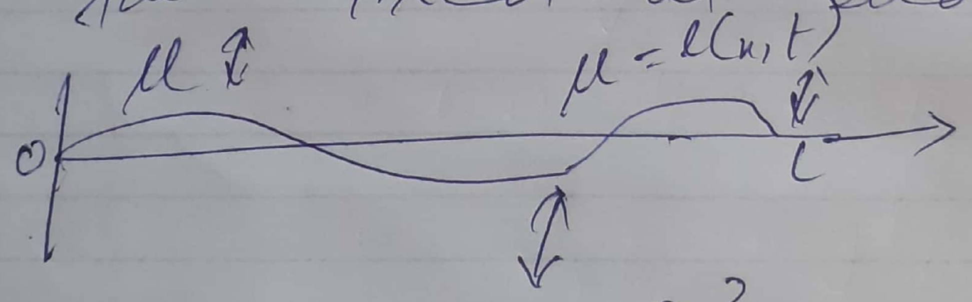
Consider a long thin bar or wire of constant cross-section and of homogeneous material oriented along the x-axis.



Imagine that the basic thermally insulated laterally and is sufficiently thin that heat flows (by condition) only in the x-axis direction then the temprature u at any point in the bar depends only the x-coordinates of the point and the time t.

(iv) wave equation:-

The simplest situation to give rise to the one-dimensional wave equation is the motion of a stretched string. Specifically the transverse vibration of a string such as the string of a musical instrument. Assume that a string is placed along the x-axis is streched and then fixed at end.



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

Other important PDEs in Science & Engineering :-

(i) Poisson equation:-

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

This equation arises in electronics, elesticity theory and else where

(ii) Helmholtz equation:-

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

(iii) Schrodinger Equation:

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

(iv) Transverse vibrations equation:-

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

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