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Assignment No. 01

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Summer Task

TYPES OF DIFFERENTIAL EQUATIONS

(1) ODE (ORDINARY DIFFERENTIAL EQUATION

An Equation contains only ordinary derivates of one or more dependent variables of a single independent variable.

For Example:

$$dy/dx + 5y = e^x,$$

$$\left(\frac{dx}{dt}\right) + \left(dy/dt\right) = 2x + y$$

APPLICATIONS OF ODE:

* MODELLING WITH FIRST-ORDER EQUATIONS
  - → Newton's Law of Cooling
  - → Electrical Circuits (RLC)

* MODELLING FREE MECHANICAL OSCILLATIONS
  - → No Damping

→ Light Damping

→ Heavy Damping.

* MODELLING FORCED MECHANICAL OSCILLATIONS

* COMPUTER EXERCISE OR ACTIVITY

→ Creating Softwares

→ Constraint Logic Programming

→ Creating Games, Aspects of Algorithm

→ Mother Nature

→ Bots.

→ Artificial Intelligence

→ Networking

→ In theories & Explanations.

→ Mathematical Modelling.

→ Motion of a Charged Particles.

(2) PDE (PARTIAL DIFFERENTIAL EQUATIONS)

PDE are used to mathematically formulate, and thus aid the solution of physical and other problems involving functions of several variables,

For Example,

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial t^2} = 2\frac{\partial u}{\partial t} \qquad \frac{\partial u}{\partial y} = -\frac{\partial v}{\partial x}$$

Such as,

→ Propagation of heat.

→ Sound.

→ Fluid flow.

→ Elasticity.

→ Electrostatics.

→ Electrodynamics.

PDEs are used to model many systems in many different fields of science and engineering.

Important Examples:

→ Laplace Equation.

→ Heat Equation.

→ wave Equation.

APPLICATIONS OF PDE

→ Poisson's Equation

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

which arises in electrostatics, elasticity theory and elsewhere.

→ Helmholtz's Equation:-

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + k^2 u = 0$$ (two dimensional form)

which arises in wave theory.

→ Schrodinger's Equation:-

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

which arises in quantum mechanics.

⇒ HEAT FLOW EQUATION

$$\frac{\partial u(x,t)}{\partial t}=\Delta u(x,t)$$

$$\Delta=\sum_{i=1}^{3}\frac{\partial^2}{\partial x_i^2}$$

⇒ TRANSVERSE VIBRATIONS IN ELASTIC MEMBRANE :

$$w_{xx}+w_{yy}=-\frac{q}{T}+\frac{\rho h}{T}w_{tt}$$

$$w=w(x,y)$$

$$q=(x,y)$$