G. H. RAISONI COLLEGE OF ENGG. & MANAGEMENT
Gat No. 1200, Wagholi, Pune – 412 207

Session 2020-21

Presentation on

APPLICATIONS OF DIFFERENTIAL EQUATIONS

By

C69 – SUSHMA DIPAK YEMMEWAR

C70 – SWAYAM PRAMOD TERODE

C71 - TANMAY RADHAKRISHNA ASWALE

C72 – VALLABH RAJARAM SHRIMANGALE

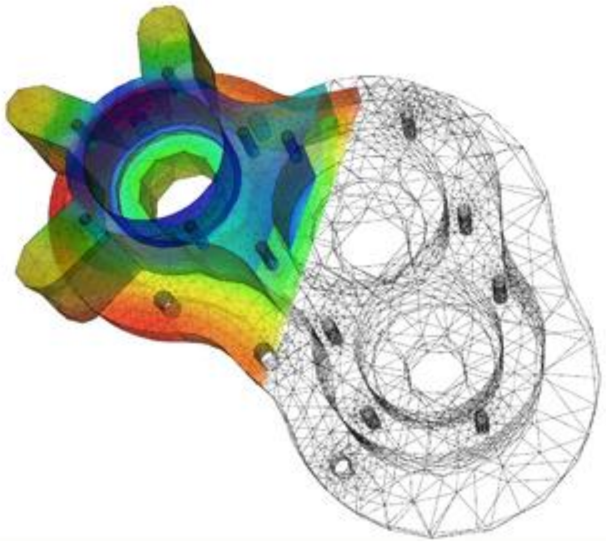
Faculty Name: Prof. Moienahmad Borotikar

FY B.Tech: Div C

Introduction to Differential equation

In mathematics, a differential equation is an equation that relates one or more functions and their derivatives

In applications, the functions generally represent physical quantities, the derivatives represent their rates of change, and the differential equation defines a relationship between the two.



Mainly the study of differential equations consists of the study of their solutions (the set of functions that satisfy each equation), and of the properties of their solutions.

Invention Of Differential Equation

In mathematics, the history of differential equations traces the development of "differential equations " from calculus independently invented by English physicist Isaac Newton and German mathematician Gottfried Leibniz.

The history of the subject of differential equations, in concise form, from a synopsis of the recent article “The history of Differential equations, 1670-1950”

“Differential equations began with Leibniz, the bernoulli’s brothers, and others from the 1680s, not long after Newton’s ‘fluxional equations’ in the 1670s

Examples of Differential equation

$$\frac{dy}{dx} = x \sin x$$

$$\frac{dy}{dx} = y \sin x$$

$$\frac{dy}{dx} = x \sin y$$

$$\frac{dy}{dx} = x \sin y + y \sin x$$

$$\frac{d^2y}{dx^2} = -\frac{1}{100}\frac{dy}{dx} - k\left(y - \frac{1}{6}y^3\right)$$

$$\frac{dy}{dx} = \sin x\, e^y$$

$$\frac{d^2y}{dx^2} + 10\frac{dy}{dx} + 9y = 0$$

$$\frac{d^4y}{dx^4} + \frac{d^3y}{dx^3} + \frac{d^2y}{dx^2} + \frac{dy}{dx} + y = \cos x$$

$$\frac{dy}{dx} + x^2 y = x$$

$$\frac{1}{x}\frac{d^2y}{dx^2} - y^3 = 3x$$

$$\frac{dy}{dx} - lny = 0$$

$$\frac{d^3y}{dx^3} - 2\frac{d^2y}{dx^2} + \frac{dy}{dx} = 2\sin x$$

Types of Differential equation

Ordinary differential equations

An ordinary differential equation (*ODE*) is an equation containing an unknown function of one real or complex Variable *x*, its derivatives, and some given functions of *x*.

The unknown function is generally represented by a variable (often denoted *y*), which, therefore, *depends* on *x*. Thus *x* is often called the independent variable of the equation.

The term "*ordinary*" is used in contrast with the term partial differential equation, which may be with respect to *more than* one independent variable.

Second - order ODE : $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} - 10y = e^x$

Third - order ODE : $\frac{d^3y}{dx^3} + \frac{d^2y}{dx^2} + y = 0$

Fourth - order ODE : $x^2\frac{d^4y}{dx^4} + \cos y = x$

Types of Differential equation

Partial differential equations

A partial differential equation (*PDE*) is a differential equation that contains unknown multivariable functions and their partial derivatives.

PDEs are used to formulate problems involving functions of several variables, and are either solved in closed form, or used to create a relevant computer model.

PDEs can be used to describe a wide variety of phenomena in nature such
as sound, heat, electrostatics, electrodynamics, fluid
flow, elasticity, or quantum mechanics.

Partial Differential Equations

Classifications of PDE's according to order

First Order $$\frac{\partial \phi}{\partial x} - G\frac{\partial \phi}{\partial y} = 0$$

Second Order $$\frac{\partial^2 \phi}{\partial x^2} - \phi\frac{\partial \phi}{\partial y} = 0$$

Third Order $$\left(\frac{\partial^3 \phi}{\partial x^3}\right)^2 + \left(\frac{\partial^2 \phi}{\partial x \partial y}\right) + \frac{\partial \phi}{\partial x} = 0$$

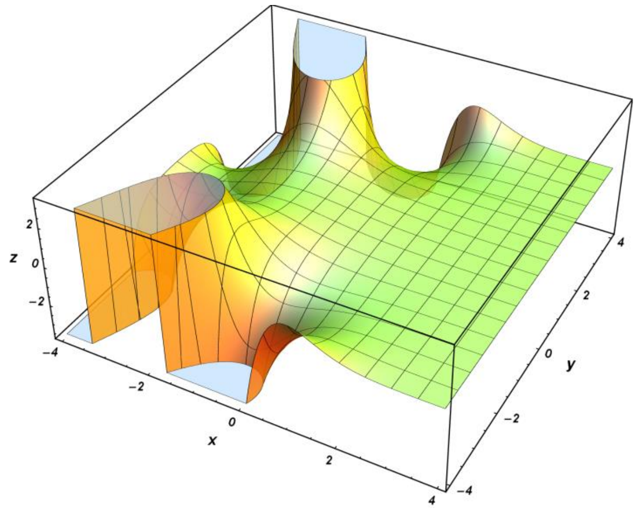
Applications of Differential equation

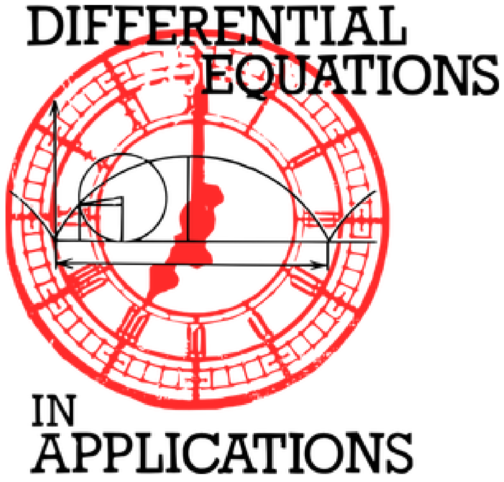
❖MODELLING WITH FIRST-ORDER EQUATIONS
- Newton's Law of Cooling
- Electrical Circuits

❖MODELLING FREE MECHANICAL OSCILLATIONS
- No Damping
- Light Damping
- Heavy Damping

❖MODELLING FORCED MECHANICAL OSCILLATIONS

❖COMPUTER EXERCISE OR ACTIVITY



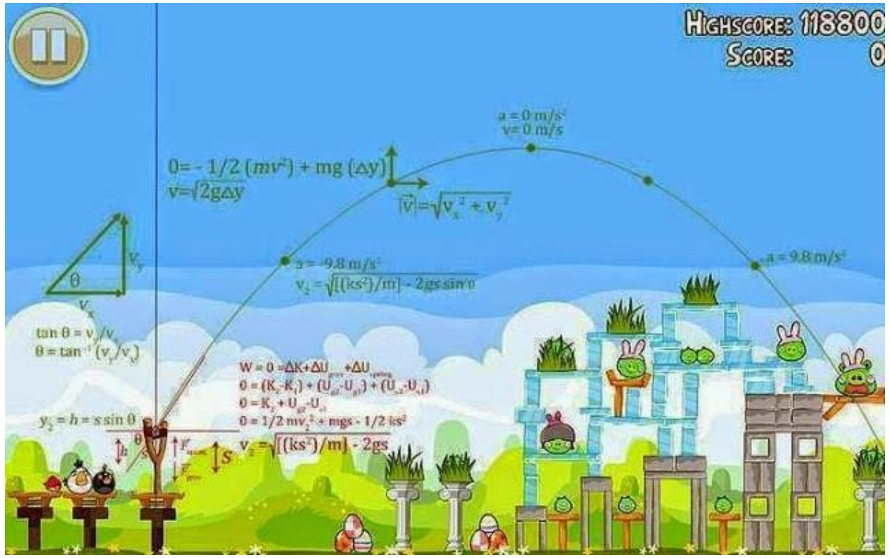


Ordinary differential equations applications in real life are used to calculate the movement or flow of electricity, motion of an object to and fro like a pendulum, to explain thermodynamics concepts. Also, in medical terms, they are used to check the growth of diseases in graphical representation.

Partial differential equations are used to mathematically formulate, and thus aid the solution of, physical and other problems involving functions of several variables, such as the propagation of heat or sound, fluid flow, elasticity, electrostatics, electrodynamics, etc.04-Nov-2011

Game Apps Development

Game theorytic models, building block concept and many applications are solve with differential equation.



Graphical interference of analyzing data and creating browser based on partial differential equation solving with finite element method

The game is based on a simple set of ordinary differential equations. These differential equations are used in classical mechanics to describe the dynamics of a set of point masses subject to a force chosen by the human player, elastic forces and friction forces (i.e. viscous damping).

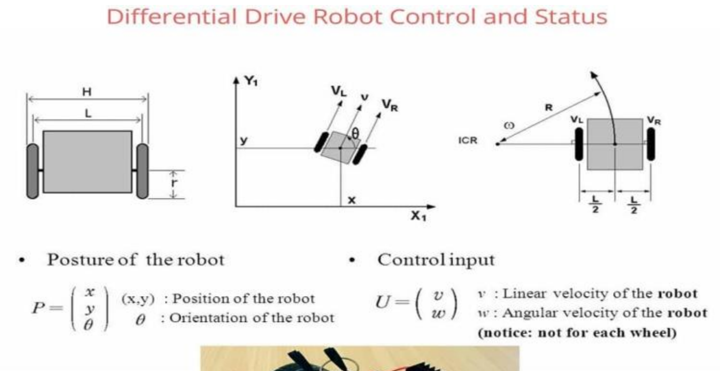
Robotics Industrialization

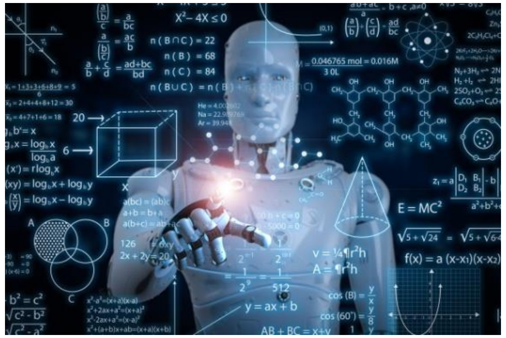
Differential equations, mathematical modeling and control theory are theoretical parts of the robot project.

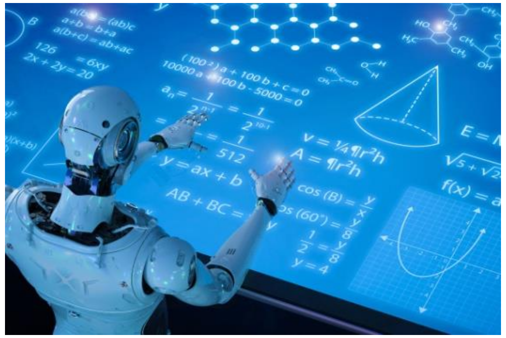
In order to explain the dynamical behavior of the robot, students have to learn more mathematics.

The examination results show improved learning potential, when using this method of educating mathematics.

Auto motion and robotic technologies for customized component ,module and building.
Prefabrication are based on differential equation







Application Newton’s laws

Population growth and decay

WE have seen in section that the differential equation

$$\frac{dN(t)}{dt} = kN(t)$$

Where N(t) denotes population at a time t and k is a constant of proportionality , serves as model for population growth and decay of insects , animals and human population

Applications on Newton’s law of cooling

- Investigations.
  - It can be used to determine the time of death.
- Computer manufacturing.
  - Processors.
  - Cooling systems.
- solar water heater.
- calculating the surface area of an object.


Thank
you