SPD COLLEGE, GARHWA (JH)
DEPARTMENT OF PHYSICS

PRESENTATION ON:

DIFFERENTIAL EQUATION

UG NEP SEM-1 MJ-1

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MAIN POINTS OF THE TOPIC

1. DIFFERENTIAL EQUATION
2. TYPES OF DIFFERENTIAL EQUATION
3. FIRST ORDER DIFFERENTIAL EQUATION
4. INTEGRATING FACTOR OF 1^{ST} ORDER DIFFERENTIAL EQUATION
5. SECOND ORDER DIFFERENTIAL EQUATION
6. INTEGRATING FACTOR OF 2^{ND} ORDER DIFFERENTIAL EQATION

Differential Equation

- *A differential equation is an equation which contains one or more terms and the derivatives of one variable (i.e., dependent variable) with respect to the other variable (i.e., independent variable)*

- $dy/dx = f(x)$

- *Here "x" is an independent variable and "y" is a dependent variable*
- *For example,*

- $dy/dx = 5x$
- *A differential equation contains derivatives which are either partial derivatives or ordinary derivatives. The derivative represents a rate of change, and the differential equation describes a relationship between the quantity that is continuously varying with respect to the change in another quantity*

Types of differential equation

- *There are basically five types of differential equations in the first order. They are:*
- *Linear Differential Equations*
- *Homogeneous Equations*
- *Exact Equations*
- *Separable Equations*
- *Integrating Factor*

1st order differential equation

- *A first-order differential equation is defined by an equation*
- *$dy/dx = f(x,y)$ of two variables x and y with its function $f(x,y)$ defined on a region in the xy-plane. It has only the first derivative dy/dx so that the equation is of the first order and no higher-order derivatives exist. The differential equation in first-order can also be written as;*

- $y' = f(x,y)$ *or*

- $(d/dx)\, y = f(x,y)$

- *The differential equation is generally used to express a relation between the function and its derivatives. In Physics and chemistry, it is used as a technique for determining the functions over its domain if we know the functions and some of the derivatives*.

Integrating factor of 1st Order

- *If a linear differential equation is written in the standard form:*

- $y' + a(x)y = 0$
- *Then, the integrating factor is defined by the formula*

- $u(x) = \exp(\int a(x)dx)$
-
- *Multiplying the integrating factor u(x) on the left side of the equation that converts the left side into the derivative of the product y(x)u(x).*

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2nd order differential equation

- *A differential equation is an equation that consists of a function and its derivative. A differential equation that consists of a function and its second-order derivative is called a second order differential equation. Mathematically, it is written as*

- $y'' + p(x)y' + q(x)y = f(x)$,

- *which is a non-homogeneous second order differential equation if $f(x)$ is not equal to the zero function and $p(x)$, $q(x)$ are functions of x. It can also be written as*

- $F(x, y, y', y'') = 0$.

- *Further, let us explore the definitions of the different types of the second order differential equation.*

2nd order differential equation

$$\frac{d^2y}{dx^2} + P(x)\frac{dy}{dx} + Q(x)y = f(x)$$

Where P(x) ,Q(x) and f(x) are function of x.

Integrating Factor of 2nd order diffential equation

The second-order differential equation can be solved using the integrating factor method.
Let the given differential equation be,

$$y'' + P(x)\, y' = Q(x)$$

The second-order equation of the above form can only be solved by using the integrating factor.
Substitute $y' = u$; so that the equation becomes similar to the first-order equation as shown:

$$u' + P(x)\, u = Q(x)$$

Now, this equation can be solved by integrating factor technique as described in the section above for first-order equations and we reach the equation: $\mu u = \int \mu Q(x) dx + C$
Find the value of u from this equation.
Since $u = y'$, hence to find the value of y, integrate the equation.

THE END

THANKS FOR WATCHING

- ***PRESENTED BY :***
- ***PROF. NIKETA KUMARI***
- ***HOD PHYSICS***
- ***SPD COLLEGE,GARHWA (JH)***

Contact via Email Id. raushnikumari950@gmail.com