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Find the eigenvalues of the following system

$$X' = \begin{pmatrix} 3 & -9 \\ 4 & -3 \end{pmatrix} X$$

Answer ([Please click here to Add Answer](#))

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Is generally in matrices following laws hold or not?

- 1- Associative Law
- 2- Distributive Law
- 3- Commutative Law

Answer ([Please click here to Add Answer](#))

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Define regular and irregular singular points?

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Answer ([Please click here to Add Answer](#))



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Solve the differential equation:

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

Answer ([Please click here to Add Answer](#))

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Find the complementary solution for the DE $y'' - 4y' + 4y = 2e^{2x}$?

Answer ([Please click here to Add Answer](#))

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When roots of indicial equation differ by a positive integer then explain the case when $r_1 = r_2$, where r_1 and r_2 are roots of the indicial equation.

Answer ([Please click here to Add Answer](#))

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State Principal of superposition of set of solution vectors of a homogeneous system.

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Answer (Please [click here](#) to Add Answer)



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Write down the procedure of solution of the system of differential equations by "Operator Method".

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Find the general solution of the given differential equation on $(0, \infty)$

$$x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + \left(x^2 - \frac{1}{64}\right)y = 0$$

Answer (Please [click here](#) to Add Answer)

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Write the following system in matrix form

$$\frac{dx}{dt} = x - y + z + t - 1$$

$$\frac{dy}{dt} = 2x + y - z - 3t^2$$

\vdots

Answer ([Please click here to Add Answer](#))

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What is indicial equation and exponent in the differential equation $xy'' + 3y' - y = 0$ with $x=0$ regular singular point?

Answer ([Please click here to Add Answer](#))

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Determine the order and state the linearity of each of the following differential equations.

1) $\left(\frac{d^3 y}{dx^3}\right)^4 + 2\frac{dy}{dx} = \sin x$

2) $\frac{dy}{dx} - 2xy = x^2 - x$

Answer ([Please click here to Add Answer](#))

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Discuss the linearly dependence of solution vectors.

Answer ([Please click here to Add Answer](#))

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Whether or not all singular points have real numbers if not then give some example?

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Give an example of the non-linear differential equation.

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Answer ([Please click here to Add Answer](#))



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Find the radius of convergence of power series $\sum_{n=0}^{\infty} c_n (x-a)^n$?

Answer ([Please click here to Add Answer](#))

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If a mass weighing $8lb$ and $k = 5 lb/ft$ then find the amount of elongation's'.

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Write down the procedure of solution of the system of differential equations by "Operator Method".

Answer ([Please click here to Add Answer](#))

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Write the following system in matrix form

$$\frac{dx}{dt} = -3x + 4y - 9z$$

$$\frac{dy}{dt} = 6x - y$$

dz

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Answer ([Please click here to Add Answer](#))



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$$\frac{dx}{dt} = -3x + 4y - 9z$$

$$\frac{dy}{dt} = 6x - y$$

$$\frac{dz}{dt} = 10x + 4y + 3z$$

Answer ([Please click here to Add Answer](#))

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Write the system $\frac{dx}{dt} = 6x + y + 6t$, $\frac{dy}{dt} = 4x + 3y - 10t + 4$ in the form of $X' = AX + F(t)$

Answer ([Please click here to Add Answer](#))

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Find the general solution of the given differential equation on $(0, \infty)$

$$4x^2 \frac{d^2y}{dx^2} + 4x \frac{dy}{dx} + (4x^2 - 25)y = 0$$

Answer ([Please click here to Add Answer](#))

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For solving a series solution for the differential equation $y'' + y = 0$ about $x_0 = 0$
Find the condition for the coefficients a_{n+2} and a_n (c_{n+2} and c_n).

Answer ([Please click here to Add Answer](#))

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Given that $y = c_1e^x + c_2e^{-x}$ is a two parameter family of solutions of the differential equation $\frac{d^2y}{dx^2} - y = 0$ on $(-\infty, \infty)$ find a member of the family satisfying the boundary conditions $y(0) = 0, y'(1) = 1$

Answer ([Please click here to Add Answer](#))

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Find the eigenvalues of the following system

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Answer (Please [click here](#) to Add Answer)

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$$\begin{pmatrix} 3-a & -9 \\ 4 & -3-a \end{pmatrix}$$

here use the lamanda..! not a

$$-9 - 3a + 3a + a^2 + 36 = 0$$

$$a^2 + 27$$

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Is generally in matrices following laws hold or not?

- 1- Associative Law
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Answer (Please [click here](#) to Add Answer)

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yes, $A + B + C = A + (B + C) = (A + B) + C$ (Associative law of addition)

$A + B = B + A$ (Commutative law of addition)

$A(B + C) = AB + AC$ (Distributive law)

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Define regular and irregular singular points?

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Definition: Regular and Irregular Singular Points

A Singular point $x = x_0$ of the given equation $a_2(x)y'' + a_1(x)y' + a_0(x)y = 0$ is said to be a *regular singular point* if both $(x - x_0)P(x)$ and $(x - x_0)^2Q(x)$ are analytic at x_0 . A singular point that is not regular is said to be an *irregular singular point* of the equation.

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Solve the differential equation:

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

Answer (Please [click here](#) to Add Answer)

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$$2 \int y dy = \int x^2 dx$$

$$y^2 = \frac{x^3}{3} + c$$

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Write down the procedure of solution of the system of differential equations by "Operator Method".

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Systematic Elimination: Operator Method

- This method of solution of a system of linear homogeneous or linear nonhomogeneous differential equations is based on the process of systematic elimination of the dependent variables.
- This elimination provides us a single differential equation in one of the dependent variables that has not been eliminated.
- --->> This equation would be a linear homogeneous or a linear non-homogeneous differential equation and can be solved by employing one of the methods discussed earlier to obtain the dependent variables.

Notice that the analogue of multiplying an algebraic equation by a constant is operating on a differential equation with some combination of derivatives.

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Find the general solution of the given differential equation on $(0, \infty)$

$$x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + \left(x^2 - \frac{1}{64}\right)y = 0$$

Answer ([Please click here to Add Answer](#))

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Write the following system in matrix form

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Answer ([Please click here to Add Answer](#))

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What is indicial equation and exponent in the differential equation $xy'' + 3y' - y = 0$ with $x=0$ regular singular point?

Answer (Please [click here](#) to Add Answer)

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Determine the order and state the linearity of each of the following differential equations.

$$1) \left(\frac{d^3 y}{dx^3} \right)^4 + 2 \frac{dy}{dx} = \sin x$$

$$2) \frac{dy}{dx} - 2xy = x^2 - x$$

Answer (Please [click here](#) to Add Answer)

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Answers to Above Exercises

1. order 3 , non linear.

2. order 1 , linear.

3. order 1 , non linear.

4. order 2 , linear.

$$1. \left(\frac{d^3 y}{dx^3} \right)^4 + 2 \frac{dy}{dx} = \sin x$$

$$2. \frac{dy}{dx} - 2xy = x^2 - x$$

$$3. \frac{dy}{dx} - \sin y = -x$$

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For differential equation $x(x-1)y'' + (3x-1)y' + y = 0$ if $y_1 = \sum_{k=0}^{\infty} x_k = 1 + x + x^2 + \dots = \frac{1}{1-x}; |x| < 1$ is one solution about regular singularity $x = 0$, then which method will be use to find 2nd solution?

Answer ([Please click here to Add Answer](#))

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frobenius, i think and .

$$y_2 = y_1(x) \int \frac{e^{-\int P dx}}{y_1^2} dx$$

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Discuss the linearly dependence of solution vectors.

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Any two solution vectors X_1 and X_2 are linearly dependent if and only if one of the two vectors is a constant multiple of the other.

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What is Legendre's differential equation

An

Lecture 34

Legendre's Differential Equation

A second order linear differential equation of the form

$$(1-x^2)y'' - 2xy' + n(n+1)y = 0$$

is called Legendre's differential equation and any of its solution is called Legendre's function. If n is positive integer then the solution of Legendre's differential equation is called a Legendre's polynomial of degree n and is denoted by $P_n(x)$.

We assume a solution of the form $y = \sum_{k=0}^{\infty} C_k x^k$

$$\therefore (1-x^2)y'' - 2xy' + n(n+1)y =$$

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If the complementary solution of the following differential equation is $c_1 \sin 2x + c_2 \cos 2x$, then what will be the general form of its particular solution:

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

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Answer ([Please click here to Add Answer](#))



$$y_p = A \sin 2x + B \cos 2x$$

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Can the power series method be directly applied if the coefficients $P(x)$ and $Q(x)$ for the differential equations $y'' + P(x)y' + Q(x)y = 0$ are not polynomials?
If $P(x) = \sin x$ and $Q(x) = \cos x$, then how we solve it?

Answer ([Please click here to Add Answer](#))

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Write the homogenous system of differential equations

$$2 \frac{dx}{dt} - 5x + \frac{dy}{dt} = 5e^t$$

$$\frac{dx}{dt} - x + \frac{dy}{dt} = e^t$$

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Answer ([Please click here to Add Answer](#))



$$(2D - 5)x + Dy = 5e^t$$

$$(D - 1)x + Dy = e^t$$

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Find the characteristic equation of coefficient matrix of the following system

$$\frac{dx}{dt} = -3x - 2y$$

$$\frac{dy}{dt} = 5x + 7y$$

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Answer ([Please click here to Add Answer](#))



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$$\begin{vmatrix} -3-\lambda & -2 \\ 5 & 7-\lambda \end{vmatrix} = -21 + 3\lambda - 7\lambda + \lambda^2 + 10$$

$$\lambda^2 - 4\lambda - 11 = 0$$

$$\lambda = \frac{4 \pm \sqrt{16 - 4(-11)}}{2} = \frac{4 \pm \sqrt{60}}{2}$$

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Determine whether the following functions are linearly dependent or linearly independent ?

$$y_1 = 9 \cos(2x), y_2 = 2 \cos^2 x - 2 \sin^2 x$$

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Answer (Please [click here](#) to Add Answer)



$$\begin{vmatrix} 9 \cos 2x & 2(\cos^2 x - \sin^2 x) \\ -18 \sin 2x & 2(2 \cos x(-\sin x) - 2 \sin x(\cos x)) \end{vmatrix}$$

$$\begin{vmatrix} 9 \cos 2x & 2(\cos^2 x - \sin^2 x) \\ -18 \sin 2x & -4 \cos x(\sin x) - 4 \sin x(\cos x) \end{vmatrix}$$

$$\begin{vmatrix} 9 \cos 2x & 2(\cos^2 x - \sin^2 x) \\ -18 \sin 2x & -8 \cos x(\sin x) \end{vmatrix}$$

$$-8 \cos x(\sin x)[9 \cos 2x] + 18 \sin 2x[2(\cos^2 x - \sin^2 x)]$$

independent

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Find the general solution of the given differential equation on $(0, \infty)$

$$x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + \left(x^2 - \frac{1}{64}\right)y = 0$$

Answer ([Please click here to Add Answer](#))

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$$v^2 = \frac{1}{64}$$

$$v = \pm \frac{1}{8}$$

$$y = C_1 J_{1/8}(x) + C_2 J_{-1/8}(x)$$

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Find the wronskian of the Differential equation $y''' - 2y'' - 21y' - 18y = 3 + 4e^{-t}$ using variation of parameter and the root of the auxiliary equation is $m_1 = -3, m_2 = -1, m_3 = 6$?

Answer ([Please click here to Add Answer](#))

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$$w = \begin{vmatrix} e^{-3t} & e^{-t} & e^{6t} \\ -3e^{-3t} & -e^{-t} & 6e^{6t} \\ 9e^{-3t} & e^{-t} & 36e^{6t} \end{vmatrix}$$

also find w_1, w_2, w_3

$$w_2 = \begin{vmatrix} e^{-3t} & 0 & e^{6t} \\ -3e^{-3t} & 0 & 6e^{6t} \\ 9e^{-3t} & 3+4e^{-t} & 36e^{6t} \end{vmatrix}$$

$$w_1 = \begin{vmatrix} 0 & e^{-t} & e^{6t} \\ 0 & -e^{-t} & 6e^{6t} \\ 3+4e^{-t} & e^{-t} & 36e^{6t} \end{vmatrix}$$

$$w_3 = \begin{vmatrix} e^{-3t} & e^{-t} & 0 \\ -3e^{-3t} & -e^{-t} & 0 \\ 9e^{-3t} & e^{-t} & 0 \end{vmatrix}$$

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Write the following system in matrix form

$$\frac{dx}{dt} = -3x + 4y + e^{-t} \sin 2t$$

$$\frac{dy}{dt} = 5x + 9y + 4e^{-t} \cos 2t$$

Answer ([Please click here to Add Answer](#))

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$$\begin{bmatrix} \frac{dx}{dt} \\ \frac{dy}{dt} \end{bmatrix} = \begin{bmatrix} -3 & 4 \\ 5 & 9 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} \sin 2t \\ 4 \cos 2t \end{bmatrix} e^{-t}$$

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As $x=0$ is regular singular point of the differential equation $10xy'' + 10y' - y = 0$, find the relation of C_{k+1} and C_k in the process of finding solution.

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