بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِيْمِ

In the Name of Allāh, the Most Gracious, the Most Merciful

Paper Pattern

MCQS 40 each 1 mark
Short 4 each 2 marks
Short 4 each 3 marks
long 4 each 5 marks

Question No : 1 of 52 — Marks: 1 (Budgeted Time 1 Min)

The conversion of Cauchy Euler equation $4x^2\frac{d^2y}{dx^2}+8x\frac{dy}{dx}+y=0$ after putting $x=e^t$ becomes

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Answer (Please select your correct option)

- $(4\Delta^2-4\Delta-1)y=0$
- $(4\Delta^2+4\Delta+1)y=0$
- $(4\Delta^2+8\Delta+1)y=0$
- None of them

Made by: Waqar Siddhu

Question No : 2 of 52 — Marks: 1 (Budgeted Time 1 Min)

Consider a power series $\sum_{n=1}^{\infty}a_n=\sum_{n=1}^{\infty}(x-1)^n$ then power series clearly converges for the value of x lies in

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rrect option)

- 0<x<1
- 0<x<2
- 0<x<3
- None of them

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Question No : 3 of 52 Marks: 1 (Budgeted Time 1 Min)

Consider a power series $\sum_{n=1}^{\infty} a_n = \sum_{n=1}^{\infty} \frac{1}{\sqrt{n}} x^n$ then power series gives an inconclusive result if

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Answer (Please select your correct option)

- $|x| \le 1$
- $|x| = 1$
- $|x| > 1$
- None of them

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Question No : 4 of 52 Marks: 1 (Budgeted Time 1 Min)

Suppose that a power series $\sum_{n=1}^{\infty} a_n (x-a)^n$ is represented by a function "**f**" whose domain is the interval of the convergence of the power series. That function "**f**" is continuous, differentiable and integrable on

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Answer (Please select your correct option)

- (a + R, a - R)
- (R -a, R + a)
- (a - R, a + R)
- None of them

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Question No : 5 of 52 Marks: 1 (Budgeted Time 1 Min)

Solution of the D.Equation $4y'' + y = 0$ is

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Answer (Please select your correct option)

- $y(x) = c_1 \cos\frac{x}{2} + c_2 Sin\frac{x}{2}$
- $y(x) = c_1 \cos\frac{x}{2}$
- $y(x) = c_1 Sin\frac{x}{2}$
- None of them

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Question No : 6 of 52 Marks: 1 (Budgeted Time 1 Min)

A function **f** is said to be convergent at a point **a** if it can be represented by the power series in (x-a) which has

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Answer (Please select your correct option)

- Divergent series
- Convergent series
- Both of the Ist and 2nd option
- None of them

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Question No : 7 of 52 Marks: 1 (Budgeted Time 1 Min)

If E(t)=0, $R \neq 0$ (E(t) is the source voltage & R is the resistance) then electric vibration of the circuit is said to be

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Answer (Please select your correct option)

- Free damped oscillation
- Free un-damped oscillation
- Both damped and un-damped oscillation
- None of them

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Question No : 8 of 52 Marks: 1 (Budgeted Time 1 Min)

If E(t)=0, $R = 0$ (E(t) is the source voltage & R is the resistance) then electric vibration of the circuit is said to be

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Answer (Please select your correct option)

- Free damped oscillation
- Free un-damped oscillation
- Both damped and un-damped oscillation
- None of them

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Question No : 9 of 52 Marks: 1 (Budgeted Time 1 Min)

The Quasi-frequency of the solution **x(t)** of free damped motion is given by the number

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Answer (Please select your correct option)

sure

- $\frac{\sqrt{\omega^2 - \lambda^2}}{2\pi}$
- $\frac{2\pi}{\sqrt{\omega^2 - \lambda^2}}$
- $\sqrt{\omega^2 - \lambda^2}$
- None of them

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Question No : 10 of 52 Marks: 1 (Budgeted Time 1 Min)

Since $x(t) = \frac{2\sqrt{10}}{3} e^{-t} \sin[3t + 4.391]$ is the solution of $\frac{d^2x}{dt^2} + 2\frac{dx}{dt} + 10x = 0$ $with\ x(0) = -2$, $x'(0) = 0$ .So the phase angle is

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Answer (Please select your correct option)

- 4.193
- 4.391
- 4.931
- None of them

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Question No : 11 of 52 Marks: 1 (Budgeted Time 1 Min)

The standard unit for measurement of inductance is

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Answer (Please select your correct option)

- Volt
- Ohms
- Henry
- None of them

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Question No : 12 of 52 Marks: 1 (Budgeted Time 1 Min)

The second order linear differential equation $x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}+(x^2-49)=0$ is a Bessel equation of degree

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Answer (Please select your correct option)

- 5
- 6
- 7
- None of them

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Question No : 13 of 52 Marks: 1 (Budgeted Time 1 Min)

$J_{-\frac{2}{3}}(x)-J_{\frac{4}{3}}(x)=$

$$\Rightarrow 2J_n'(x)=J_{n-1}(x)-J_{n+1}(x)$$

put n=1/3

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Answer (Please select your correct option)

- $2J'_{\frac{1}{3}}(x)$
- $2J'_{\frac{2}{3}}(x)$
- $2J'_{\frac{4}{3}}(x)$
- None of them

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Question No : 14 of 52 Marks: 1 (Budgeted Time 1 Min)

Which of the rule in matrices under multiplication does not hold true?

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Answer (Please select your correct option)

- Commutative law
- Associative law
- Identity law
- None of them

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Question No : 15 of 52 Marks: 1 (Budgeted Time 1 Min)

If a matrix has 3 rows and 2 columns then the given matrix is called

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Answer (Please select your

- Column matrix
- Square Matrix
- Inverse matrix
- Rectangular matrix

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Question No : 16 of 52 Marks: 1 (Budgeted Time 1 Min)

If $A=\begin{bmatrix}1 & 2 & 3\\ 5 & 6 & 7\end{bmatrix}$ & $B=\begin{bmatrix}x & y & z & a\\ p & q & r & b\\ l & mn & o\end{bmatrix}$ then the order of *matirx* $A\times B$ is

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Answer (Please select your correct option)

- 2×4
- 2×3
- 3×3
- None of them

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Question No : 17 of 52 Marks: 1 (Budgeted Time 1 Min)

The given system without the use of matrices $\frac{d}{dt}\begin{pmatrix}x\\ y\end{pmatrix}=\begin{pmatrix}3 & -7\\ 1 & 1\end{pmatrix}\begin{pmatrix}x\\ y\end{pmatrix}+\begin{pmatrix}4\\ 8\end{pmatrix}\sin t$ is

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Answer (Please select your correct option)

- $\frac{dx}{dt}=3x-7y+4\sin 2t$; $\frac{dy}{dt}=x+y+8\cos 2t$
- $\frac{dx}{dt}=3x-7y+4\sin t$; $\frac{dy}{dt}=x+y+8\cos t$
- $\frac{dx}{dt}=3x-7y+4\sin t$; $\frac{dy}{dt}=x+y+8\sin t$
- None of them

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Question No : 18 of 52 Marks: 1 (Budgeted Time 1 Min)

The given system without the use of matrices $\frac{d}{dt}\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 3 & -7 \\ 1 & 1 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} 4 \\ 8 \end{pmatrix} e^{-t}$ is

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Answer (Please select your correct option)

- $\frac{dx}{dt} = 3x - 7y + 4\sin 2t$; $\frac{dy}{dt} = x + y + 8\cos 2t$
- $\frac{dx}{dt} = 3x - 7y + 4e^{-t}$; $\frac{dy}{dt} = x + y + 8e^{-t}$
- $\frac{dx}{dt} = 3x - 7y + 4e^{t}$; $\frac{dy}{dt} = x + y + 8e^{-t}$
- None of them

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Question No : 19 of 52 Marks: 1 (Budgeted Time 1 Min)

The coefficient matrix of the following homogeneous system of differential equation $\frac{dx}{dt} = 3x + 2y$, $\frac{dy}{dt} = x + 2y$ *is*

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Answer (Please select your correct option)

- $\begin{bmatrix} 3 & 2 \\ 2 & 2 \end{bmatrix}$
- $\begin{bmatrix} 3 & 1 \\ 2 & 2 \end{bmatrix}$
- $\begin{bmatrix} 3 & 2 \\ 1 & 2 \end{bmatrix}$
- None of them

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Question No : 20 of 52 Marks: 1 (Budgeted Time 1 Min)

$\begin{vmatrix} 4-\lambda & 1 & 0 \\ 0 & 4-\lambda & 1 \\ 0 & 0 & 4-\lambda \end{vmatrix} = 0$ *gives*

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Answer (Please select your correct option)

- $\lambda = 4$ of multiplicity of 1
- $\lambda = 4$ of multiplicity of 2
- $\lambda = 4$ of multiplicity of 3
- None of them

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Question No : 21 of 52 Marks: 1 (Budgeted Time 1 Min)

By applying the Operator method or systematic elimination on a system of linear homogeneous or linear non-homogeneous differential equations we always get a

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Answer (Please select your correct option)

- Single linear differential equation
- Double linear differential equation
- Partial linear differential equation
- None of them

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Question No : 22 of 52 Marks: 1 (Budgeted Time 1 Min)

For the system of differential equations $\frac{dy}{dt} = 2x$, $\frac{dx}{dt} = 3y$ the independent variable(s) is (are)

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Answer (Please select your correct option)

- x, t
- y, t
- x, y
- t

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Question No : 23 of 52 Marks: 1 (Budgeted Time 1 Min)

The differential equation $2\frac{dy}{dx} + x^2 y = 2x + 3, y(0) = 5$ is

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Answer (Please select your correct option)

- Linear
- Nonlinear
- Linear with fixed constants
- Undeterminable to be linear or nonlinear

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Question No : 24 of 52 Marks: 1 (Budgeted Time 1 Min)

If A is a square matrix and its determinant is zero, then

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Answer (Please select your correct option)

- A is singular matrix.
- A is non singular matrix.
- A is scalar matrix.
- A is diagonal matrix.

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Question No : 25 of 52 Marks: 1 (Budgeted Time 1 Min)

The Period of oscillator in the solution X=50Sin (20t+8.5) is

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Answer (Please select your correct option)

- 0.17643
- 0.32045
- 0.31400
- 0.58000

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Question No : 26 of 52 Marks: 1 (Budgeted Time 1 Min)

An electronic component of an electronic circuit that has the ability to store charge and opposes any change of voltage in the circuit is called

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Answer (Please select your correct option)

- Inductor
- Resistor
- Capacitor
- None of them

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Question No : 27 of 52 Marks: 1 (Budgeted Time 1 Min)

If determinant $\begin{vmatrix} D-3 & 1 \\ -1 & D-1 \end{vmatrix} = 0$, then .....

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Answer (Please select your correct option)

- $D^2 - 4D + 1 = 0$
- $D^2 - 4D + 3 = 0$
- $D^2 - 4D + 4 = 0$
- None of them

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Question No : 28 of 52 Marks: 1 (Budgeted Time 1 Min)

A rectangular arrangement of numbers or functions enclosed in the square brackets is called

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Answer (Please select your correct option)

- Equation
- derterminant
- Matrix
- None of them

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Question No : 29 of 52 Marks: 1 (Budgeted Time 1 Min)

If wroskian of the solution vectors X_1 & X_2 is zero, then vectors are .....

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Answer (Please select your correct option)

- Linearly Independent
- Linearly dependent
- None of them
- Parallel

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Question No : 30 of 52 Marks: 1 (Budgeted Time 1 Min)

If $A = \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix}$, then eigen values are

1-a(2-a)=2-a-2a+a^2
a^2-3a+2=0
a^2-2a-a+2=0
a(a-2)-1(a-2)=0
a=1,2

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Answer (Please select your correct option)

- 1,2
- 0,1
- 0,2
- None of them

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Question No : 31 of 52 Marks: 1 (Budgeted Time 1 Min)

Let λ be an eigen value of a non zero square matrix A. Then the equation $\det(A - \lambda I) = 0$ is called

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Answer (Please select your correct option)

- Trivial equation
- Characteristics equation
- Non-trivial equation
- None of them

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Question No : 32 of 52 Marks: 1 (Budgeted Time 1 Min)

Eigen values of the following homogeneous system of Differential equation $\frac{dx}{dt} = x$, $\frac{dy}{dt} = 2x + 2y$ with coefficient matrix $\begin{bmatrix} 1 & 0 \\ 2 & 2 \end{bmatrix}$

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Answer (Please select your correct option)

- $\lambda = 2, 2$
- $\lambda = 1, 1$
- None of them
- $\lambda = 1, 2$

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Question No : 33 of 52 Marks: 1 (Budgeted Time 1 Min)

The equation $\frac{dy}{dx} = \frac{x(x+1)}{y(y-1)}$ is a/an ----------

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Answer (Please select your correct option)

- partial differential equation.
- ordinary differential equation.
- polynomial equation.
- transcendental equation.

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Question No : 34 of 52 Marks: 1 (Budgeted Time 1 Min)

The differential equation $dx + (\frac{x}{y} - \sin y)\, dy = 0$ is ----------

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Answer (Please select your correct option)

- Exact.
- Non-exact.
- Homogenous.
- Linear.

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Question No : 35 of 52 Marks: 1 (Budgeted Time 1 Min)

If $f(x)$ and $g(x)$ are linearly dependent on I, then-----.

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Answer (Please select your correct option)

- $W(f,g)(x) \neq 0$ (Wronskian) for all x in the interval I.
- $W(f,g)(x) = 0$ (Wronskian) for all x in the interval I.
- $W(f,g)(x)$ *may or may not be* zero for all x in the interval I.
- $W(f,g)(x)$ is not defined for all x in the interval I.

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Question No : 36 of 52 Marks: 1 (Budgeted Time 1 Min)

If the auxiliary equation has roots $-2, -2$, then the general solution of the differential equation is_____

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Answer (Please select your correct option)

- $y = c_1 e^{-2x} + c_2 e^{-2x}$
- $y = c_1 e^{-2+2x}$
- $y = c_1 e^{2x} + c_2 e^{-2x}$
- $y = (c_1 + c_2 x) e^{-2x}$

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Question No : 37 of 52 Marks: 1 (Budgeted Time 1 Min)

If the annihilator operator of $2x$ is D^2 and of xe^{3x} is $(D-3)^2$, then which of the following is the correct option?

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- The annihilator operator of $2x + xe^{3x}$ is $(D-3)^2$.
- The annihilator operator of $2x + xe^{3x}$ is D^2.
- The annihilator operator of $2x + xe^{3x}$ is $D^2 + (D-3)^2$.
- The annihilator operator of $2x + xe^{3x}$ is $D^2 (D-3)^2$.

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Question No : 38 of 52 Marks: 1 (Budgeted Time 1 Min)

If $y_1 = x$ and $y_2 = xe^x$ are the first and second solution of $x^2 \frac{d^2y}{dx^2} - x(x+2)\frac{dy}{dx} + (x+2)y = 0$ on $(0, \infty)$, then which of the following is the most accurate option?

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Answer (Please select your correct option)

- $y_1 = x$ and $y_2 = xe^x$ may or may not be linearly dependent.
- $y_1 = x$ and $y_2 = xe^x$ must be linearly independent.
- $y_1 = x$ and $y_2 = xe^x$ may or may not be linearly independent.
- $y_1 = x$ and $y_2 = xe^x$ must be linearly dependent.

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Question No : 39 of 52 Marks: 1 (Budgeted Time 1 Min)

If $y_1 = xe^{-x}$ is the first solution of the differential equation $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = 0$, then which of the following is true for it?

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Answer (Please select your correct option)

- Its second solution is $xe^{-x}\int \frac{2}{e^{-2x}}dx$
- Its second solution is $xe^{-x}\int \frac{2}{x^2e^{-2x}}dx$
- Its second solution is $xe^{-x}\int \frac{1}{x^2e^{-2x}}dx$
- Its second solution is $xe^{-x}\int \frac{1}{x^2}dx$

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

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Question No : 40 of 52 Marks: 1 (Budgeted Time 1 Min)

If $x^2\frac{d^2y}{dx^2} - 2\frac{dy}{dx} = 0$ is the particular form of $\frac{d^2y}{dx^2} + P(x)\frac{dy}{dx} + Q(x)y = 0$, then which of the following is the most accurate option?

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Answer (Please select your correct option)

- $P(x) = \frac{2}{x^2}$ and $Q(x) = 0$
- $I.F = e^x$ $P(x) = -2$ and $Q(x) = x^2$
- $P(x) = \frac{-2}{x^2}$ and $Q(x) = 0$
- $P(x) = 0$ and $Q(x) = \frac{-2}{x^2}$

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Question No : 41 of 52 Marks: 2 (Budgeted Time 4 Min)

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

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Answer (Please click here to Add Answer)

frobenius, i think and .

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

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Question No : 42 of 52 — **Marks: 2 (Budgeted Time 4 Min)**

Discuss the linearly dependence of solution vectors.

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Answer (Please click here to Add Answer)

Any two solution vectors X1 and X2 are linearly dependent if and only if one of the two vectors is a constant multiple of the other.

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Question No : 43 of 52 — **Marks: 2 (Budgeted Time 4 Min)**

What is Legendre's differential equation

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Lecture 34

Legendre's Differential Equation

A second order linear differential equation of the form

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

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 Legendere's polynomial of degree n and is denoted by $P_n(x)$.

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

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

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Question No : 44 of 52 — **Marks: 2 (Budgeted Time 4 Min)**

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:

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

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Answer (Please click here to Add Answer)

yp=Asin2x+Bcos2x

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Question No : 45 of 52 — **Marks: 3 (Budgeted Time 6 Min)**

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?

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Answer (Please click here to Add Answer)

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Question No : 46 of 52 — **Marks: 3 (Budgeted Time 6 Min)**

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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Question No : 47 of 52 — **Marks: 3 (Budgeted Time 6 Min)**

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)

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

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

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

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Question No : 48 of 52 Marks: 3 (Budgeted Time 6 Min)

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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Question No : 49 of 52 Marks: 5 (Budgeted Time 10 Min)

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

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

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Answer (Please click here to Add Answer)

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

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

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

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Question No : 50 of 52 Marks: 5 (Budgeted Time 10 Min)

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 $m_1 = -3, m_2 = -1, m_3 = 6$?

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Answer (Please click here to Add Answer)

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

also find w1,w2,w3

$$w1 = \begin{vmatrix} 0 & e^{-t} & e^{6t} \\ 0 & -e^{-t} & 6e^{6t} \\ 3+4e^{-t} & e^{-t} & 36e^{6t} \end{vmatrix}$$

$$w2 = \begin{vmatrix} e^{-3t} & 0 & e^{6t} \\ -3e^{-3t} & 0 & 6e^{6t} \\ 9e^{-3t} & 3+4e^{-t} & 36e^{6t} \end{vmatrix}$$

$$w3 = \begin{vmatrix} e^{-3t} & e^{-t} & 0 \\ -3e^{-3t} & -e^{-t} & 0 \end{vmatrix}$$

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Question No : 51 of 52 — **Marks: 5 (Budgeted Time 10 Min)**

Write the following system in matirx form

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

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

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Answer (Please click here to Add Answer)

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

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Question No : 52 of 52 — **Marks: 5 (Budgeted Time 10 Min)**

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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Answer (Please click here to Add Answer)

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