20CB/CE/CS/DS/EC/EE/EI/IT/ME 101(MA01)

Hall Ticket Number:

I/IV B.Tech (Supplementary) DEGREE EXAMINATION

September, 2022 — **Common to all branches**

First Semester — **Linear Algebra and ODE**

Time: Three Hours — **Maximum:** 70 Marks

Answer Question No.1 compulsorily. (1X14 = 14 Marks)

Answer ONE question from each unit. (4X14=56 Marks)

1 Answer all questions (1X14=14 Marks)

a) Define rank of a matrix. CO1

b) When the systems of equations has an infinite number of solutions. CO1

c) If A = $\begin{bmatrix} -1 & 2 & 3 \\ 0 & 3 & 5 \\ 0 & 0 & -2 \end{bmatrix}$ then the Eigen values of A^2 are CO1

d) Find the order of the differential equation $(1 + {y_1}^2)^{\frac{3}{2}} = C\, y_2$. CO2

e) Find the integrating factor of the differential equation $\frac{dy}{dx} + y \cos x = \frac{\sin 2x}{2}$. CO2

f) Write general form of a Linear differential equation of first order. CO2

g) Solve $y'' - 4y' - 5y = 0$. CO3

h) Find the P.I of $(D^2 - 16)y = \sin 2x$. CO3

i) Find the Wronskian of cos2x,sin2x. CO3

j) Find Inverse Laplace transform of $\frac{1}{(s+a)(s+b)}$. CO4

k) Find the value of L [3^t]. CO4

l) Find $L[e^{at}]$ CO4

m) Write Convolution theorem for Laplace transforms. CO4

n) State change of scale property. CO4

UNIT I

2. a) Use Gauss-Jordan method , find the inverse of a matrix A = $\begin{bmatrix} 8 & 4 & 3 \\ 2 & 1 & 1 \\ 1 & 2 & 1 \end{bmatrix}$. CO1 7M

b) Find the values of 'a 'and 'b 'for which the equations x+ ay+ z=3, x + 2y+ 2z= b, x + 5y+ 3z= 9 are consistent. When will the equations have a unique solution. CO1 7M

(OR)

3. a) Verify Cayley – Hamilton theorem for the matrix $\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ and find its inverse. CO1 7M

b) Find the Eigen values and Eigen vectors of the matrix $\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$. CO1 7M

		UNIT II		
4.	a)	Solve $xy(1+xy^2)\frac{dy}{dx}=1$.	CO2	7M
	b)	The number N of bacteria in a culture grow at a rate proportional to N. The value of N will was initially 100 and increased to 332 in one hour. What would be value of N after $1\frac{1}{2}$ hours?.	CO2	7M
		(OR)		
5.	a)	Solve $(1+y^2)dx+\left(x-e^{-\tan^{-1}y}\right)dy=0$.	CO2	7M
	b)	Solve $(x^2-ay)\,dx=(ax-y^2)dy$.	CO2	7M
		UNIT III		
6.	a)	Solve $\frac{d^2y}{dx^2}+4y=\sin x$.	CO3	7M
	b)	solve $\frac{d^2y}{dx^2}+a^2y=\cot ax$ by the method of variation of parameters.	CO3	7M
		(OR)		
7.	a)	Solve $\frac{d^2y}{dx^2}+16y=x\sin 3x$.	CO3	7M
	b)	Solve $(D^2+5D+6)y=x^2+2x+4$.	CO3	7M
		UNIT IV		
8.	a)	Find the Laplace transform of $\left(\sqrt{t}-\frac{1}{\sqrt{t}}\right)^3$	CO4	7M
	b)	Apply Convolution theorem to evaluate $L^{-1}\left[\frac{s}{(s^2+a^2)^2}\right]$.	CO4	7M
		(OR)		
9.	a)	Find the Laplace transform of $f(t)=\|t-1\|+\|t+1\|,\ t\geq 0$	CO4	7M
	b)	Solve $\frac{d^2x}{dt^2}+9x=\cos 2t$, if $x(0)=1$, $x\left(\frac{\pi}{2}\right)=-1$ by transform method.	CO4	7M

BAPATLA ENGINEERING COLLEGE, BAPATLA

DEPARTMENT OF MATHEMATICS

I/IV B.Tech (Supplementary) DEGREE EXAMINATION

Linear Algebra And ODE Scheme of Evaluation September-2022

20 (B/CE/CS/DS/EC/EE/EI/IT/ME 101 (MA01)

1(a). Rank of a matrix: A matrix is said to be of rank r when
(i) it has at least one non-zero minor of order r, and
(ii) every minor of order higher than r vanishes.

(b). $\rho(A) = \rho(A:B) < n$, then the system of equations has an infinite number of solutions.

(c). The eigen values of A^2 are 1, 4, 9.

(d). Given DE is $(1+y_1^2)^{3/2} = c\,y_2$.
order = 2, Degree = 2.

(e). The IF of the DE $\frac{dy}{dx} + y\cos x = \frac{\sin 2x}{2}$ is $e^{\int \cos x\,dx} = e^{\sin x}$

(f). The general form of a linear DE of first order is

$$\frac{dy}{dx} + P(x)\,y = Q(x).$$

(g). Given DE is $y'' - 4y' - 5y = 0$.
It's symbolic form is $(D^2 - 4D - 5)y = 0$
AE is $\Rightarrow (D-5)(D+1) = 0$
$\Rightarrow D = -1, 5.$

$\therefore$ CS is $y = c_1 e^{-x} + c_2 e^{5x}$

(h). $P.I = \frac{1}{D^2-16}\sin 2x = \frac{1}{-2^2-16}\sin 2x = \frac{-1}{20}\sin 2x.$

(i). Wronskian of $\cos 2x$, $\sin 2x$ is $W(\cos 2x, \sin 2x) = \begin{vmatrix} \cos 2x & \sin 2x \\ -2\sin 2x & 2\cos 2x \end{vmatrix} = 2.$

(j) $L^{-1}\left[\frac{1}{(s+a)(s+b)}\right] = L^{-1}\left[\frac{1}{a-b}\left\{\frac{1}{s+b} - \frac{1}{s+a}\right\}\right] = \frac{1}{a-b}\left[e^{-bt} - e^{-at}\right].$

(k). $L[3^t] = L[e^{t\ln 3}] = \frac{1}{s-\ln 3}$.

(l). $L[e^{at}] = \frac{1}{s-a}$

(m). Convolution theorem: If $L^{-1}\{\bar{f}(s)\} = f(t)$ and $L^{-1}\{\bar{g}(s)\} = g(t)$, then

$$L^{-1}\{\bar{f}(s)\,\bar{g}(s)\} = F * G = \int_0^t f(u)\,g(t-u)\,du.$$

(n). If $L[f(t)] = \bar{f}(s)$ then $L[f(at)] = \frac{1}{a}\bar{f}\left(\frac{s}{a}\right)$.

UNIT-I

2(a). Given $A = \begin{bmatrix} 8 & 4 & 3 \\ 2 & 1 & 1 \\ 1 & 2 & 1 \end{bmatrix}$

consider $[A : I_3] = \left[\begin{array}{ccc|ccc} 8 & 4 & 3 & 1 & 0 & 0 \\ 2 & 1 & 1 & 0 & 1 & 0 \\ 1 & 2 & 1 & 0 & 0 & 1 \end{array}\right]$

$$\sim \left[\begin{array}{ccc|ccc} 1 & 0 & 0 & 1/3 & -2/3 & -1/3 \\ 0 & 1 & 0 & 1/3 & -5/3 & 2/3 \\ 0 & 0 & 1 & -1 & 4 & 0 \end{array}\right]$$

$$A^{-1} = \begin{bmatrix} \frac{1}{3} & \frac{-2}{3} & \frac{-1}{3} \\ \frac{1}{3} & \frac{-5}{3} & \frac{2}{3} \\ -1 & 4 & 0 \end{bmatrix} = \frac{1}{3}\begin{bmatrix} 1 & -2 & -1 \\ 1 & -5 & 2 \\ -1 & 4 & 0 \end{bmatrix}.$$

2(b). Given equations are $x + ay + z = 3$, $x + 2y + 2z = b$, $x + 5y + 3z = 9$.

Augmented matrix, $[A : B] = \begin{bmatrix} 1 & a & 1 & 3 \\ 1 & 2 & 2 & b \\ 1 & 5 & 3 & 9 \end{bmatrix}$

$R_2 - R_1$; $R_3 - R_1$

$$\sim \begin{bmatrix} 1 & a & 1 & 3 \\ 0 & 2-a & 1 & b-3 \\ 0 & 5-a & 2 & 6 \end{bmatrix}$$

$(2-a)R_3 - (5-a)R_2$

$$\sim \begin{bmatrix} 1 & a & 1 & 3 \\ 0 & 2-a & 1 & b-3 \\ 0 & 0 & -a-1 & 27-9a-5b+ab \end{bmatrix}$$

If $a \neq -1$, b has any value, equations will be consistent and have a unique solution.

(OR)

3(a). Let $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$

The characteristic equation of A is $|A - \lambda I| = 0$

$$\Rightarrow \begin{vmatrix} 2-\lambda & -1 & 1 \\ -1 & 2-\lambda & -1 \\ 1 & -1 & 2-\lambda \end{vmatrix} = 0$$

$$\Rightarrow \lambda^3 - 6\lambda^2 + 9\lambda - 4 = 0.$$

By cayley - Hamilton theorem, Every square matrix satisfies its own characteristic equation. i.e, $A^3 - 6A^2 + 9A - 4I = 0$.

$$A^2 = A \cdot A = \begin{bmatrix} 6 & -5 & 5 \\ -5 & 6 & -5 \\ 5 & -5 & 6 \end{bmatrix}$$

$$A^3 = A^2 \cdot A = \begin{bmatrix} 22 & -21 & 21 \\ -21 & 22 & -21 \\ 22 & -21 & 22 \end{bmatrix}$$

$$\therefore A^3 - 6A^2 + 9A - 4I = 0.$$

Hence cayley - Hamilton theorem is verified.

3(b). Let $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$

The characteristic equation of A is $|A - \lambda I| = 0$

$$\Rightarrow \begin{vmatrix} 8-\lambda & -6 & 2 \\ -6 & 7-\lambda & -4 \\ 2 & -4 & 3-\lambda \end{vmatrix} = 0$$

$$\Rightarrow \lambda^3 - 18\lambda^2 + 45\lambda = 0.$$

$$\Rightarrow \lambda = 0, 3, 15$$

when $\lambda = 0$, the corresponding eigen vector, $X_1 = (1, 2, 2)$

when $\lambda = 3$, the corresponding eigen vector, $X_2 = (2, 1, -2)$

when $\lambda = 15$, the corresponding eigen vector, $X_3 = (2, -2, 1)$.

UNIT-II

4(a). Given $xy(1 + xy^2)\dfrac{dy}{dx} = 1$

$$\Rightarrow \frac{dx}{dy} - xy = x^2y^3$$

$$\Rightarrow \frac{1}{x^2}\frac{dx}{dy} - \frac{y}{x} = y^3 \quad \text{—①} \; ; \text{ let } \frac{1}{x} = z \Rightarrow \frac{-1}{x^2}\frac{dx}{dy} = \frac{dz}{dy}$$

(1) $\Rightarrow \frac{dz}{dy} + yz = -y^3$, which is Leibnitz's linear in z.

$IF = e^{\int y\,dy} = e^{y^2/2}$

$\therefore$ The solution is $z(IF) = \int (-y^3)(IF)\,dy + c$

$\Rightarrow z\,e^{y^2/2} = \int (-y^3)\,e^{y^2/2}\,dy + c$ Let $\frac{y^2}{2} = t$ $\Rightarrow y\,dy = dt$

$= -2\int t\,e^t\,dt + c$

$= -2\left[t e^t - e^t\right] + c$

$(2-y^2)\,e^{y^2/2} + c$

$\Rightarrow z = (2-y^2) + c\,e^{-y^2/2}$.

4(b). Let 'N' be the amount of substance at the time t.

By law of natural growth and Decay $\frac{dN}{dt} \propto N$.

$\Rightarrow N = c\,e^{kt}$

In initial condition, $t=0$, $N=100$.

$\therefore c = 100$.

Also given $N = 332$ when $t = 1$ hr.

$\therefore 332 = 100\,e^{K} \Rightarrow K = \log(3.32)$

$\therefore N = 100\,e^{\log(3.32)t}$

we have to find N when $t = 1\frac{1}{2}$ hr $= \frac{3}{2}$ hrs.

$N = 100\,e^{\log(3.32)\cdot\frac{3}{2}}$

$= 100\,e^{\log(3.32)^{3/2}}$

$= 100\,(3.32)^{3/2}$

$= 604.932$

$\simeq 605$.

(OR)

5(a) Given DE is $(1+y^2)\,dx + (x - e^{-\tan^{-1}y})\,dy = 0$

$\Rightarrow \frac{dx}{dy} + \frac{x}{1+y^2} = \frac{e^{-\tan^{-1}y}}{1+y^2}$ which is linear in x.

Here $P = \frac{1}{1+y^2}$ and $Q = \frac{e^{-\tan^{-1}y}}{1+y^2}$

Now $IF = e^{\int P(x)\,dx} = e^{\int \frac{1}{1+y^2} dy} = e^{\tan^{-1}y}$.

Thus the solution of DE is $x\,(IF) = \int Q\,(IF)\,dy + c$

$\Rightarrow x\,e^{\tan^{-1}y} = \int \frac{e^{-\tan^{-1}y}}{1+y^2} \cdot e^{\tan^{-1}y}\,dy + c$

$\Rightarrow x\,e^{\tan^{-1}y} = \tan^{-1}y + c$ is the solution.

5(b). Given DE is $(x^2 - ay)\,dx = (ax - y^2)\,dy$.

$\Rightarrow (x^2 - ay)\,dx + (y^2 - ax)\,dy = 0$.

Here $M = x^2 - ay$ and $N = y^2 - ax$

$\Rightarrow \frac{\partial M}{\partial y} = -a$ and $\frac{\partial N}{\partial x} = -a$ $\quad \therefore \frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$.

Thus the equation is exact and its solution is

$$\int_{(y\text{ constant})} M\,dx + \int (\text{Terms of } N \text{ not containing } x)\,dy = c$$

$$\Rightarrow \int_{y\text{ constant}} (x^2 - ay)\,dx + \int y^2\,dy = c$$

$\Rightarrow \frac{x^3}{3} - axy + \frac{y^3}{3} = c$

$\Rightarrow x^3 + y^3 - 3axy = c$. is the solution.

6(a). Given DE is $\frac{d^2y}{dx^2} + 4y = \sin x$

It's symbolic form is $(D^2+4)y = \sin x$

Auxiliary equation is $D^2+4=0 \Rightarrow D = \pm 2i$

$CF = c_1 \cos 2x + c_2 \sin 2x$

$PI = \frac{1}{D^2+4} \sin x = \frac{1}{-1^2+4} \sin x = \frac{1}{3} \sin x.$

Hence the CS is $y = CF + PI$

$\Rightarrow y = c_1 \cos 2x + c_2 \sin 2x + \frac{1}{3} \sin x.$

6(b). Given DE is $\frac{d^2y}{dx^2} + a^2y = \cot ax.$

It's symbolic form is $(D^2+a^2)y = \cot ax.$

Auxiliary equation is $D^2+a^2=0 \Rightarrow D = \pm ai$

$CF = c_1 \cos ax + c_2 \sin ax$

Here $y_1 = \cos ax$, $y_2 = \sin ax$, $X = \cot ax$. And $W = \begin{vmatrix} y_1 & y_2 \\ y_1' & y_2' \end{vmatrix} = a.$

$$PI = -y_1 \int \frac{y_2 X}{W} dx + y_2 \int \frac{y_1 X}{W} dx$$

$$= -\cos ax \int \frac{\sin ax \cdot \cot ax}{a} dx + \sin ax \int \frac{\cos ax \cdot \cot ax}{a} dx$$

$$= -\frac{\cos ax}{a} \int \cos ax \, dx + \frac{\sin ax}{a} \int \frac{\cos^2 ax}{\sin ax} dx$$

$$= -\frac{1}{a^2} \cos ax \sin ax + \frac{\sin ax}{a} \int (\operatorname{cosec} ax - \sin ax) dx$$

$$= -\frac{1}{a^2} \cos ax \sin ax + \frac{1}{a^2} \sin ax \log(\operatorname{cosec} ax - \cot ax) + \frac{1}{a^2} \cos ax \sin ax$$

$$= \frac{1}{a^2} \sin ax \log(\operatorname{cosec} ax - \cot ax).$$

Hence the CS is $y = CF + PI$

$\Rightarrow y = c_1 \cos ax + c_2 \sin ax + \frac{1}{a^2} \sin ax \log(\operatorname{cosec} ax - \cot ax)$

(OR)

7(a). Given DE is $\frac{d^2y}{dx^2} + 16y = x \sin 3x$.

It's symbolic form is $(D^2+16)y = x \sin 3x$

Auxiliary equation is $D^2+16=0 \Rightarrow D = \pm 4i$

$CF = c_1 \cos 4x + c_2 \sin 4x$.

$$PI = \frac{1}{D^2+16}(x \sin 3x)$$

$$= \frac{1}{D^2+16}(x \cdot \text{I.P. of } e^{3ix})$$

$$= \text{I.P. of } \left[\frac{1}{D^2+16} x e^{3ix}\right]$$

$$= \text{I.P. of } \left[e^{3ix} \frac{1}{(D+3i)^2+16} x\right]$$

$$= \text{I.P. of } \left[e^{3ix} \frac{1}{7}\left[1 + \frac{6iD}{7} + \frac{D^2}{7}\right]^{-1}(x)\right]$$

$$= \text{I.P. of } \left[\frac{1}{7}(\cos 3x + i \sin 3x)\left(x - \frac{6i}{7}\right)\right]$$

$$= \frac{1}{7}\left(x \sin 3x - \frac{6}{7}\cos 3x\right)$$

Hence the CS is $y = CF + PI$

$$\Rightarrow y = c_1 \cos 4x + c_2 \sin 4x + \frac{1}{7}\left(x \sin 3x - \frac{6}{7}\cos 3x\right)$$

7(b). Given DE is $(D^2+5D+6)y = x^2+2x+4$.

Auxiliary equation is $D^2+5D+6=0 \Rightarrow (D+2)(D+3)=0 \Rightarrow D = -2, -3$.

$CF = c_1 e^{-2x} + c_2 e^{-3x}$.

$$PI = \frac{1}{(D+2)(D+3)}(x^2+2x+4)$$

$$= \left[\frac{1}{D+2} - \frac{1}{D+3}\right](x^2+2x+4)$$

$$= \frac{1}{2}\left(1+\frac{D}{2}\right)^{-1}(x^2+2x+4) - \frac{1}{3}\left(1+\frac{D}{3}\right)^{-1}(x^2+2x+4)$$

$$= \frac{1}{2}\left[1 - \frac{D}{2} + \frac{D^2}{4}\right](x^2+2x+4) - \frac{1}{3}\left[1 - \frac{D}{3} + \frac{D^2}{9}\right](x^2+2x+4)$$

$$= \frac{1}{2}\left(x^2+x+\frac{7}{2}\right) - \frac{1}{3}\left(x^2+\frac{4}{3}x+\frac{32}{9}\right)$$

Hence the CS is $y = c_1 e^{-2x} + c_2 e^{-3x} + \frac{1}{2}\left(x^2+x+\frac{7}{2}\right) - \frac{1}{3}\left(x^2+\frac{4}{3}x+\frac{32}{9}\right)$.

UNIT-IV

8(a). $L\left[\left(\sqrt{t}-\frac{1}{\sqrt{t}}\right)^3\right]$

Since $\left(\sqrt{t}-\frac{1}{\sqrt{t}}\right)^3 = t^{3/2} - 3t^{1/2} + 3t^{-1/2} - t^{-3/2}$

$$\therefore L\left(\left(\sqrt{t}-\frac{1}{\sqrt{t}}\right)^3\right) = L(t^{3/2}) - 3L(t^{1/2}) + 3L(t^{-1/2}) - L(t^{-3/2})$$

$$= \frac{\Gamma(\frac{3}{2}+1)}{s^{3/2+1}} - 3\cdot\frac{\Gamma(\frac{1}{2}+1)}{s^{\frac{1}{2}+1}} + 3\frac{\Gamma(-\frac{1}{2}+1)}{s^{-\frac{1}{2}+1}} - \frac{\Gamma(-\frac{3}{2}+1)}{s^{-\frac{3}{2}+1}}$$

$$= \frac{\frac{3}{2}\Gamma(\frac{3}{2})}{s^{5/2}} - 3\frac{\frac{1}{2}\Gamma(\frac{1}{2})}{s^{3/2}} + 3\cdot\frac{\Gamma(\frac{1}{2})}{s^{1/2}} - \frac{\Gamma(-\frac{1}{2})}{s^{-1/2}}$$

$$= \frac{3}{4}\frac{\sqrt{\pi}}{s^{5/2}} - \frac{3}{2}\frac{\sqrt{\pi}}{s^{3/2}} + \frac{3\sqrt{\pi}}{s^{1/2}} + \frac{2\sqrt{\pi}}{s^{-1/2}}$$

$$= \frac{\sqrt{\pi}}{4}\left[\frac{3}{s^{5/2}} - \frac{6}{s^{3/2}} + \frac{12}{s^{1/2}} + \frac{8}{s^{-1/2}}\right].$$

8(b). $L^{-1}\left[\frac{s}{(s^2+a^2)^2}\right]$

$$= L^{-1}\left[\frac{s}{s^2+a^2}\cdot\frac{1}{s^2+a^2}\right]$$

$$= \int_0^t \cos au \cdot \frac{\sin a(t-u)}{a}\, du$$

$$= \frac{1}{2a}\int_0^t \left[\sin at - \sin(2au-at)\right] dt$$

$$= \frac{1}{2a}\left[u \sin at + \frac{1}{2a}\cos(2au-at)\right]_0^t$$

$$= \frac{1}{2a}\left[\left(t \sin at + \frac{1}{2a}\cos at\right) - \frac{1}{2a}\cos(-at)\right]$$

$$= \frac{1}{2a} t \sin at.$$

Hence $L^{-1}\left\{\frac{s}{(s^2+a^2)^2}\right\} = \frac{t}{2a}\sin at.$

(OR)

9(a). Given $f(t) = |t-1| + |t+1|,\ t \geq 0$.

Given function is equivalent to $f(t) = \begin{cases} 2, & 0 \leq t < 1 \\ 2t, & t \geq 1. \end{cases}$

$$\therefore L\{f(t)\} = \int_0^1 e^{-st}(2)\,dt + \int_1^\infty e^{-st}(2t)\,dt$$

$$= 2\left(\frac{e^{-st}}{-s}\right)_0^1 + 2\left[t\left(\frac{e^{-st}}{-s}\right) - \left(\frac{e^{-st}}{(-s)^2}\right)\right]_1^\infty$$

$$= 2\left(\frac{e^{-s}}{-s} + \frac{1}{s}\right) + 2\left[\frac{0 - e^{-s}}{-s} - \frac{0 - e^{-s}}{s^2}\right]$$

$$= \frac{2}{s}\left[1 + \frac{e^{-s}}{s}\right]$$

9(b). Given DE is $\frac{d^2x}{dt^2} + 9x = \cos 2t,\ x(0) = 1,\ x\left(\frac{\pi}{2}\right) = -1$.

Since $x'(0)$ is not given, we assume $x'(0) = a$.

Taking the Laplace transforms of both sides of the equation

$$L(x'') + 9\,L(x) = L(\cos 2t)$$

$$\Rightarrow s^2\bar{x} - s\,x(0) - x'(0) + 9\,\bar{x} = \frac{s}{s^2+4}$$

$$\Rightarrow (s^2+9)\,\bar{x} = s + a + \frac{s}{s^2+4}$$

$$\Rightarrow \bar{x} = \frac{s+a}{s^2+9} + \frac{s}{(s^2+4)(s^2+9)} = \frac{a}{s^2+9} + \frac{1}{5}\cdot\frac{s}{s^2+4} + \frac{4}{5}\cdot\frac{s}{s^2+9}$$

$$\Rightarrow x = \frac{a}{3}\sin 3t + \frac{1}{5}\cos 2t + \frac{4}{5}\cos 3t$$

when $t = \pi/2$, $-1 = -\frac{a}{3} - \frac{1}{5}$ (or) $\frac{a}{3} = \frac{4}{5}$.

Hence the solution is $x = \frac{1}{5}(\cos 2t + 4\sin 3t + 4\cos 3t)$.

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