20MA001

Hall Ticket Number:

I/IV B.Tech(Regular/Supplementary) DEGREE EXAMINATION

March,2023 **Common to all branches**

First Semester **Linear Algebra and ODE**

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

Answer question 1 compulsory. **(14X1 = 14 Marks)**

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

1. a) Define rank of a matrix — CO1 L1 1M

b) Find the characteristic equation of $A=\begin{bmatrix}0 & 1\\ -1 & 0\end{bmatrix}$ — CO1 L2 1M

c) If $A=\begin{bmatrix}2 & 1\\ 1 & 2\end{bmatrix}$ then find the eigen values of A^{-1} — CO1 L1 1M

d) Define integrating factor — CO2 L1 1M

e) Find the value of 'm', if $ydx-mxdy=0$ is an exact differential equation — CO2 L3 1M

f) What do you mean by Linear differential equation. — CO2 L1 1M

g) Find the general solution of $\frac{d^3x}{dt^3}-x=0.$ — CO3 L1 1M

h) Find PI of $\left(D^2-2D+1\right)y=e^x$ — CO3 L3 1M

i) Evaluate $\frac{1}{D^2}\sin 2x$ where D is differentiable operator with respect to x. — CO3 L1 1M

j) Find the Wronskian of e^{2x} and e^{-x} — CO3 L3 1M

k) Find $L\{2^t\}$ — CO4 L1 1M

l) Find $L^{-1}\left\{\frac{1}{s^2}\right\}$ — CO4 L2 1M

m) Evaluate $\int_0^\infty t^2e^{-st}dt$ using Laplace transform — CO4 L1 1M

n) State convolution theorem in Laplace transforms. — CO4 L1 1M

Unit –I

2. a) Reduce the matrix $\begin{bmatrix}-1 & 2 & 1 & 8\\ 2 & 1 & -1 & 0\\ 3 & 2 & 1 & 7\end{bmatrix}$ into Echelon form and hence find its rank — CO1 L3 7M

b) Test for consistency and solve the system of equations — CO1 L2 7M

$x+y+z=9,\ 2x+5y+7z=52,\ 2x+y-z=0$

(OR)

3. a) Find the Eigen values and the corresponding Eigen vectors of the matrix — CO1 L3 7M

A= $\begin{bmatrix}-2 & 2 & -3\\ 2 & 1 & -6\\ -1 & -2 & 0\end{bmatrix}$.

b) Find the inverse of a matrix $A=\begin{bmatrix}-1 & 1 & 1\\ 1 & -1 & 1\\ 1 & 1 & -1\end{bmatrix}$ using Gauss Jordon method. — CO1 L2 7M

P.T.O

Unit –II

4.	a)	Solve $2xydx+(x^2+y^2)dy=0$	CO2	L3	7M
	b)	If 30% of a radioactive substance disappears in 10 days, how long will it take for 90% of it to disappear?	CO2	L2	7M

(OR)

5.	a)	A body originally at 80^0C cools down to 60^0C in 20 minutes. The temperature of the air being 40^0C. What will be the temperature of the body after 40 minutes from the original and when the temperature will be 45^0C?	CO2	L2	7M
	b)	Solve $\dfrac{dy}{dx}=\dfrac{1}{x+y}$	CO2	L1	7M

Unit –III

6.	a)	Solve $(D^2+4)y = \sin 2x$.	CO3	L3	7M
	b)	Solve $(D^2-4D+4)y = 8e^{2x}\sin 2x$	CO3	L2	7M

(OR)

7.	a)	Solve $(D^2-6D+9)\,y = e^{2x}/x^2$ by the method of variation of parameters	CO3	L3	7M
	b)	Solve $(D^2-3D+2)y = xe^{3x}+\sin 2x$.	CO3	L2	7M

Unit –IV

8.	a)	Find the Laplace transform of $\dfrac{e^{at}-\cos bt}{t}$	CO4	L2	7M
	b)	Using convolution theorem, Evaluate $L^{-1}\left[\dfrac{1}{(s^2+4)^2}\right]$.	CO4	L3	7M

(OR)

9.		Using Laplace transform technique find the solution of $(D^3-3D^2+3D-1)y = t^2e^t$; $y(0)=1$, $y'(0)=0$ and $y''(0)=-2$.	CO4	L4	14M

BAPATLA ENGINEERING COLLEGE, BAPATLA

DEPARTMENT OF MATHEMATICS

I/IV B.Tech (Regular / Supplementary) DEGREE EXAMINATION

Linear Algebra and ODE Scheme of Evaluation | March, 2023 |

(common to all branches) | 20MA001/101 |

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

(b) Given $A = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$

The characteristic equation of A is $\begin{vmatrix} -\lambda & 1 \\ -1 & -\lambda \end{vmatrix} = 0 \Rightarrow \boxed{\lambda^2 + 1 = 0}$

(c) Given $A = \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$

The charateristic equation of A is $\begin{vmatrix} 2-\lambda & 1 \\ 1 & 2-\lambda \end{vmatrix} = 0 \Rightarrow \lambda^2 - 4\lambda + 3 = 0$
$\Rightarrow \lambda = 1, 3.$

The eigen values of A are 1,3.

$\therefore$ The eigen values of A^{-1} are $1, \frac{1}{3}$.

(d) Integrating factor: Sometimes a differential equation which is not exact can be made so on multiplication by a suitable factor called an integrating factor.

(e) $y\,dx - mx\,dy = 0$ is an exact DE.

$\therefore \frac{\partial}{\partial y}(y) = \frac{\partial}{\partial x}(-mx) \Rightarrow 1 = -m \Rightarrow \boxed{m = -1}$

(f) A DE is said to be linear if the dependent variable and its differential coefficients occur in the first degree and not multiplied together.

The standard form of a linear DE is $\frac{dy}{dx} + P(x)y = Q(x)$.

(g) Given DE is $\frac{d^3x}{dt^3} - x = 0$.

Its symbolic form is $(D^3-1)x = 0$, where $D = \frac{d}{dt}$.

It's auxiliary equation is $D^3 - 1 = 0$

$\Rightarrow (D-1)(D^2+D+1) = 0$

$\Rightarrow D = 1, \frac{-1 \pm \sqrt{3}i}{2}$

The general solution is $x = c_1 e^t + e^{-t/2}\left[c_2 \cos\frac{\sqrt{3}}{2}t + c_3 \sin\frac{\sqrt{3}}{2}t\right]$

(h) The PI of $(D^2-2D+1)y = e^x$ is $\frac{1}{D^2-2D+1}e^x = \frac{x}{2D-2}e^x = \frac{x^2}{2}e^x$.

(i) $\frac{1}{D^2}\sin 2x = \frac{1}{-2^2}\sin 2x = -\frac{\sin 2x}{4}$.

(j) The wronskian of e^{2x} and e^{-x} is $\begin{vmatrix} e^{2x} & e^{-x} \\ 2e^{2x} & -e^{-x} \end{vmatrix} = -3e^{x}$.

(k) $L[2^t] = L[e^{t\ln 2}] = \frac{1}{s-\ln 2}$

(l) $L^{-1}\left[\frac{1}{s^2}\right] = t$

(m) $\int_0^\infty t^2 e^{-st}\,dt = L[t^2] = \frac{2}{s^3}$.

(n) Convolution theorem: If $L^{-1}\{\bar{f}(s)\} = f(t)$ and $L^{-1}\{\bar{g}(s)\} = g(t)$,
then $L^{-1}\{\bar{f}(s)\,\bar{g}(s)\} = f * g = \int_0^t f(u)\,g(t-u)\,du$.

UNIT-I

2(a) Let $A = \begin{bmatrix} -1 & 2 & 1 & 8 \\ 2 & 1 & -1 & 0 \\ 3 & 2 & 1 & 7 \end{bmatrix}$

$R_2 + 2R_1$

$R_3 + 3R_1$

$$\sim \begin{bmatrix} -1 & 2 & 1 & 8 \\ 0 & 5 & 1 & 16 \\ 0 & 8 & 4 & 31 \end{bmatrix}$$

$5R_3 - 8R_2$

$$\sim \begin{bmatrix} -1 & 2 & 1 & 8 \\ 0 & 5 & 1 & 16 \\ 0 & 0 & 12 & 27 \end{bmatrix}$$

The rank of A, $\rho(A) = 3$.

2(b). Given equations are $x + y + z = 9$, $2x + 5y + 7z = 52$, $2x + y - z = 0$.

The given system of equations can be represented in the matrix equation as $AX = B$.

$$\Rightarrow \begin{bmatrix} 1 & 1 & 1 \\ 2 & 5 & 7 \\ 2 & 1 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 9 \\ 52 \\ 0 \end{bmatrix}$$

consider $[A|B] = \left[\begin{array}{ccc|c} 1 & 1 & 1 & 9 \\ 2 & 5 & 7 & 52 \\ 2 & 1 & -1 & 0 \end{array}\right]$

$R_2 - 2R_1$; $R_3 - 2R_1$

$$\sim \left[\begin{array}{ccc|c} 1 & 1 & 1 & 9 \\ 0 & 3 & 5 & 34 \\ 0 & -1 & -3 & -18 \end{array}\right]$$

$3R_3 + R_2$

$$\sim \left[\begin{array}{ccc|c} 1 & 1 & 1 & 9 \\ 0 & 3 & 5 & 34 \\ 0 & 0 & -4 & -20 \end{array}\right]$$

$\rho(A) = \rho(A:B) = n = 3$.

The equations are $-4z = -20 \Rightarrow z = 5$

$3y + 5z = 34 \Rightarrow y = 3$

$x + y + z = 9 \Rightarrow x = 1$

Hence the equations are consistent and has a unique solution

And its solution is $(x, y, z) = (1, 3, 5)$.

3(a) Given $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$

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

$$\Rightarrow \begin{vmatrix} -2-\lambda & 2 & -3 \\ 2 & 1-\lambda & -6 \\ -1 & -2 & -\lambda \end{vmatrix} = 0$$

$$\Rightarrow \lambda^3 + \lambda^2 - 21\lambda - 45 = 0$$

$$\Rightarrow \lambda = -3, -3, 5.$$

when $\lambda = -3$, the corresponding eigen vectors are $X_1 = (-2, 1, 0)$

$X_2 = (3, 0, 1)$

when $\lambda = 5$, the corresponding eigen vector is $X_3 = (1, 2, -1)$.

3(b). Given $A = \begin{bmatrix} -1 & 1 & 1 \\ 1 & -1 & 1 \\ 1 & 1 & -1 \end{bmatrix}$

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

$R_2 + R_1$; $R_3 + R_1$

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

$\frac{R_2}{2}, \frac{R_3}{2}$

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

$R_{23} \sim \left[\begin{array}{ccc|ccc} -1 & 1 & 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1/2 & 0 & 1/2 \\ 0 & 0 & 1 & 1/2 & 1/2 & 0 \end{array}\right]$

$R_1 - R_2 \sim \left[\begin{array}{ccc|ccc} -1 & 0 & 1 & 1/2 & 0 & -1/2 \\ 0 & 1 & 0 & 1/2 & 0 & 1/2 \\ 0 & 0 & 1 & 1/2 & 1/2 & 0 \end{array}\right]$

$R_1 - R_3 \sim \left[\begin{array}{ccc|ccc} -1 & 0 & 0 & 0 & -1/2 & -1/2 \\ 0 & 1 & 0 & 1/2 & 0 & 1/2 \\ 0 & 0 & 1 & 1/2 & 1/2 & 0 \end{array}\right]$

$(-1)R_1 \sim \left[\begin{array}{ccc|ccc} 1 & 0 & 0 & 0 & 1/2 & 1/2 \\ 0 & 1 & 0 & 1/2 & 0 & 1/2 \\ 0 & 0 & 1 & 1/2 & 1/2 & 0 \end{array}\right]$

$$\therefore A^{-1} = \begin{bmatrix} 0 & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & 0 & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix} = \frac{1}{2}\begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$

4(a) Given DE is $2xy\,dx + (x^2+y^2)\,dy = 0$.

Here $M = 2xy$ and $N = x^2+y^2$

$\Rightarrow \frac{\partial M}{\partial y} = 2x$ and $\frac{\partial N}{\partial x} = 2x$ $\quad \therefore \frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$

Thus the equation is exact and its solution is

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

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

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

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

4(b) Let 'u' be the amount of radio active substance at any time 't'.

By Decay law, $\frac{du}{dt} \propto u \Rightarrow u = c\,e^{-kt}$ ——— (1)

And let u_0 be the initial amount of radio active material present.

i.e, $u = u_0$ when $t = 0$.

from (1), $c = u_0$.

$\therefore u = u_0\,e^{-kt}$ ——— (2)

Given 30% of radio active material disappeared after 10 days.

i.e, when $t = 10$ days, $u = u_0 - 30\%$ of $u_0 = 0.7u_0$.

from (2), $k = \frac{1}{10}\ln\left(\frac{1}{0.7}\right)$

$\therefore u = u_0\,e^{-\frac{t}{10}\ln\left(\frac{1}{0.7}\right)}$ ——— (3)

we have to find t, when $u = u_0 - 90\%$ of $u_0 = 0.1\,u_0$

from (3), $0.1\,u_0 = u_0\,e^{-\frac{t}{10}\ln\left(\frac{1}{0.7}\right)}$

$$\Rightarrow t = \frac{10\ln(0.1)}{\ln(0.7)} = 64.55 \text{ days}.$$

It will take 64.55 days to disappear 90% of radio active substance from the original.

(OR)

5(a) Let 'θ' be the temperature of the body at any time 't',
and 'θ_0' be the temperature of surrounding medium

By Newton's law of cooling, $\theta = \theta_0 + c\, e^{-kt}$ ——— ①

Given $\theta_0 = 40$.

And original temperature of the body is $80^\circ c$

i.e, $\theta = 80$ when $t = 0$.

from ①, $80 = 40 + c\, e^{-k(0)} \Rightarrow c = 40$.

$\therefore \theta = 40 + 40\, e^{-kt}$ ——— ②

Also given after 20 minutes, temperature of the body is $60^\circ c$.

i.e, $\theta = 60$ when $t = 20$.

from ②, $60 = 40 + 40\, e^{-k(20)} \Rightarrow k = \frac{-1}{20} \ln\left(\frac{1}{2}\right)$

$\therefore \theta = 40 + 40\, e^{\frac{t}{20}\ln\left(\frac{1}{2}\right)}$

when $t = 40$ mins, $\theta = 40 + 40\, e^{\frac{40}{20}\ln\left(\frac{1}{2}\right)} = 50^\circ c$.

when $\theta = 45^\circ c$, $t = \dfrac{20 \ln\left(\frac{1}{8}\right)}{\ln(1/2)} = 60$ mins.

5(b). Given DE is $\dfrac{dy}{dx} = \dfrac{1}{x+y}$.

let $x + y = t$

$\Rightarrow 1 + \dfrac{dy}{dx} = \dfrac{dt}{dx} \Rightarrow \dfrac{dy}{dx} = \dfrac{dt}{dx} - 1$.

$\therefore$ Given DE becomes,

$$\frac{dt}{dx} - 1 = \frac{1}{t}$$

$$\Rightarrow \frac{t}{t+1}\, dt = dx$$

$$\Rightarrow \int\left(1 - \frac{1}{t+1}\right) dt = \int dx$$

$$\Rightarrow t - \ln(t+1) = x + c$$

$$\Rightarrow x + y - \ln(x+y+1) = x + c$$

$$\Rightarrow y - \ln(x+y+1) = c.$$

6(a) Given DE is $(D^2+4)y = \sin 2x$

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

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

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

$$= \frac{x}{2D} \sin 2x$$

$$= \frac{x}{2} \int \sin 2x \, dx$$

$$= \frac{x}{2}\left(-\frac{\cos 2x}{2}\right) = -\frac{x}{4} \cos 2x$$

Hence the CS is $y = CF + PI$

$$\Rightarrow y = c_1 \cos 2x + c_2 \sin 2x - \frac{x}{4} \cos 2x.$$

6(b). Given DE is $(D^2-4D+4)y = 8e^{2x} \sin 2x$

Auxiliary equation is $D^2-4D+4=0 \Rightarrow (D-2)^2 \Rightarrow D = 2, 2.$

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

$$PI = \frac{1}{D^2-4D+4} 8e^{2x} \sin 2x$$

$$= 8 \frac{1}{(D-2)^2} e^{2x} \sin 2x$$

$$= 8e^{2x} \frac{1}{D^2} \sin 2x$$

$$= 8e^{2x} \frac{1}{-2^2} \sin 2x$$

$$= -2e^{2x} \sin 2x$$

Hence the CS is $y = CF + PI$

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

7(a) Given DE is $(D^2-6D+9)y = \frac{e^{2x}}{x^2}$

Auxiliary equation is $D^2-6D+9=0 \Rightarrow (D-3)^2=0$
$\Rightarrow D = 3,3$

$$CF = (c_1 + c_2 x)e^{3x}.$$

Here $y_1 = e^{3x}$; $y_2 = x e^{3x}$; $X = \frac{e^{2x}}{x^2}$

And $W = \begin{vmatrix} y_1 & y_2 \\ y_1' & y_2' \end{vmatrix} = \begin{vmatrix} e^{3x} & x e^{3x} \\ 3e^{3x} & 3xe^{3x}+e^{3x} \end{vmatrix} = e^{6x}\begin{vmatrix} 1 & x \\ 3 & 3x+1 \end{vmatrix} = e^{6x}$

By the method of Variarition of parameters,

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

$$= -e^{3x}\int \frac{x e^{3x}\, e^{2x}/x^2}{e^{6x}}dx + x e^{3x}\int \frac{e^{3x}\cdot e^{2x}/x^2}{e^{6x}}dx$$

$$= -e^{3x}\int \frac{1}{x e^{x}}dx + x e^{3x}\int \frac{1}{x^2 e^{x}}dx.$$

7(b). Given DE is $(D^2-3D+2)y = x e^{3x} + \sin 2x.$

Auxiliary equation is $D^2-3D+2=0. \Rightarrow D = 1,2.$

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

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

$$= \frac{1}{D^2-3D+2}x e^{3x} + \frac{1}{D^2-3D+2}\sin 2x$$

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

$$= e^{3x}\frac{1}{D^2+3D+2}x + \frac{3D-2}{-(9D^2-4)}\sin 2x$$

$$= \frac{e^{3x}}{2}\left[1+\frac{D^2+3D}{2}\right]^{-1}(x) - \frac{(6\cos 2x - 2\sin 2x)}{-36-4}$$

$$= \frac{e^{3x}}{2}\left[1-\frac{D^2+3D}{2}\right](x) + \frac{1}{20}(3\cos 2x - \sin 2x) = \frac{e^{3x}}{4}(2x-3) + \frac{1}{20}(3\cos 2x - \sin 2x)$$

Hence the GS is $y = CF + PI \Rightarrow y = c_1 e^{x} + c_2 e^{2x} + \frac{e^{3x}}{4}(2x-3) + \frac{1}{20}(3\cos 2x - \sin 2x)$

8(a) we have $L\left[\frac{f(t)}{t}\right] = \int_s^{\infty} \bar{f}(s)\, ds$

$$\Rightarrow L\left[\frac{e^{at} - \cos bt}{t}\right] = \int_s^{\infty}\left(\frac{1}{s-a} - \frac{s}{s^2+b^2}\right) ds$$

$$= \left[\ln(s-a) - \frac{1}{2}\ln(s^2+b^2)\right]_s^{\infty}$$

$$= \left[\ln\left(\frac{s-a}{\sqrt{s^2+b^2}}\right)\right]_s^{\infty}$$

$$= \left\{\ln\left(\frac{1-a/s}{\sqrt{1+b^2/s^2}}\right)\right\}_s^{\infty}$$

$$= \ln 1 - \ln\left(\frac{1-a/s}{\sqrt{1+b^2/s^2}}\right) = \ln\left(\frac{\sqrt{s^2+b^2}}{s-a}\right).$$

8(b). $L^{-1}\left[\frac{1}{(s^2+4)^2}\right] = L^{-1}\left[\frac{1}{s^2+2^2} \cdot \frac{1}{s^2+2^2}\right]$

$$= \frac{1}{2}\sin 2t * \frac{1}{2}\sin 2t$$

$$= \frac{1}{4}\int_0^t \sin 2u \sin(2t-2u)\, du$$

$$= \frac{1}{8}\int_0^t \left[\cos(4u-2t) - \cos 2t\right] du$$

$$= \frac{1}{8}\left[\frac{\sin(4u-2t)}{4} - u\cos 2t\right]_0^t$$

$$= \frac{1}{8}\left[\frac{\sin 2t}{2} - t\cos 2t\right] = \frac{1}{16}\left[\sin 2t - 2t\cos 2t\right].$$

(OR)

9. Given DE is $(D^3 - 3D^2 + 3D - 1)y = t^2 e^t$; $y(0) = 1$, $y'(0) = 0$ and $y''(0) = -2$

Taking the Laplace transforms of both sides, we get

$$L\{y''' - 3y'' + 3y' - y\} = L\{t^2 e^t\}$$

$$\Rightarrow L(y''') - 3L(y'') + 3L(y') - L(y) = L(e^t t^2).$$

$$\Rightarrow \left\{s^3\bar{y}(s) - s^2 y(0) - s y'(0) - y''(0)\right\} - 3\left\{s^2\bar{y}(s) - s y(0) - y'(0)\right\}$$
$$+ 3\left\{s\bar{y}(s) - y(0)\right\} - \bar{y}(s) = \frac{2}{(s-1)^3}$$

$$\Rightarrow \bar{y}(s)\left(s^3 - 3s^2 + 3s - 1\right) - s^2 + 3s - 1 = \frac{2}{(s-1)^3}$$

$$\Rightarrow \bar{y}(s)\,(s-1)^3 = \frac{2}{(s-1)^3} + s^2 - 3s + 1$$

$$\Rightarrow \bar{y}(s) = \frac{2}{(s-1)^6} + \frac{s^2 - 3s + 1}{(s-1)^3}$$

$$\Rightarrow \bar{y}(s) = \frac{2}{(s-1)^6} + \frac{(s-1)^2 - (s-1) - 1}{(s-1)^3}$$

$$\Rightarrow \bar{y}(s) = \frac{2}{(s-1)^6} + \frac{1}{s-1} - \frac{1}{(s-1)^2} - \frac{1}{(s-1)^3}.$$

$$\Rightarrow y = L^{-1}\left\{\frac{2}{(s-1)^6} + \frac{1}{s-1} - \frac{1}{(s-1)^2} - \frac{1}{(s-1)^3}\right\}$$

$$\Rightarrow y = 2e^t \frac{t^5}{5!} + e^t - e^t t - e^t \frac{t^2}{2!}$$

$$\Rightarrow y = e^t\left[\frac{t^5}{60} - \frac{t^2}{2} - t + 1\right]$$

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