MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous Institution – UGC, Govt. of India)
UG Model question paper

Time: 3 hours **Mathematics- II** **Max Marks: 70**

Note: This question paper contains of 5 sections. Answer five questions, choosing one question from each section and each question carries 14 marks.

Section-I

1. a) Prove that $\Delta = \frac{1}{2}\delta^2 + \delta\sqrt{1+\frac{\delta^2}{4}}$ [4M]

   b) Find the unique polynomial P(x) of degree 2 or less such that P(1) = 1, P(3) = 27, P(4) = 64 using Lagrange interpolation formula [10M]

OR

2. a) Use Gauss forward interpolation formulae to find f(22) from the following [7M]

x	20	25	30	35	40	45
F(x)	354	332	291	260	231	204

   b) By the fixed point iteration process, find the root correct to 3-decimal places, of the equation 3x = cosx+1 [7M]

Section-II

3. a) By the method of least squares, find the straight line that best fits the following data [7M]

x	0	5	10	15	20	25
F(x)	12	15	17	22	24	30

   b) Evaluate $\int_0^{\pi} sinx\ dx$ by dividing the range into 6 equal parts using
   (i) Trapezoidal rule (ii) Simpson's 1/3rd rule [7M]

OR

4. a) Find the Solution of $\frac{dy}{dx} = x - y$, y(0) = 1 at x=0.1,0.2 using modified Euler's method. [5M]

   b) Evaluate $\int_0^1 \frac{1}{1+x}dx$ by Simpson's 1/3rd and 3/8th rule [4M]

   c) Given that y' = y – x , y(0)=2 find y(0.2) using Runge -Kutta 4th order [5M]

Section-III

5. a) Find the Fourier series representing f(x) = x , $0 < x < 2\pi$ [5M]

   b) Obtain the Fourier Cosine Series for f(x) = x sinx, $0 < x < \pi$ and show that $\frac{1}{1.3} - \frac{1}{3.5} + \frac{1}{5.7} + \ldots\ldots = \frac{\pi-2}{4}$ [9M]

OR

6. a) Find the Fourier series of periodicity 3 for $f(x) = 2x-x^2$ in $0 < x < 3$ [7M]
   b) Express $f(x) = x$ as a half-range cosine series in the interval $0 < x < 2$ [7M]

Section-IV

7. a) Solve the partial differential equation $p\sqrt{x} + q\sqrt{y} = \sqrt{z}$ [4M]
   b) Solve $z(p^2-q^2) = x - y$ [4M]
   c) Solve by the method of separation of variables $2xz_x - 3yz_y = 0$ [6M]

OR

8. a) Solve $z^2 = pqxy$ by charpit's method [7M]
   b) Solve $p^2+q^2 = x^2+y^2$ [7M]

Section-V

9. a) Find the Laplace transform of $e^{3t} - 2e^{-2t} + \sin2t + \cos3t + \sinh t - 2\cosh3t + 8$ [4M]
   b) Using Laplace transform, evaluate $\int_0^\infty te^{-t}\, sintdt$ [10M]

OR

10. a) Find inverse Laplace transform of $\frac{5s-2}{s^2(s+2)(s-1)}$ [4M]
    b) Find $L\{\int_0^t te^{-t}\, sin4tdt\}$ [6M]
    c) Find the inverse Laplace transform of $\frac{e^{-\pi(s+2)}}{s+2}$ [4M]

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Note: This question paper contains of 5 sections. Answer five questions, choosing one question from each section and each question carries 14 marks.

Section-I

1. a) Explain Regula-Falsi method geometrically. [4M]
   b) Using Lagrange's interpolation formula, find y(10) from the following table [10M]

x	5	6	9	11
y	12	13	14	16

OR

2. a) The following are the measurements T made on a curve recorded by the oscilograph representing a change of current 1 due to a change in the conditions of an electric current. [7M]

T	1.2	2.0	2.5	3.0
I	1.36	0.58	0.34	0.2

   Using Largrange's formula, find I at t = 1.6.
   b) Find a positive root x-cosx =0 by bisection method. [7M]

Section-II

3. a) Evaluate $\int_0^1 \frac{dx}{1+x} by$ (i) Trapezoidal (ii) Simpson's one –third rule. [7M]
   b) Fit a second degree parabola to the following data: [7M]

x	0	1	2	3	4
F(x)	1	1.8	1.3	2.5	6.3

OR

4. a) Solve the following using R-K fourth method $y` = y - x, y(0) = 2, h = 0.2$ find y(0.2). [7M]
   b) Fit a curve of the form $y = ae^{bx}$ to the data [7M]

X	0	1	2	3
Y	1.05	2.10	3.85	8.3

Section-III

5. a) Expand $f(x) = e^x, -\pi < x < \pi$ as a Fourier Series. Derive a series for $\frac{\pi}{\sinh \pi}$ [7M]
   b) Find the Fourier series in $[-\Pi, \Pi]$ for the function $f(x) = \begin{cases} \frac{1}{2}(\Pi + x) & for \quad -\Pi \le x \le 0 \\ \frac{1}{2}(\Pi + x) & for \quad 0 \le x \le \Pi \end{cases}$

OR

6. a) Find Fourier coefficient a_n for $f(x) = x^2$ in (0,2) [4M]

b) Obtain the Fourier Series expansion of f(x) given that $f(x) = (\pi - x)^2$ in $0<x<2\pi$

and deduce the value of $\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + ------ = \frac{\pi^2}{6}$. [10M]

Section-IV

7. a) Solve $p^2 + q^2 = 4pq$. [7M]

b) solve the partial differential equation $x^2 p^2 + y^2 q^2 = z^2$ [7M]

OR

8. a) Form the partial differential equations by eliminating the arbitrary functions.

i) $z = f(x^2 + y^2)$ ii) $z = yf(x) + xg(y)$ [7M]

b) Solve $(z^2 - 2yz - y^2)p + (xy + zx)q = xy - zx.$ [7M]

Section-V

9. Solve by Laplace transform

$\frac{d^3y}{dt^3} + 2\ \frac{d^2y}{dt^2} - \frac{dy}{dt} - 2y = 0$, $y(0) = 1$, $y'(0) = y''(0) = 2$ [14M]

OR

10. (a) Find $L^{-1}\left\{\frac{S+1}{(S^2 + 2S+2)^2}\right\}$ [5M]

(b) Find the Laplace transform of $e^{-3t}(2\cos 5t - 3\sin 5t)$ [5M]

c) Find the Laplace transform of $te^{2t}\sin 3t$ [5M]

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Section-I

1. a)Using Newton Raphson method find the square root of a number [2M]
   b) Using bisection method ,find the negative root of $x^3 - 4x + 9 = 0$ correct to two decimals [12M]

OR

2. a) Using appropriate interpolation formula ,find y(8) from the following table [7M]

x	0	5	10	15	20	25
y	7	11	14	18	24	32

   b) A curve passes through the points (0,18) ,(1,10),(3,-18) and (6,90).Find the slope of the curve at x=2 [7M]

Section-II

3. a) Derive normal equations for fitting a straight line [4M]
   b) Using Modified Eulers method find y(0.2) y(0.4)with h=0.2,given that $\frac{dy}{dx}$=x + siny, y(0)=1 [10M]

OR

4. a) Evaluate $\int_0^1 \frac{1}{1+x}dx$ by using trapezoidal , simpson's 1/3,Simpsons 3/8 rule [7M]
   b) Fit a parabola of the form $y = ax^2 + bx + c$ [7M]

x	1	2	3	4	5	6	7
y	2.3	5.2	9.7	16.5	29.4	35.5	54.4

Section-III

5. a) Find the Fourier series of period 2π for the function $f(x) = x^2 - x \; in \; (-\pi, \pi)$.
   Hence deduce the sum of the series $\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+---=\frac{\pi^2}{6}$. [7M]
   b) Find the half – range cosine series for the function $f(x)=(x-1)^2$ in the interval $0<x<1$ and show that $\sum_{n=1}^{\infty}\frac{1}{(2n-1)^2}=\frac{\pi^2}{8}$ [7M]

OR

6. Find the Fourier expansion of f(x) = xcosx in $0<x<2\pi$ [14M]

Section-IV

7. a) Using the method of separation of variables solve $4\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}=3u$ given

$u = 3e^{-y} - e^{-5y}$ Where x=0 [10M]

b) Form the partial differential equations by eliminating the arbitrary functions. [4M]

$(i) z = f\left(x^2 + y^2\right)$ $(ii) z = yf(x) + xg(y)$

OR

8. a) Solve by charpit's method $px + qy = pq$ [7M]

b) Solve $\frac{x^2}{p}+\frac{y^2}{q}=z$ [7M]

Section –V

9. a) Show that $\int_0^\infty t^2 e^{-4t}.sin2t\ dt = \frac{11}{500}$ [4M]

b) Using the Convolution theorem find $L^{-1}\left\{\frac{s}{(s^2+a^2)^2}\right\}$ [10M]

OR

10. Solve by Laplace transform

$\frac{d^3y}{dt^3}+2\frac{d^2y}{dt^2}-\frac{dy}{dt}-2y=0\ ,y(0)=1\ ,y'(0)=y''(0)=2$ [14M]

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Section-I

1. a) Find a root of an equation 3x = cosx + 1 using Newton Raphson Method.
   b) Find a root of an equation e^x sinx = 1 using Regula Falsi Method. [7+7M]

OR

2. a) Find f(22) from the following table using Gauss forward formula [7+7M]

x	20	25	30	35	40	45
y	354	332	291	260	231	204

   b) Find y (10), Given that Y (5) = 12, y(6) = 13, y(9)= 14, Y (11)=16 using Lagrange's formula

Section-II

3. a) Fit a parabola $y = a + bx + cx^2$ to the data given below [7+7M]

x	1	2	3	4	5
y	10	12	8	10	14

   b) Find the value $\int_1^{10} \frac{dx}{x}$ using Simpsons 3/8 rule

OR

4. a) Solve $y' = y - x^2, y(0) = 1,$ by Picard's method upto the third approximation. Hence find the value of f(.1), y(0.2). [7+7M]

   b) Use Eulers method of find y(0.1),y(0.2) given $y' = \left(x^3 + xy^2\right)e^{-x}, y(0) = 1$

Section-III

5. a) If f(x) = cosh ax expand f(x) as a Fourier series in $[-\pi, \pi]$. [7+7M]
   b) Obtain the half-range sine series for $f(x) = e^x \text{in} (0, \pi)$

OR

6. a) Find the Fourier series of period 2π for the function $f(x) = x^2 - x \; in \; (-\pi, \pi)$.
Hence deduce the sum of the series $\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+---=\frac{\pi^2}{6}$. [7+7M]

b) Find half- range Fourier sine series for $f(x) = ax+b \; in \; 0<x<1$.

Section-IV

7. a)Form the partial differential equation by eliminating the constants from
$(x-a)^2+(y-b)^2 = z^2\cot^2\alpha$ where α is a parameter [7+7M]

b) Solve the partial differential equation $x^2p^2 + y^2q^2 = 1$

OR

8. Solve the equation $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u \, , u(x,0) = 6e^{-3x}$ by the method of separation of variables [14M]

Section-V

9. a)Find Laplace transform of (i) $e^{-3t}\left(2\cos 5t - 3\sin 5t\right)$ (ii) $L\left\{e^{3t}\sin^2 t\right\}$ [7+7M]

b)State and prove second shifting theorem

OR

10. a) Find $L^{-1}\left\{\frac{s+3}{s^2-10s+29}\right\}$ [7+7M]

b) Using the convolution theorem find $L^{-1}\left\{\frac{s}{\left(s^2+a^2\right)^2}\right\}$

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Section-I

1. a) Prove **E▼ =Δ = ▼E** [2M]
   b) Find a positive root of the equation by iteration method: 3x = cosx+1 correct to 3-decimal places [6M]
   c) Using Lagrange's interpolation formula, find y (10) from the following table. [6M]

X	5	6	9	11
Y	12	13	14	16

(OR)

2. a) Use Gauss forward interpolation formulae to find f(22) from the following [7M]

x	20	25	30	35	40	45
F(x)	354	332	291	260	231	204

   b) Using bisection method, find the negative root of $x^3 - 4x + 9 = 0$ [7M]

Section-II

3. a) B y the method of least squares, find the straight line that best fits the following data [7M]

x	0	5	10	15	20	25
F(x)	12	15	17	22	24	30

   b) Evaluate $\int_0^{\pi} (\frac{sinx}{x})\, dx$ by dividing the range into 6 equal parts using
   (i) Trapezoidal rule (ii) Simpson's $1/3^{rd}$ rule [7M]

(OR)

4. a) Solve $y` = y - x^2, y(0) = 1$, by Picard's method up to the third approximation. Hence find the value of y (0.1), y(0.2). [7M]
   b) Solve the following using R-K fourth method $y` = y - x, y(0) = 2, h = 0.2$ [7M] find y(0.2).

Section-III

5. a) Expand $f(x) = e^{ax}$ in Fourier series in 0<x< 2π [5M]
   b) Obtain the Fourier Cosine Series for f(x) = x sinx, 0 < x < π and show that

$$\frac{1}{1.3} - \frac{1}{3.5} + \frac{1}{5.7} + \ldots\ldots = \frac{\pi - 2}{4}$$ [9M]

(OR)

6. a) Expand f(x) = cosx for $0 < x < \Pi$ in half range sine series. [6M]

   b)Find the Fourier series of periodicity 3 for f(x) = $2x-x^2$ in 0 < x < 3 [8M]

Section-IV

7. a) Solve the partial differential equation $p\sqrt{x} + q\sqrt{y} = \sqrt{z}$ [4M]
   b) Solve $z(p^2-q^2) = x - y$ [4M]
   c) Solve by the method of separation of variables $2xz_x - 3yz_y = 0$ [6M]

OR

8. a) Solve $z^2 = pqxy$ by Charpit's method [7M]
   b) Solve $p^2+q^2 = x^2+y^2$ [7M]

Section-V

9. a) Find the Laplace transform of Sin2t.cost [2M]
   b) Find $L^{-1}\left[\frac{4}{(s+1)(s+2)}\right]$ [2M]
   b) Using Laplace transform, evaluate $\int_0^\infty te^{-t}\,sintdt$ [10M]

(OR)

10. a) Find the inverse Laplace transform of $\frac{e^{-\pi(s+2)}}{s+2}$ [4M]

    b) Solve $y^{111} + 2y^{11} - y^1 - 2y = 0$ using Laplace Transformation given that

    $y(0) = y^1(0) = 0$ and $y^{11}(0) = 6$ [10M]

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Section-I

1. a) Define Root of an equation [2M]
   b) Find out the square root of 25 given a=2.0, b=7.0 using Bisection Method. [6M]
   c) Find a real root of $x + \log_{10}x - 2 = 0$ using Newton Raphson Method. [6M]

OR

2. a) If the interval of differencing is unity, P.T. $\Delta\tan^{-1}(n-1/n) = \tan^{-1}(1/2n^2)$ [2M]
1. b) Using Gauss formula, find y(8) from the following table [6M]

x	0	5	10	15	20	25
y	7	11	14	18	24	32

c) A Curve passes through the points (0,18),(1,10),(3,-18) and (6,90). Find the slope of the curve at x=2. [6M]

x	0	1	3	6
y	18	10	-18	90

Section-II

3. a) Find y(0.1) using Taylor's Series Method given that $y^1 = y^2 + x$ [2M]

   b) Evaluate $\int_0^1 \frac{1}{1+x}dx$ by using trapezoidal , simpson's 1/3, Simpson's 3/8 rules. [6M]

   c) Using Modified Euler's method find y(0.2) y(0.4)with h=0.2,given that $\frac{dy}{dx}$=x + siny,

   y(0)=1 [6M]

OR

4. a) Write the normal equations of a straight line [2M]
   b) Fit a second degree parabola to the following data: [6M]

x:	0	1	2	3	4
$f(x)$:	1	1.8	1.3	2.5	6.3

   c) Compute y(0.1) and y(0.2) by R-K method of 4^{th} order for the D.E. $y^1 = xy+y^2$,

   y(0)=1 [6M]

Section-III

5. a) Write Euler's formula. [2M]

   b) Obtain Fourier series expansion of $f(x)=(\pi-x)^2$ in $0<x<2\pi$ and deduce the value of $\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+----=\frac{\pi^2}{6}$ [6M]

   c) Express $f(x)=x^2$ as a Fourier series in $[-l,l]$ [6M]

OR

6. a) If f(x) = x^2 – 2, $-2 \le x \le 2$ Find a_0. [2M]

   b) Find the half range sine series for f(x) = x(π − x), *in* $0 < x < \pi$ Deduce that $\frac{1}{1^3}-\frac{1}{3^3}+\frac{1}{5^3}-\frac{1}{7^3}+----=\frac{\pi^3}{32}$ [6M]

   c) Find a Fourier series with period 3 to represent $f(x)=x+x^2$ *in* $(0,3)$ [6M]

Section-IV

7. a) Form the partial differential equation by eliminating the arbitrary constants ***a and b*** from z=ax+by+ab [2M]

   b) Solve $px+qy=pq$ [6M]

   c) Find the integral surface of $x(y^2+z)p-y(x^2+z)q=(x^2-y^2)z$ which contains the straight line x+y=0, z=1 [6M]

OR

8. a) Form a partial differential equation by eliminating the arbitrary function $\boldsymbol{z=f(x^2+y^2)}$ [2M]

   b) Solve $x^2p^2+y^2q^2=1$ [6M]

   c) Solve $z(p^2-q^2)=x-y$ [6M]

Section-V

9. a) Find $L\{\cosh at \sin at\}$ [2M]

   b)Find L.T of $e^{-t}\int_0^t \frac{sint}{t}dt$ [6M]

   c) Use convolution theorem to evaluate $L^{-1}\left\{\frac{1}{s(s^2+4)^2}\right\}$ [6M]

OR

10. a) Find $L^{-1}\left\{\frac{s+3}{s^2-10s+29}\right\}$ [2M]

b) Find the inverse Laplace Transform of $\frac{1}{s^2(s^2+a^2)}$ [6M]

c) Solve $\frac{d^2x}{d^2t} + 9x = cos2t$ using L.T. given x (0) =1, x $(\frac{\pi}{2})$ = -1. [6M]

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Section-I

1 a) Explain about root graphically.
b) Derive a formula to find Cube root of N Using Newton Raphson method and hence find cube root of 15.
c) Find a root of an equation e^x sinx = 1 using method of False Position.

OR

2. a) *Prove* $(1+\Delta)(1-\nabla)=1$
b) Using Gauss back ward difference formula, find y(8) from the following table

x	0	5	10	15	20	25
y	7	11	14	18	24	32

c) A curve passes through the points (0,18),(1,10),(3,18) and (6,90). Find the slope of the curve at x = 2.

Section-II

3. a) Derive the normal equation to fit the straight line $y = a + bx$
b) Solve the equation $\frac{dy}{dx} = x - y^2$ with the conditions y(0) = 1 and y`(0) =1. Find y(0.2) and y(0.4) using Taylor's series method

OR

4. a) Fit a parabola $y = a + bx + cx^2$ to the data given below

x	1	2	3	4	5
y	10	12	8	10	14

b) Evaluate $\int_0^6 \frac{dx}{1+x^2}$ by dividing the range into 6 equal parts using Trapezoidal rule, Simpson's rule, Simpson's 3/8th rules.

Section-III

5. a) Obtain the Fourier Series expansion of f(x) given that $f(x)=(\pi-x)^2$ in 0<x<2 π and deduce the value of $\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+------=\frac{\pi^2}{6}$.

b) Find cosine and sine series for $f(x)=\Pi-x\ in\ [0,\Pi]$

OR

6. a) Find the Fourier series of period 2π for the function $f(x)=x^2-x\ in\ (-\pi,\pi)$. Hence deduce the sum of the series $\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+---=\frac{\pi^2}{6}$.

b) Find the half – range cosine series for the function $f(x)=(x-1)^2$ in the interval $0<x<1$ and Hence show that $\sum_{n=1}^{\infty}\frac{1}{(2n-1)^2}=\frac{\pi^2}{8}$

Section-IV

7. a) Form the partial differential equation by eliminating the arbitrary functions $z=f(2x+y)+g(3x-y)$.

b) Solve the partial differential equation $\frac{x^2}{p}+\frac{y^2}{q}=z$

c) Solve $x^2(z-y)p+y^2(x-z)q=z^2(y-x)$

OR

8. a) Form the partial differential equation by eliminating the constants from $(x-a)^2+(y-b)^2=z^2\cot^2\alpha$ where α is a parameter.

b) Solve the equation $\frac{\partial u}{\partial x}=2\frac{\partial u}{\partial t}+u$, $u(x,0)=6e^{-3x}$ by the method of separation of variables

c) Solve $q^2y^2=z(z-px)$

Section-V

9. a) Find $L\{e^{2t}+4t^3-2\sin 3t+3\cos 3t\}$

b) Evaluate $L\{t\sin 3t\cos 2t\}$

c) Find $L^{-1}\left\{\frac{1}{s(s^2-1)(s^2+1)}\right\}$

OR

10. a) Using Laplace transform, solve $\frac{d^2y}{dt^2}+2\frac{dy}{dt}+5y=e^{-t}\sin t$, given that y(0)=0, $y^1(0)=1$.

b) Using the convolution theorem find $L^{-1}\left\{\frac{s}{(s^2+a^2)^2}\right\}$

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Section-I

1. a) Find a real root of the equation $x^3 - x - 4 = 0$ by bisection method. [7M]
   b) Find an approximate root of $x\log_{10} - 1.2 = 0$ by Regular False method. [7M]

OR

2. a) Use Newton's forward difference formula to find the polynomial satisfied by (0, 5), (1, 12), (2, 37) and (3, 86). [7M]
   b) Using Lagrange's interpolation formula, find y (10) from the following table

x	5	6	9	11
y:	12	13	14	16

[7M]

Section-II

3. a) Evaluate $\int_0^1 \frac{dx}{1+x} by$ (i) Trapezoidal (i) Trapezoidal rule (ii) Simpson's rule [7M]
   b) Fit a second degree parabola to the following data:

x:	0	1	2	3	4
$F(x)$:	1	1.8	1.3	2.5	6.3

[7M]

OR

4. a) Using Taylor series method, find an approximate value of y at x = 0.1, 0.2 for the differential equation $y' - 2y = 3e^x$ for y (0) = 0. [15M]

Section-III

5. a) Find the Fourier expansions of f(x) = xcosx; 0<x<2 π. [15M]

OR

6. a) Find the Fourier series of periodicity of $f(x) = 2x - x^2, in\ 0 < x < 3$. [7M]
   b) Expand the function f(x) = x as a Fourier series in (-π,π). [7M]

Section-IV

7. a) Form a partial differential equation by eliminating a, b, c from $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$ [7M]

   b) Find the integral surface of $x\left(y^2+z\right)p-y(x^2+z)q=(x^2+y^2)z.$ [7M]

OR

1. a) Solve (x + y) p + (y + z) q = (z + x) [7M]

   b) Solve the partial differential equation $x^2p^2+y^2q^2=1$ [7M]

Section-V

9. a) Find $L^{-1}\left\{\frac{3s-8}{4s^2+25}\right\}$ [7M]

   b) Find $L^{-1}\left\{\frac{1}{s\left(s^2+2s+2\right)}\right\}$ [7M]

OR

10. Using Laplace transform, solve $\frac{d^2y}{dt^2}+2\frac{dy}{dt}+5y=e^{-t}\sin t$, given that y (0) =0, $y^1(0)$ =1

[15M]