INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal,Hyderabad-500043

ELECTRONICS AND COMMUNICATION ENGINEERING

TUTORIAL QUESTION BANK

Course Title	MATHEMATICAL TRANSFORM TECHNIQUES			
Course Code	AHSB11			
Programme	B.Tech			
Semester	II			
Course Type	Core			
Regulation	IARE - R18			
Course Structure	Lectures	Tutorials	Practical	Credits
	3	1	-	4
Course Coordinator	Dr. S Jagadha, Associate Professor			
Course Faculty	Dr. P. Srilatha, Associate Professor Ms. L Indira, Assistant Professor Ms. C Rachana, Assistant Professor Ms. P Rajani, Assistant Professor Ms. B. Praveena, Assistant Professor			

COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Enrich the knowledge solving algebra and transcendental equations and understanding Laplace transforms.
II	Determine the unknown values of a function by interpolation and applying inverse Laplace transforms
III	Fitting of a curve and determining the Fourier transform of a function
IV	Solving the ordinary differential equations by numerical techniques
V	Formulate to solve Partial differential equation

COURSE OUTCOMES (COs):

CO 1	Analyzing real roots of algebraic and transcendental equations by Bisection method, False position and Newton -Raphson method. Applying Laplace transform and evaluating given functions using shifting theorems, derivatives, multiplications of a variable and periodic function.
CO 2	Understanding symbolic relationship between operators using finite differences. Applyiing Newton's forward, Backward, Gauss forward and backward for equal intervals and Lagrange's method for unequal interval to obtain the unknown value. Evaluating inverse Laplace transform using derivatives, integrals, convolution method. Finding solution to linear differential equation
CO 3	Applying linear and nonlinear curves by method of least squares. Understanding Fourier integral, Fourier transform, sine and cosine Fourier transforms, finite and infinite and inverse of above said transforms.
CO 4	Using Numericals methods such as Taylors, Eulers, Modified Eulers and Runge-Kutta methods to solve ordinary differential equations.
CO 5	Analyzing order and degree of partial differential equation, formation of PDE by eliminating arbitrary constants and functions, evaluating linear equation b Lagrange's method. Applying the heat equation and wave equation in subject to boundary conditions.

COURSE LEARNING OUTCOMES (CLOs):

Students, who complete the course, will have demonstrated the asking to do the following:

AHSB11.01	Evaluate the real roots of algebraic and transcendental equations by Bisection method, False position and Newton -Raphson method.
AHSB11.02	Apply the nature of properties to Laplace transform and inverse Laplace transform of the given function.
AHSB11.03	Solving Laplace transforms of a given function using shifting theorems.
AHSB11.04	Evaluate Laplace transforms using derivatives of a given function.
AHSB11.05	Evaluate Laplace transforms using multiplication of a variable to a given function.
AHSB11.06	Apply Laplace transforms to periodic functions.
AHSB11.07	Apply the symbolic relationship between the operators using finite differences.
AHSB11.08	Apply the Newtons forward and Backward, Gauss forward and backward Interpolation method to determine the desired values of the given data at equal intervals, also unequal intervals.
AHSB11.09	Solving Laplace transforms and inverse Laplace transform using derivatives and integrals.
AHSB11.10	Evaluate inverse of Laplace transforms and inverse Laplace transform by the method of convolution.
AHSB11.11	Solving the linear differential equations using Laplace transform.
AHSB11.12	Understand the concept of Laplace transforms to the real-world problems of electrical circuits, harmonic oscillators, optical devices, and mechanical systems
AHSB11.13	Ability to curve fit data using several linear and non linear curves by method of least squares.
AHSB11.14	Understand the nature of the Fourier integral.
AHSB11.15	Ability to compute the Fourier transforms of the given function.
AHSB11.16	Ability to compute the Fourier sine and cosine transforms of the function
AHSB11.17	Evaluate the inverse Fourier transform, Fourier sine and cosine transform of the given function.
AHSB11.18	Evaluate finite and infinite Fourier transforms
AHSB11.19	Understand the concept of Fourier transforms to the real-world problems of circuit analysis, control system design
AHSB11.20	Apply numerical methods to obtain approximate solutions to Taylors, Eulers, Modified Eulers
AHSB11.21	Runge-Kutta methods of ordinary differential equations.
AHSB11.22	Understand the concept of order and degree with reference to partial differential equation
AHSB11.23	Formulate and solve partial differential equations by elimination of arbitrary constants and functions
AHSB11.24	Understand partial differential equation for solving linear equations by Lagrange method.
AHSB11.25	Learning method of separation of variables.
AHSB11.26	Apply solving the heat equation and wave equation in subject to boundary conditions
AHSB11.27	Understand the concept of partial differential equations to the real-world problems of electromagnetic and fluid dynamics

S. No	QUESTIONS	Blooms Taxonomy level	Course Outcomes (COs)	Course Learning Outcomes (CLOs
	MODULE - I **ROOT FINDING TECHNIQUES AND LAPLACE TRANSFORMS**			
	Part - A (Short Answer Questions)			
1	Define an Algebraic equation.	Remember	CO 1	AHSB11.01
2	Define an Transcendental equation .	Remember	CO 1	AHSB11.01
3	Write the Bisection formulae to find the real root of algebraic equation in an interval .	Remember	CO 1	AHSB11.01
4	Write the Regula-Falsi formula to find the real root of algebraic equation in an interval .	Remember	CO 1	AHSB11.01
5	Write the Newton-Raphson formulae to find the real root of algebraic equation in an interval .	Remember	CO 1	AHSB11.01
6	By using Regula-Falsi method, find an approximate root of the equation $x^4 - x - 10 = 0$ that lies between 1.8 and 2. Carry out two approximations	Remember	CO 1	AHSB11.01
7	Apply Newton –Raphson method to find an approximate root of the equation $x^3 - 3x - 5 = 0,$ which lies near x=2 carry out two approximations.	Understand	CO 1	AHSB11.01
8	Find a real root of the transcendental equation $xe^x = 2$ using method of False Position carry out three approximations.	Understand	CO 1	AHSB11.01
9	Explain bisection method.	Understand	CO 1	AHSB11.01
10	Find a real root of the transcendental equation xe^x-cosx = 0 using Newton –Raphson method carry out three approximations.	Understand	CO 1	AHSB11.01
11	Define Laplace Transform, and write the sufficient conditions for the existence of Laplace Transform.	Remember	CO 1	AHSB11.02
12	Find the Laplace transform of $(\sin t - \cos t)^3$	Remember	CO 1	AHSB11.02
13	Verify whether the function f(t)=t^3 is exponential order and find its transform.	Understand	CO 1	AHSB11.02
14	Find the Laplace transform of Dirac delta function	Remember	CO 1	AHSB11.02
15	Find the Laplace transform of $\lvert\sin \omega t\rvert, t \geq 0$	Understand	CO 1	AHSB11.02
16	State and prove Linearity property of Laplace transform.	Understand	CO 1	AHSB11.02
17	Find $L\{g(t)\}$ where $g(t)=\begin{cases} \cos(t-\frac{2\pi}{3}), & \text{if } t>\frac{2\pi}{3} \\ 0, & \text{if } t<\frac{2\pi}{3} \end{cases}$	Understand	CO 1	AHSB11.02
18	Find the Laplace transform of Sinht	Remember	CO 1	AHSB11.02
19	Verify the initial and final value theorem for $e^{-t}(t+1)^2$	Remember	CO 1	AHSB11.03
20	State and prove change of scale property of Laplace Transforms	Understand Understand	CO 1 CO 1	AHSB11.09 AHSB11.03
	Part - B (Long Answer Questions)			
1	Find the positive root of $x^3 - x - 1 = 0$ using Bisection method.	Remember	CO 1	AHSB11.01
2	Find a real root of the transcendental equation $e^x \sin x = 1$ by using False position method correct up to three decimals.	Remember	CO 1	AHSB11.01
3	Solve transcendental equation 2x = cosx +3 by Newton-Raphson method correct up to three decimals.	Remember	CO 1	AHSB11.01

4	Find a real root of transcendental equation $\log x = \cos x$ using method of False position correct up to four decimals.	Remember	CO 1	AHSB11.01
5	Find a real root of transcendental equation 3x- cos*x* -1=0 using Newton Raphson method correct up to four decimals.	Remember	CO 1	AHSB11.01
6	Find a real root of the transcendental equation xtanx+1=0 by Newton- Raphson method correct up to four decimals.	Remember	CO 1	AHSB11.01
7	Find the real root algebraic equation x^3- x- 4=0 by Bisection method correct up to four decimals.	Apply	CO 1	AHSB11.01
8	Find the real root of algebraic equation 3x = e^x by Bisection method correct up to two decimals.	Remember	CO 1	AHSB11.01
9	Find the square root of 26 up to 4 decimal places by using Newton-Raphson method.	Remember	CO 1	AHSB11.01
10	Find by using Bisection method the real root of the equation $xe^x - 3 = 0$ carry out three approximations.	Remember	CO 1	AHSB11.01
11	Find the Laplace transform of $f(t) = (t+3)^2 e^t$	Remember	CO 1	AHSB11.03
12	Find $L\left\{\frac{\cos 4t \sin 2t}{t}\right\}$	Remember	CO 1	AHSB11.05
13	Using Laplace transform evaluate $\int_0^\infty \frac{e^{-t} - e^{-2t}}{t} dt$	Understand	CO 1	AHSB11.04
14	Find $L\{\cosh at \sin bt\}$	Understand	CO 1	AHSB11.01
15	Find $L\{e^{-3t} \sinh 3t\}$	Understand	CO 1	AHSB11.05
16	Find $L\{t \sin 3t \cos 2t\}$	Understand	CO 1	AHSB11.05
17	Find the Laplace transform of $\frac{\cos 2t - \cos 3t}{t}$	Understand	CO 1	AHSB11.05
18	Find the Laplace transform of $te^{2t} \sin 3t$	Remember	CO 1	AHSB11.05
19	Find the Laplace transform of $\left\{\frac{1-\cos at}{t}\right\}$	Remember	CO 1	AHSB11.06
20	Find the Laplace transform of $\cos t \cos 2t \cos 3t$	Remember	CO 1	AHSB11.06
Part - C (Problem Solving and Critical Thinking Questions)				
1	Derive a formula to find a cube root of N using Newton-Raphson method and hence find cube root of 15.	Understand	CO 1	AHSB11.01
2	Find reciprocal of real number 18 using Newton-Raphson method.	Remember	CO 1	AHSB11.01
3	Find a root of the equation 4sinx=e^x using Bisection method correct up to four decimals.	Remember	CO 1	AHSB11.01
4	Find a root of the equation 2x-logx=7 using the False Position method correct up to three decimals.	Remember	CO 1	AHSB11.01
5	Find a root of the equation x+$\log_{10}$ x=3.375 using Newton-Raphson method.	Remember	CO 1	AHSB11.01
6	Using the theorem on transforms of derivatives, find the Laplace Transform of the following functions (a) e^{at} (b) cosat (c) t sin at	Understand	CO 1	AHSB11.04
7	Find the Laplace transform of (a) $e^{-3t} \cosh 4t \sin 3t$ (b) $(t+1)^2 e^t$	Understand	CO 1	AHSB11.04
8	Find the Laplace transform of (a) $t^2 e^t \sin 4t$ (b) $t \cos^2 t$	Understand	CO 1	AHSB11.04
9	Find the Laplace transform of $\int_0^t \frac{e^t \sin t}{t} dt$	Apply	CO 1	AHSB11.05

10	Find the L{f(t)} and L{ $f'(t)$ } for the function (a) $\frac{\sin t}{t}$ (b) $e^{-5t}\sin t$	Understand	CO 1	AHSB11.04
MODULE-II INTERPOLATION AND INVERSE LAPLACE TRANSFORMS				
Part – A (Short Answer Questions)				
1	Define the term Interpolation.	Remember	CO 2	AHSB11.07
2	State Newton's forward interpolation formula for equal length of intervals.	Remember	CO 2	AHSB11.08
3	State Newton's backward interpolation formula for equal length of intervals.	Remember	CO 2	AHSB11.08
4	State Gauss forward interpolation formula for equal length of intervals and state Lagrange's Interpolation formulae for unequal intervals	Remember	CO 2	AHSB11.08
5	Define average operator and shift operator.	Remember	CO 2	AHSB11.07
6	Prove the relationship between forward difference operator and shift operator.	Remember	CO 2	AHSB11.07
7	Prove the relationship between backward difference operator and shift operator.	Remember	CO 2	AHSB11.07
8	Prove the relationship between forward and backward difference operator.	Remember	CO 2	AHSB11.07
9	Construct a forward difference table for $f(x)=x^3+5x-7$ if x= -1,0,1,2,3,4,5	Understand	CO 2	AHSB11.07
10	For what values of p the Gauss forward and backward interpolation formula is used to interpolate?	Understand	CO 2	AHSB11.08
11	Find the inverse Laplace transform of $\frac{s}{s^2-a^2}$	Understand	CO 2	AHSB11.09
12	Find the inverse Laplace transform of $\frac{1}{s}\cos\frac{1}{s}$	Understand	CO 2	AHSB11.09
13	Find the inverse Laplace transform of $\left\{\frac{2s-5}{4s^2+25}+\frac{4s-18}{9-s^2}\right\}$	Understand	CO 2	AHSB11.09
14	Find the inverse Laplace transform of $\frac{e^{-2s}}{(s+4)^3}$	Remember	CO 2	AHSB11.09
15	Find $L^{-1}\left\{\frac{3s+7}{s^2-2s-3}\right\}$	Understand	CO 2	AHSB11.09
16	Find $L^{-1}\left\{\frac{s}{(s+1)^2(s^2+1)}\right\}$	Understand	CO 2	AHSB11.09
17	Find the inverse Laplace transform of $\frac{s}{(s^2+1)(s^2+4)}$	Understand	CO 2	AHSB11.09
18	Find the inverse Laplace transform $\frac{s}{(s^2+1)(s^2+9)(s^2+25)}$	Understand	CO 2	AHSB11.09
19	Find the inverse Laplace transform of $\log\left(\frac{s^2+4}{s^2+9}\right)$	Understand	CO 2	AHSB11.09
20	Find the inverse Laplace transform $\frac{e^{-2s}}{s^2+4s+5}$	Understand	CO 2	AHSB11.09
Part - B (Long Answer Questions)				
1	Find y(2.8) for the following data using Newton's forward interpolation formula. x: 2.4, 3.2, 4.0, 4.8, 5.6 f(x): 22, 17.8, 14.2, 38.3, 51.7	Apply	CO 2	AHSB11.08

x	2.4	3.2	4.0	4.8	5.6
f(x)	22	17.8	14.2	38.3	51.7

<table>
<tr><td>2</td><td>Find f(42) from the following data using Newton’s Backward interpolation formula.
<table><tr><td>x</td><td>20</td><td>25</td><td>30</td><td>35</td><td>40</td><td>45</td></tr><tr><td>y</td><td>354</td><td>332</td><td>291</td><td>260</td><td>231</td><td>204</td></tr></table></td><td>Apply</td><td>CO 2</td><td>AHSB11.08</td></tr>
<tr><td>3</td><td>The population of a town in the decimal census was given below. Estimate the population for the year 1895
<table><tr><td>Year (x)</td><td>1891</td><td>1901</td><td>1911</td><td>1921</td><td>1931</td></tr><tr><td>Population (y)</td><td>46</td><td>66</td><td>81</td><td>93</td><td>101</td></tr></table></td><td>Apply</td><td>CO 2</td><td>AHSB11.08</td></tr>
<tr><td>4</td><td>Find y(25) given that y(20)=24, y(24)=32, y(28)=35, y(32)=40 using Gauss forward interpolation formula.</td><td>Remember</td><td>CO 2</td><td>AHSB11.08</td></tr>
<tr><td>5</td><td>Find by Gauss’s backward interpolating formula the value of y at x = 1936 using the following table
<table><tr><td>x</td><td>1901</td><td>1911</td><td>1921</td><td>1931</td><td>1941</td><td>1951</td></tr><tr><td>y</td><td>12</td><td>15</td><td>20</td><td>27</td><td>39</td><td>52</td></tr></table></td><td>Remember</td><td>CO 2</td><td>AHSB11.08</td></tr>
<tr><td>6</td><td>Find by Gauss’s backward interpolating formula the value of y at x = 14 using the following table
<table><tr><td>x</td><td>0</td><td>5</td><td>10</td><td>15</td><td>20</td><td>25</td></tr><tr><td>y</td><td>7</td><td>11</td><td>14</td><td>18</td><td>24</td><td>32</td></tr></table></td><td>Remember</td><td>CO 2</td><td>AHSB11.08</td></tr>
<tr><td>7</td><td>Find f (1.6) using Lagrange’s formula from the following table.
<table><tr><td>x</td><td>1.2</td><td>2.0</td><td>2.5</td><td>3.0</td></tr><tr><td>f(x)</td><td>1.36</td><td>0.58</td><td>0.34</td><td>0.20</td></tr></table></td><td>Apply</td><td>CO 2</td><td>AHSB11.08</td></tr>
<tr><td>8</td><td>Find y(5) given that y(0)=1, y(1)=3, y(3)=13 and y(8) =123 using Lagrange’s interpolation formula.</td><td>Remember</td><td>CO 2</td><td>AHSB11.08</td></tr>
<tr><td>9</td><td>Find y(10), given that y(5)=12, y(6)=13, y(9)=14, y(11)=16 using Lagrange’s interpolation formula.</td><td>Remember</td><td>CO 2</td><td>AHSB11.08</td></tr>
<tr><td>10</td><td>Fit a curve which passes through the points (0, 18), (1, 10), (3,-18) and (6, 90) using Lagrange’s formula.</td><td>Remember</td><td>CO 2</td><td>AHSB11.08</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>11</td><td>Find the inverse Laplace transform of $\frac{2S^2-6S+5}{S^3-6S^2+11S-6}$</td><td>Understand</td><td>CO 2</td><td>AHSB11.09</td></tr>
<tr><td>12</td><td>Find the inverse Laplace transform $\frac{1}{(s^3+1)s^3}$</td><td>Understand</td><td>CO 2</td><td>AHSB11.09</td></tr>
<tr><td>13</td><td>Find the inverse Laplace transform $\frac{(s+1)e^{-\pi s}}{s^2+s+1}$</td><td>Understand</td><td>CO 2</td><td>AHSB11.09</td></tr>
<tr><td>14</td><td>Find the inverse Laplace transform of $\tan^{-1}\left(\frac{a}{s}\right)+\cot^{-1}\left(\frac{s}{b}\right)$</td><td>Understand</td><td>CO 2</td><td>AHSB11.09</td></tr>
<tr><td>15</td><td>Find the inverse Laplace transform $\frac{s^2+2s-4}{(s^2+9)(s-5)}$</td><td>Understand</td><td>CO 2</td><td>AHSB11.09</td></tr>
<tr><td>16</td><td>Solve the following initial value problem by using Laplace transform
$(D^2+2D+5)y=e^{-t}\sin t,\ \ y(0)=0,\ \ y'(0)=1$</td><td>Apply</td><td>CO 2</td><td>AHSB11.11</td></tr>
<tr><td>17</td><td>Solve the following initial value problem by using Laplace transform
$y''+9y=\cos 2t, y(0)=1, y(\frac{\pi}{2})=-1$</td><td>Understand</td><td>CO 2</td><td>AHSB11.11</td></tr>
</table>

<table>
<tr><td>18</td><td>Solve the following initial value problem by using Laplace transform
$y''' - 2y'' + 5y' = 0, y(0) = 1, y'(0) = 0, y''(0) = 1$</td><td>Understand</td><td>CO 2</td><td>AHSB11.11</td></tr>
<tr><td>19</td><td>Solve the following initial value problem by using Laplace transform
$(D^3 - D^2 + 4D - 4)y = 68e^x \sin 2x, \quad y = 1, \; Dy = -19,$
$D^2 y = -37 \; at \; x = 0$</td><td>Apply</td><td>CO 2</td><td>AHSB11.11</td></tr>
<tr><td>20</td><td>Solve the following initial value problem by using Laplace transform
$\frac{dy}{dt} + 2y + \int_0^t y dt = \sin t, y(0) = 1$</td><td>Understand</td><td>CO 2</td><td>AHSB11.11</td></tr>
<tr><td colspan="4">Part – C (Problem Solving and Critical Thinking)</td><td></td></tr>
<tr><td>1</td><td>Evaluate f(10) given f(x)=168, 192, 336 at x=1, 7, 15 respectively using Lagrange’s interpolation formula.</td><td>Remember</td><td>CO 2</td><td>AHSB11.08</td></tr>
<tr><td>2</td><td>Prove that Δ[x(x+1)(x+2)(x+3)]=4(x+1)(x+2)(x+3) by taking difference as unity.</td><td>Apply</td><td>CO 2</td><td>AHSB11.07</td></tr>
<tr><td>3</td><td>Find y(1.6) from the following data using Newton’s forward interpolation formula
<table><tr><td>x</td><td>1</td><td>1.4</td><td>1.8</td><td>2.2</td></tr><tr><td>y</td><td>3.49</td><td>4.82</td><td>5.96</td><td>6.5</td></tr></table></td><td>Remember</td><td>CO 2</td><td>AHSB11.08</td></tr>
<tr><td>4</td><td>Using Gauss back ward difference formula find y(24) from the following table
<table><tr><td>x</td><td>0</td><td>5</td><td>10</td><td>15</td><td>20</td><td>25</td></tr><tr><td>y</td><td>7</td><td>11</td><td>14</td><td>18</td><td>24</td><td>32</td></tr></table></td><td>Remember</td><td>CO 2</td><td>AHSB11.08</td></tr>
<tr><td>5</td><td>Compute f(0.3) for the data using Lagrange’s interpolation formula.
<table><tr><td>x</td><td>0</td><td>1</td><td>3</td></tr><tr><td>y</td><td>1</td><td>3</td><td>49</td></tr></table></td><td>Apply</td><td>CO 2</td><td>AHSB11.08</td></tr>
<tr><td colspan="4"></td><td></td></tr>
<tr><td>6</td><td>Find the inverse Laplace transform $\frac{s+3}{s^2 - 10s + 29}$</td><td>Understand</td><td>CO 2</td><td>AHSB11.09</td></tr>
<tr><td>7</td><td>Find the inverse transform of $\frac{s+2}{s^2 - 4s + 13}$</td><td>Understand</td><td>CO 2</td><td>AHSB11.09</td></tr>
<tr><td>8</td><td>Find the inverse Laplace transform $\frac{s^2 + s - 2}{s(s+3)(s-2)}$</td><td>Understand</td><td>CO 2</td><td>AHSB11.09</td></tr>
<tr><td>9</td><td>Apply convolution theorem to evaluate $L^{-1}\left\{\frac{s^2}{(s^2 + a^2)(s^2 + b^2)}\right\}$</td><td>Apply</td><td>CO 2</td><td>AHSB11.10</td></tr>
<tr><td>10</td><td>Apply convolution theorem to evaluate $L^{-1}\left\{\frac{1}{s(s^2 + 4)^2}\right\}$</td><td>Apply</td><td>CO 2</td><td>AHSB11.10</td></tr>
<tr><td colspan="4">MODULE-III
CURVE FITTING AND FOURIER TRANSFORMS</td><td></td></tr>
<tr><td colspan="4">Part - A (Short Answer Questions)</td><td></td></tr>
<tr><td>1</td><td>State the normal equations of the straight line y = a + bx</td><td>Understand</td><td>CO 3</td><td>AHSB11.13</td></tr>
<tr><td>2</td><td>State the normal equations of the second degree equation
$y = a + bx + cx^2$</td><td>Understand</td><td>CO 3</td><td>AHSB11.13</td></tr>
</table>

3	State the normal equations to fit the exponential curve of the form $y = ae^{bx}$.	Remember	CO 3	AHSB11.13
4	State the normal equations to fit the power curve of the form $y = ab^x$	Remember	CO 3	AHSB11.13
5	If $y = a + \frac{b}{x}$ is a curve then write normal equations to find the constants a and b.	Remember	CO 3	AHSB11.13
6	If $y = a_0 + a_1 x + a_2 x^2$ then what is the third normal equation of $\sum x_i^2 y_i$ by least squares method?	Remember	CO 3	AHSB11.13
7	If $y = ax^b$, then what is the first normal equation of $\sum \log y_i$?	Remember	CO 3	AHSB11.13
8	Fit a curve of the form $y = ax^b$ by the method of least squares to the following data. x: 1, 2, 3 y: 2.98, 4.26, 5.21	Understand	CO 3	AHSB11.13
9	Fit a straight line to the form $y = a + bx$ by the method of least squares for the following data x: 0, 5, 10 y: 12, 15, 17	Understand	CO 3	AHSB11.13
10	Fit a curve y = ae^{bx} to the data x: 0, 2, 4 y: 5.1, 10, 31.1	Apply	CO 3	AHSB11.13
11	Write the Fourier sine integral and cosine integral.	Remember	CO 3	AHSB11.14
12	Find the Fourier sine transform of xe^{-ax}	Understand	CO 3	AHSB11.15
13	Write the infinite Fourier transform of f(x).	Remember	CO 3	AHSB11.18
14	Write the properties of Fourier transform of f(x)	Remember	CO 3	AHSB11.15
15	Find the Fourier sine transform of f(x) = x	Understand	CO 3	AHSB11.14
16	State Fourier integral theorem.	Understand	CO 3	AHSB11.15
17	Define Fourier transform.	Remember	CO 3	AHSB11.18
18	Find the finite Fourier cosine transformof f(x)=1 in $0 < x < \pi$	Understand	CO 3	AHSB11.18
19	Find the inverse finite sine transform f(x) if $F_S(n) = \frac{1 - \cos n\pi}{n^2\pi^2}$	Understand	CO 3	AHSB11.18
20	State the Modulation property of Fourier transforms.	Understand	CO 3	AHSB11.15
	Part – B (Long Answer Questions)			
1	By the method of least squares find the straight line that best fits the following data: x: 1, 3, 5, 7, 9 y: 1.5, 2.8, 4.0, 4.7, 6	Apply	CO 3	AHSB11.13
2	By the method of least squares find the straight line that best fits the following data: x: 1, 2, 3, 4, 5 y: 14, 27, 40, 55, 68	Understand	CO 3	AHSB11.13
3	Fit a straight line y=ax+b for the following data by method of least squares: x: 0, 1, 2, 3, 4 y: 1, 1.8, 3.3, 4.5, 6.3	Understand	CO 3	AHSB11.13

<table>
<tr><td>4</td><td>Fit a straight line to the form y=a+bx for the following data by method of least squares:
<table><tr><td>x</td><td>0</td><td>5</td><td>10</td><td>15</td><td>20</td><td>25</td></tr><tr><td>y</td><td>12</td><td>15</td><td>17</td><td>22</td><td>24</td><td>30</td></tr></table></td><td>Understand</td><td>CO 3</td><td>AHSB11.13</td></tr>
<tr><td>5</td><td>By the method of least squares, fit a second degree polynomial $y=a+bx+cx^2$ to the following data.
<table><tr><td>x</td><td>2</td><td>4</td><td>6</td><td>8</td><td>10</td></tr><tr><td>y</td><td>3.07</td><td>12.85</td><td>31.47</td><td>57.38</td><td>91.29</td></tr></table></td><td>Understand</td><td>CO 3</td><td>AHSB11.13</td></tr>
<tr><td>6</td><td>Fit a second degree curve $y=a+bx+cx^2$ for the following data by method of least square.
<table><tr><td>x</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>y</td><td>6</td><td>11</td><td>18</td><td>27</td></tr></table></td><td>Understand</td><td>CO 3</td><td>AHSB11.13</td></tr>
<tr><td>7</td><td>Using the method of least squares find the constants a and b such that $y=ae^{bx}$ fits the following data:
<table><tr><td>x</td><td>0</td><td>0.5</td><td>1</td><td>1.5</td><td>2</td><td>2.5</td></tr><tr><td>y</td><td>0.10</td><td>0.45</td><td>2.15</td><td>9.15</td><td>40.35</td><td>180.75</td></tr></table></td><td>Apply</td><td>CO 3</td><td>AHSB11.13</td></tr>
<tr><td>8</td><td>Obtain a relation of the form $y=ab^x$ for the following data by the method of least squares.
<table><tr><td>x</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>y</td><td>8.3</td><td>15.4</td><td>33.1</td><td>65.2</td><td>127.4</td></tr></table></td><td>Understand</td><td>CO 3</td><td>AHSB11.13</td></tr>
<tr><td>9</td><td>Fit a second degree curve $y=a+bx+cx^2$ by method of least squares
<table><tr><td>x</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>y</td><td>23</td><td>5.2</td><td>9.7</td><td>16.5</td><td>29.4</td></tr></table></td><td>Understand</td><td>CO 3</td><td>AHSB11.13</td></tr>
<tr><td>10</td><td>Obtain a relation of the form $y=ae^{bx}$ for the following data by method of least squares.
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<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>11</td><td>Find the Fourier transform of f(x) defined by
$f(x)=\begin{cases}1, & |x|<a \\ 0, & |x|>a\end{cases}$ and hence evaluate
$\int_0^\infty \frac{\sin p}{p}dp.and \int_{-\infty}^{\infty}\frac{\sin ap.\cos px}{p}dp$</td><td>Understand</td><td>CO 3</td><td>AHSB11.15</td></tr>
<tr><td>12</td><td>Find the Fourier transform of f(x) defined by $f(x)=\begin{cases}1-x^2, & |x|\le 1 \\ 0, & |x|>1\end{cases}$
Hence evaluate
$(i)\ \int_0^\infty \frac{x\cos x-\sin x}{x^3}\cos\frac{x}{2}dx \quad (ii)\int_0^\infty \frac{x\cos x-\sin x}{x^3}dx$</td><td>Apply</td><td>CO 3</td><td>AHSB11.15</td></tr>
</table>

13	Find the Fourier Transform of f(x) defined by $f(x)=e^{\frac{-x^2}{2}},-\infty<x<\infty$ or, Show that the Fourier Transform of $e^{\frac{-x^2}{2}}$ is reciprocal.	Understand	CO 3	AHSB11.15
14	Find the Fourier sine Transform of $e^{-\|x\|}$ and hence evaluate $\int_0^\infty \frac{x\sin mx}{1+x^2}dx$	Understand	CO 3	AHSB11.17
15	Find the Fourier cosine transform of $(a)\quad e^{-ax}\cos ax \quad (b)\quad e^{-ax}\sin ax$	Apply	CO 3	AHSB11.17
16	Using Fourier integral show that $e^{-ax}-e^{-bx}=\frac{2(b^2-a^2)}{\pi}\int_0^\infty \frac{\lambda\sin\lambda x}{(\lambda^2+a^2)(\lambda^2+b^2)}d\lambda, a>0, b>0$	Apply	CO 3	AHSB11.14
17	Using Fourier Integral, show that $\int_0^\infty \frac{1-\cos\lambda\pi}{\lambda}.\sin\lambda x\, d\lambda=\begin{cases}\frac{\pi}{2} if\ 0<x<\pi\\ 0, if\ x>\pi\end{cases}$	Understand	CO 3	AHSB11.14
18	Find the finite Fourier sine and cosine transforms of $f(x)=\sin ax$ in (0, π).	Understand	CO 3	AHSB11.17
19	Find the inverse Fourier cosine transform f(x) of $F_c(p)=p^n e^{-ap}$ and inverse Fourier sine transform f(x) of $F_s(p)=\frac{p}{1+p^2}$	Apply	CO 3	AHSB11.17
20	Find the finite Fourier sine and cosine transform of f(x), defined by f(x)= $\left(1-\frac{x}{\pi}\right)^2$, where $0<x<\pi$	Understand	CO 3	AHSB11.17
Part - C (Problem Solving and Critical Thinking Questions)				
1	Describe the concept of method of least squares to fit a curve for the given data.	Understand	CO 3	AHSB11.13
2	Derive the Normal equations of a straight line by method of least squares.	Understand	CO 3	AHSB11.13
3	Derive the Normal equations of a second degree parabola method of least squares.	Understand	CO 3	AHSB11.13
4	If y = ax+b is a straight line that fits the following data by the method of least squares find a and b. x: 1, 2, 3 y: 0, -1, 4	Understand	CO 3	AHSB11.13
5	Fit a straight line to the form y= ax^2+bx+c for the following data by method of least squares: x: 0, 5, 10, 15, 20, 25 y: 12, 15, 17, 22, 24, 30	Understand	CO 3	AHSB11.13

6	Find the Fourier cosine transform of the function f(x) defined by $f(x)=\begin{cases}\cos x, & 0<x<a\\ 0, & x\ge a\end{cases}$	Understand	CO 3	AHSB11.16
7	Find the Fourier sine transform of f(x) defined by $f(x)=\begin{cases}\sin x, & 0<x<a\\ 0, & x\ge a\end{cases}$	Understand	CO 3	AHSB11.16
8	Find the Fourier sine and cosine transform of $f(x)=\begin{cases}x, & for\quad 0<x<1\\ 2-x, & for\quad 1<x<2\\ 0, & for\quad x>2\end{cases}$	Understand	CO 3	AHSB11.16
9	Find the finite Fourier sine and cosine transforms of f(x) = $x(\pi - x)$ in (0, π).	Understand	CO 3	AHSB11.16
10	State and prove the properties of Fourier transforms	Understand	CO 3	AHSB11.15
MODULE-IV NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS				
Part – A (Short Answer Questions)				
1	State the Taylor series formula to find the numerical solution of ordinary differential equation.	Remember	CO 4	AHSB11.20
2	State the Euler formula to find the numerical solution of ordinary differential equation.	Remember	CO 4	AHSB11.20
3	State the modified Euler formula to find the numerical solution of ordinary differential equation.	Remember	CO 4	AHSB11.20
4	What is the difference between Euler and modified Euler formula to find the numerical solution of ordinary differential equation	Remember	CO 4	AHSB11.20
5	What are single step methods to find the numerical solution of ordinary differential equation?	Remember	CO 4	AHSB11.20
6	What are multistep methods to find the numerical solution of ordinary differential equation?	Remember	CO 4	AHSB11.20
7	Using Taylor's series method find an approximate value of y at x = 0.1 given y(0)=1for the differential equation $y' = 3x + y^2$	Remember	CO 4	AHSB11.20
8	Using Euler's method, solve $y' = y^2 + x$,y(0)=1 to find y(0.1) and y(0.2)	Apply	CO 4	AHSB11.20
9	Using Taylors series, method solve $y' = y^2 + x$,y(0) =1 to find y (0.1) and y (0.2)	Apply	CO 4	AHSB11.20
10	Using Euler's method, solve the differential equation from $\frac{dy}{dx}$ = $3x^2$ +1, for x = 2, y(1) = 2,taking step size h = 0.5 .	Apply	CO 4	AHSB11.20
11	State the second order Runge- Kutta method to find the numerical solution of ordinary differential equation.	Remember	CO 4	AHSB11.21
12	State the third order Runge- Kutta method to find the numerical solution of ordinary differential equation.	Remember	CO 4	AHSB11.21
13	State the fourth order Runge- Kutta method to find the numerical solution of ordinary differential equation.	Remember	CO 4	AHSB11.21

14	What is the advantage of Runge- Kutta method over Taylors series method	Remember	CO 4	AHSB11.21
15	State the merits of Runge- Kutta method	Remember	CO 4	AHSB11.21
16	State the demerits of Runge- Kutta method	Remember	CO 4	AHSB11.21
17	Using Runge-Kutta method of second order, find y(0.2) where $y' = y - x$, y(0)=2 , h = 0.2	Remember	CO 4	AHSB11.21
18	Using Runge-Kutta method of third order, find y(0.2) where $10y' = y^2 + x^2$, y(0)=1 , h = 0.1	Remember	CO 4	AHSB11.21
19	Using Runge-Kutta method, find y(0.2) where $y' = yx$, y(0) =1, h = 0.2	Remember	CO 4	AHSB11.21
20	Using Runge-Kutta method, find y(0.2) where $y' = y + x$, y(0) = 1, h = 0.2	Remember	CO 4	AHSB11.21
Part – B (Long Answer Questions)				
1	Using Taylor's series method find an approximate value of y at x = 0.2 for the differential equation $y' - 2y = 3e^x$, y(0)=0.	Apply	CO 4	AHSB11.20
2	Solve by Euler's method y' + y = 0 given y(0) = 1 and find y(0.04) taking step size h = 0.01.	Understand	CO 4	AHSB11.20
3	Solve by Euler's method y' = x + y, y(0) = 1 and find the value of y(0.3) taking step size h = 0.1. compare the result obtained by this method with the result obtained by analytical methods	Remember	CO 4	AHSB11.20
4	Solve y' = x^2 – y, y(0) = 1, using Taylor's series method and compute y(0.1), y(0.2), y(0.3) and y(0.4) (correct to 4 decimal places).	Remember	CO 4	AHSB11.20
5	Using Euler's method, solve the differential equation from $\frac{dy}{dx}$ = xy, for x = 0.5, y(0) = 1, taking step size h = 0.1 .	Remember	CO 4	AHSB11.20
6	Using modified Euler's method, find the approximate value of x when $x = 0.3$ given differential equation $\frac{dy}{dx} = x + y$ and y(0) = 1.	Apply	CO 4	AHSB11.20
7	State the merits of Taylors series method	Remember	CO 4	AHSB11.20
8	State the demerits of Taylors series method	Apply	CO 4	AHSB11.20
9	Using modified Euler's method, find the approximate value of y when $x = 0.25$ given differential equation $\frac{dy}{dx} = 2xy$ and y (0) = 1.	Remember	CO 4	AHSB11.20
10	Solve by Euler's method $y' = \frac{2y}{x}$ given y(1) = 2 and find y(2)	Apply	CO 4	AHSB11.20
11	Using Runge-Kutta method of fourth order, find y(0.2) where $y' = 3x + 0.5y$, y(0) = 1 , h = 0.1 .	Remember	CO 4	AHSB11.21
12	Apply the 4th order Runge-Kutta method to find an approximate value of y when x=1.2 in steps of 0.1,given that $y' = x^2 + y^2$,y(1)=1.5	Apply	CO 4	AHSB11.21
13	Using Runge-Kutta method of second order, find $y(2.5)$ given the differential equation $\frac{dy}{dx} = \frac{x+y}{x}$,y(2)= 2, h = 0.25 .	Remember	CO 4	AHSB11.21
14	Find y(0.1) and y(0.2) by Runge-Kutta method of 4th order for the differential equation $y' = xy + y^2$, y(0) =1	Apply	CO 4	AHSB11.21
15	Using Runge-Kutta method of fourth order, find y (0.2) given the differential equation $\frac{dy}{dx} = \frac{y-x}{y+x}$,y(0) = 1, h = 0.2 .	Apply	CO 4	AHSB11.21

16	Compute $y(0.1), y(0.2)$ by Runge-Kutta method of 4th order for the differential equation $y' = x + x^2 y$, y(0) =1	Apply	CO 4	AHSB11.21
17	Using Runge-Kutta method of fourth order, given the differential equation $\frac{dy}{dx} = x^2 + 0.25y^2$, y(0)= -1 on [0,0.5], h = 0.1.	Apply	CO 4	AHSB11.21
18	Compute $y\ at\ x = (0.2), (0.4), (0.6)$ by Runge-Kutta method for the differential equation $y' = \frac{1}{1+x}$, y(0) =0	Apply	CO 4	AHSB11.21
19	Compute $y(0.3)$ by Runge-Kutta method of 4th order for the differential equation $y' + y + y^2 x = 0$, y(0) =1	Apply	CO 4	AHSB11.21
20	Using Runge-Kutta method of fourth order, find y when x= 1.1, given the differential equation $\frac{dy}{dx} = 3x + y^2$, y(1) = 1.2.	Apply	CO 4	AHSB11.21
	Part – C (Problem Solving and Critical Thinking)			
1	Using modified Euler's method find y (0.2) andy (0.4) given differential equation $y' = y + e^x$, y(0) = 0.	Understand	CO 4	AHSB11.20
2	Given the differential equation $\frac{dy}{dx} = -xy^2$, y(0) = 2. Computey(0.2) in steps of 0.1, using modified Euler's method.	Remember	CO 4	AHSB11.20
3	Solve the first order differential equation $\frac{dy}{dx} = \frac{y-x}{y+x}$, y(0) = 1 and estimate y(0.1) using Euler's method(5 steps).	Apply	CO 4	AHSB11.20
4	Given $\frac{dy}{dx}$ = - y and y(0) = 1. Determine the values of y at x = (0.01),(0.02),(0.03),(0.04) by Eulers method.	Remember	CO 4	AHSB11.20
5	Find y(4.4) by modified Eulers method given that $\frac{dy}{dx} = \frac{2-y^2}{5x}$, y=1 when x=1.	Remember	CO 4	AHSB11.20
6	Using Runge-Kutta method find y(0.2) for the differential equation $\frac{dy}{dx} = y - x$,y(0)=1,take h=0.2.	Remember	CO 4	AHSB11.21
7	Apply the 4th order Runge-Kutta method to find an approximate value of y when x = 1.2 in steps of h= 0.1 given the differential equation $y' = x^2 + y^2$, y(1)=1.5	Understand	CO 4	AHSB11.21
8	Using Runge-Kutta method find to solve $10\frac{dy}{dx} = x^2 + y^2$,y(0)=1 for the interval $0 \le x \le 0.4$ with h= 0.1	Understand	CO 4	AHSB11.21
9	Find $y(0.5), y(1), y(1.5), y(2)$ taking h = 0.5 , given that $\frac{dy}{dx} = \frac{1}{y+1}$, y(0) = 1	Understand	CO 4	AHSB11.21
10	Using Runge-Kutta method find y(0.8) for the differential equation $\frac{dy}{dx} = \sqrt{x+y}$, y(0.4) = 0.41.	Understand	CO 4	AHSB11.21

MODULE-V PARTIAL DIFFERENTIAL EQUATIONS AND APPLICATIONS				
Part - A (Short Answer Questions)				
1	Define order and degree with reference to partial differential equation	Remember	CO 5	AHSB11.22
2	Form the partial differential equation by eliminate the arbitrary constants from $z = ax^3 + by^3$	Understand	CO 5	AHSB11.22
3	Form the partial differential equation by eliminating arbitrary function $z=f(x^2+y^2)$	Understand	CO 5	AHSB11.22
4	Solve the partial differential equation $p\sqrt{x} + q\sqrt{y} = \sqrt{z}$	Understand	CO 5	AHSB11.23
5	Form the partial differential equation by eliminating a and b from $\log(az-1) = x + ay + b$	Understand	CO 5	AHSB11.22
6	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.	Apply	CO 5	AHSB11.22
7	Eliminate the arbitrary constants from $z=(x^2+a)(y^2+b)$	Understand	CO 5	AHSB11.22
8	Solve the partial differential equation $x(y-z)p+y(z-x)q=z(x-y)$.	Apply	CO 5	AHSB11.23
9	Solve $p + q = z$	Remember	CO 5	AHSB11.23
10	Solve $zp + yq = x$	Remember	CO 5	AHSB11.23
11	Define non-linear partial differential equation.	Remember	CO 5	AHSB11.22
12	Solve $xp + yq = 3z$	Remember	CO 5	AHSB11.23
13	Solve $px + qy = z$	Remember	CO 5	AHSB11.23
14	Solve $p + 3q = 5z + \tan(y - 3x)$	Understand	CO 5	AHSB11.23
15	Solve $2p + 3q = 1$	Understand	CO 5	AHSB11.23
16	Solve $(x^2 + y^2 + z^2)p - 2xyq = -2xz$	Understand	CO 5	AHSB11.23
17	Solve $(1+y)p + (1+x)q = z$	Understand	CO 5	AHSB11.23
18	Solve $y^2 p - xyq = x(z - 2y)$	Understand	CO 5	AHSB11.23
19	Write the wave one dimension equation	Remember	CO 5	AHSB11.26
20	Write the heat one dimension equation	Remember	CO 5	AHSB11.26
Part - B (Long Answer Questions)				
1	Form the partial differential equation by eliminating arbitrary function from $f(x^2+y^2+z^2, z^2-2xy)=0$	Understand	CO 5	AHSB11.23
2	Form a partial differential equation by eliminating a, b, c from $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1.$	Apply	CO 5	AHSB11.23
3	Solve the partial differential equation $(x^2 - yz)p + (y^2 - zx)q = z^2 - xy$	Understand	CO 5	AHSB11.24
4	Solve the partial differential equation $(z^2 - 2yz - y^2)p + (xy + zx)q = xy - zx.$	Understand	CO 5	AHSB11.24
5	Solve the partial differential equation $(mz - ny)p + (nx - lz)q = (ly - mx)$.	Understand	CO 5	AHSB11.24
6	Find the differential equation of all spheres whose centres lie on z-axis with a given radius r.	Understand	CO 5	AHSB11.22
7	Solve the partial differential equation $(x^2 - y^2 - yz)p + (x^2 - y^2 - zx)q = z(x - y).$	Apply	CO 5	AHSB11.24
8	Solve the partial differential equation $(x^2-y^2-z^2)p+2xyq = 2xz$	Understand	CO 5	AHSB11.24

9	Solve the partial differential equation $z(z^2+xy)(px-qy)=x^4$	Understand	CO 5	AHSB11.24
10	Solve the partial differential equation $px-qy=y^2-x^2$	Understand	CO 5	AHSB11.24
11	Solve the partial differential equation $px^2+qy^2=z(x+y)$	Understand	CO 5	AHSB11.24
12	Solve by the method of separation of variables $2xz_x-3yz_y=0$	Understand	CO 5	AHSB11.25
13	Solve the partial differential equation $y^2zp + x^2zq = xy^2$	Understand	CO 5	AHSB11.24
14	Solve the partial differential equation $p\tan x+q\tan y=\tan z$	Understand	CO 5	AHSB11.22
15	Solve the partial differential equation $(x-a)p+(y-b)q+(c-z)=0$	Understand	CO 5	AHSB11.24
16	Solve the partial differential equation $x(y^2-z^2)p-y(z^2+x^2)q=z(x^2+y^2)$=z	Understand	CO 5	AHSB11.24
17	Solve the partial differential equation $(x+y)(p-q)=z$	Understand	CO 5	AHSB11.24
18	Solve by the method of separation of variables $4u_x+u_y=3u$ and $u(o,y)=e^{-5y}$	Understand	CO 5	AHSB11.25
19	Solve by the method of separation of variables $3u_x+2u_y=0$ with $u(x,0)=4e^{-x}$	Understand	CO 5	AHSB11.25
20	Solve $(x-y)p+(y-x-z)q=z$	Understand	CO 5	AHSB11.24
Part – C (Problem Solving and Critical Thinking)				
1	Form the partial differential equation by eliminating arbitrary function $lx+my+nz=\emptyset(x^2+y^2+z^2)$	Understand	CO 5	AHSB11.22
2	Form the partial differential equation by eliminating arbitrary function $xy+yz+zx=f(\frac{z}{x+y})$	Understand	CO 5	AHSB11.22
3	Solve the partial differential equation $z(x-y)=px^2-qy^2$	Understand	CO 5	AHSB11.22
4	Solve the partial differential equation $(z^2-2yz-y^2)p+(xy+xz)q=xy-zx.$	Understand	CO 5	AHSB11.24
5	Solve the partial differential equation $(x^2+y^2+yz)p+(x^2+y^2-zx)q=z(x+y).$	Understand	CO 5	AHSB11.24
6	Solve $\frac{\partial u}{\partial x}=2\frac{\partial u}{\partial t}+u$ where $u(x,0)=6e^{-3x}$ by the method of separation of variables.	Understand	CO 5	AHSB11.25
7	Solve $\frac{\partial^2 u}{\partial x\partial t}=e^{-t}\cos x$ given that u=0 when t = 0 and $\frac{\partial u}{\partial t}=0$ When x = 0 show also that as t tends to ∞ , u tends to sin x.	Understand	CO 5	AHSB11.25
8	A tightly stretched string with fixed end points x=0 and x= l is initially at rest its equilibrium position. If it is set to vibrate by giving each of its points a velocity $\lambda x(1-x)$,find the displacement of the string at any distance x from one end at any time t.	Apply	CO 5	AHSB11.26
9	Write the boundary conditions for a rectangular plate is bounded by the line x=0, y=0, x=a, and y=b its surface are insulated the temperature along x=0 and y=0 are kept at 0^0C and the other are kept at100^0C.	Understand	CO 5	AHSB11.26

10	A tightly stretched string with fixed end points x=0 and x=l is initially in a position given by $y = y_0 \sin^3 \frac{\pi x}{l}$ .If it is released from rest from this position, find the displacement(x,t).	Apply	CO 5	AHSB11.26

Prepared by
Dr. S. Jagadha, Professor

HOD, ECE