INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

STRUCTURAL ENGINEERING

TUTORIAL QUESTION BANK

Course Name	:	**COMPUTER ORIENTED NUMERICAL METHODS**
Course Code	:	BST003
Class	:	I M. Tech I Semester
Branch	:	ST
Year	:	2017 – 2018
Course Coordinator	:	Mr.S.V.S.Hanumantharao, Associate Professor
Course Faculty	:	Mr.S.V.S.Hanumantharao, Associate Professor

OBJECTIVES

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process.

S No	**QUESTION**	**Blooms taxonomy level**	**Course Outcomes**
	UNIT - I **SOLUTIONS OF LINEAR EQUATIONS**		
	Part - A (Short Answer Questions)		
1	Write short notes on direct method.	Remember	1
2	Explain about Cramer's rule.	Remember	1
3	Define Gauss Elimination method.	Remember	1

4	What is Gauss Jordan method	Remember	1
5	Write short notes on indirect method.	Remember	1
6	Define Triangulization method	Remember	1
7	What is Jacobi Iteration method	Remember	1
8	Define Gauss-Seidel iteration method	Remember	1
9	Define successive over –relaxation method	Remember	1
10	Write short notes on Eigen values and Eigen vectors for symmetric matrices.	Understand	1
Part - B (Long Answer Questions)			
1	Solve the system x+y+z=6, 2x-3y+4z=8,x-y+2z=5 by Cramer's rule.	Understand	1
2	Solve the system of equations $x_1+2x_2+x_3=0$, $2x_1+2x_2+2x_3=3$, $-x_1-3x_2=2$ by Gauss Elimination method.	Understand	1
3	Solve the system of linear equations by Gauss Jordan method x+y+z=6, 2x+3y-2z=2, 5x+y+2z=13.	Understand	1
4	Solve by using Traingulization method 2x+3y+z=9, x+2y+3z=6, 3x+y+2z=8.	Understand	1
5	Solve the system of equations by using Jacobi's iteration method. 28x-y-z=32, x+3y+10z=24, 2x+17y+4z=35	Apply	1
6	Solve the system of equations 10x+y+z=12, 2 x+10y+z=13, 2x+2y+10z=14.by Gauss seidel iteration method.	Apply	1
7	Solve the system by Relaxation method 8 $x_1-3x_2+2x_3=20$, 4 $x_1+11x_2-x_3=33$, $6x_1+3x_2+12x_3=36$.	Apply	1
8	Solve by Jacobi's method for the symmetric matrix $A=\begin{bmatrix} 15 & 1 & 1 \\ 1 & -2 & 6 \\ 1 & 6 & 1 \end{bmatrix}$	Apply	1
9	Solve by Given's method for $A=\begin{bmatrix} 1 & 4 & 3 \\ 4 & 5 & 6 \\ 3 & 6 & 2 \end{bmatrix}$	Apply	1
10	Consider a symmetric matrix $A=\begin{bmatrix} 2 & 3 & 4 \\ 3 & 6 & 5 \\ 4 & 5 & 7 \end{bmatrix}$. Solve by Householder's method.	Apply	1
Part - C (Problem Solving and Critical Thinking Questions)			
1	Solve the system of equations x+y+z=7, x+2y+3z=16, x+3y+4z=20 by cramer's rule	Understand	1
2	Solve x+2y+3z=14, 3 x+y+2z=11, 2 x+3y+z=11 by gauss elimination method	Understand	1
3	Solve the system by Gauss Jordan method x+2y-z=2, 3x+8y+2z=10, 4x+9y-z=12.	Understand	1
4	Solve the system of equations x+y+z=6, x+2y+3z=16, x+3y+z=12 by LU decomposition method.	Understand r	1

<table>
<tr><td>5</td><td>Solve 10x+2y+z=9, x+10y-z=-22, -2 x+3y+10z=22 by Jacobi's iteration method</td><td>Apply</td><td>1</td></tr>
<tr><td>6</td><td>Solve the system of linear equations by Gauss Seidel iterative method $x_1+10x_2+x_3=6$, $10x_1+x_2+x_3=6$, $x_1+x_2+10x_3=6$.</td><td>Apply</td><td>1</td></tr>
<tr><td>7</td><td>Solve 20x+2y+6z=28, x+20y+9z=-23, 2 x-7y-20z=-57 by Jacobi's iteration method</td><td>Apply</td><td>1</td></tr>
<tr><td>8</td><td>Solve the real symmetric matrix A= $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$ by Jacobi's method.</td><td>Apply</td><td>1</td></tr>
<tr><td>9</td><td>Solve the symmetric matrix A= $\begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 3 \\ 1 & 3 & 5 \end{bmatrix}$ by Given's method.</td><td>Apply</td><td>1</td></tr>
<tr><td>10</td><td>Solve A= $\begin{bmatrix} 2 & 5 & 4 \\ 5 & 3 & 6 \\ 4 & 6 & 8 \end{bmatrix}$ by House holder's method.</td><td>Apply</td><td>1</td></tr>
<tr><td colspan="4">UNIT-II
INTERPOLATION</td></tr>
<tr><td colspan="4">Part – A (Short Answer Questions)</td></tr>
<tr><td>1</td><td>Define Interpolation</td><td>Remember</td><td>2</td></tr>
<tr><td>2</td><td>What is extrapolation?</td><td>Remember</td><td>2</td></tr>
<tr><td>3</td><td>How many types of interpolations are there?</td><td>Remember</td><td>2</td></tr>
<tr><td>4</td><td>What is Linear Interpolation?</td><td>Remember</td><td>2</td></tr>
<tr><td>5</td><td>Define higher order interpolation</td><td>Remember</td><td>2</td></tr>
<tr><td>6</td><td>Explain Lagrange's interpolation</td><td>Remember</td><td>2</td></tr>
<tr><td>7</td><td>Explain finite differences.</td><td>Remember</td><td>2</td></tr>
<tr><td>8</td><td>Define Hermite interpolation.</td><td>Remember</td><td>2</td></tr>
<tr><td>9</td><td>Define Piece-wise interpolation.</td><td>Remember</td><td>2</td></tr>
<tr><td>10</td><td>Explain Spline interpolation.</td><td>Remember</td><td>2</td></tr>
<tr><td colspan="4">Part - B (Long Answer Questions)</td></tr>
<tr><td>1</td><td>The following table contains the values of $y = f(x)$ .For what value of x does y equal $\frac{1}{2}$
<table>
<tr><td>X</td><td>0.45</td><td>0.46</td><td>0.47</td><td>0.48</td><td>0.49</td><td>0.50</td></tr>
<tr><td>y</td><td>0.4754</td><td>0.4846</td><td>0.4937</td><td>0.5027</td><td>0.5116</td><td>0.5204999</td></tr>
</table></td><td>Understand</td><td>2</td></tr>
<tr><td>2</td><td>Find the cubic spline that passes through the data points (0, 1), (1,-2), (2, 1) and (3, 16) with first derivative boundary conditions $y'(0) = -4$ & $y'(3) = 23$.</td><td>Understand</td><td>2</td></tr>
<tr><td>3</td><td>Use Lagrange's interpolation formula estimate the value of f(155) from the following table
<table>
<tr><td>x</td><td>150</td><td>152</td><td>154</td><td>156</td></tr>
<tr><td>f(x)</td><td>12.247</td><td>12.329</td><td>12.410</td><td>12.490</td></tr>
</table></td><td>Understand</td><td>2</td></tr>
</table>

<table>
<tr><td>4</td><td>Distinguish between linear interpolation and spline interpolation with an example</td><td>Understand</td><td>2</td></tr>
<tr><td>5</td><td>Construct the natural cubic spline for the data (0,-4),(1,-3),(1.5,-0.25) and (2,4)</td><td>Understand</td><td>2</td></tr>
<tr><td>6</td><td>Calculate y(1.01), y(1.12) and y(1.28) from the following data:
<table>
<tr><td>X</td><td>1.00</td><td>1.05</td><td>1.10</td><td>1.15</td><td>1.20</td><td>1.25</td></tr>
<tr><td>y</td><td>1.000</td><td>1.02470</td><td>1.04881</td><td>1.07238</td><td>1.09544</td><td>1.11803</td></tr>
</table></td><td>Understand</td><td>2</td></tr>
<tr><td>7</td><td>Find the natural cubic spline interpolate to f at the point $x_0 = 0, x_1 = 1, x_2 = 2$ and $x_3 = 3$ where $f_0 = 0, f_1 = 1, f_2 = 1$ and $f_3 = 0$</td><td>Understand</td><td>2</td></tr>
<tr><td>8</td><td>Use Hermite's interpolation formula estimate the value of f(3.2) from the following table
<table>
<tr><td>x</td><td>3</td><td>3.5</td><td>4.0</td></tr>
<tr><td>f(x)</td><td>1.09861</td><td>1.25276</td><td>1.38629</td></tr>
<tr><td>$f'(x)$</td><td>0.3333</td><td>0.28571</td><td>0.25000</td></tr>
</table></td><td>Apply</td><td>2</td></tr>
<tr><td>9</td><td>Find the value of y at x = 0 given some set of values (-2, 5), (1, 7), (3, 11), (7, 34) by lagranges interpolation</td><td>Understand</td><td>2</td></tr>
<tr><td>10</td><td>Find the value of y at x = 5 given some set of values (3, 4), (5, 7) by linear interpolation</td><td>Understand</td><td>2</td></tr>
<tr><td colspan="4">Part - C (Problem Solving and Critical Thinking Questions)</td></tr>
<tr><td>1</td><td>Find the value of y at x = 4 given some set of values (2, 4), (6, 7) by linear interpolation</td><td>Understand</td><td>2</td></tr>
<tr><td>2</td><td>Find u_6 from u_1=22, u_2=30, u_4=82, u_7=106,u_8=206 by lagranges interpolation</td><td>Understand</td><td>2</td></tr>
<tr><td>3</td><td>Find x when y=100 using Lagranges interpolation formula, given that y(3)=6, y(5)=24, y(7)=58, y(9)=108, y(11)=174.</td><td>Understand</td><td>2</td></tr>
<tr><td>4</td><td>Find the cubic Hermite polynomial or "clamped cubic" that satisfies
p (1) = 2
p' (1) = 1
p (3) = 1
p' (3) = 2</td><td>Apply</td><td>2</td></tr>
<tr><td>5</td><td>Find the cubic spline approximation for the following data with M_0=0,M_2=0
<table>
<tr><td>x</td><td>0</td><td>1</td><td>2</td></tr>
<tr><td>f(x)</td><td>-1</td><td>3</td><td>27</td></tr>
</table></td><td>Understand</td><td>2</td></tr>
<tr><td>6</td><td>Fit a cubic spine to the following data
<table>
<tr><td>x</td><td>0</td><td>1</td><td>3</td></tr>
<tr><td>f(x)</td><td>1</td><td>0</td><td>2</td></tr>
</table>
Hence find $\int_0^3 f(x)dx$</td><td>Apply</td><td>2</td></tr>
<tr><td>7</td><td>Construct difference table for the following data.
<table>
<tr><td>x</td><td>0.1</td><td>0.3</td><td>0.5</td><td>0.7</td><td>0.9</td><td>1.1</td><td>1.3</td></tr>
<tr><td>f(x)</td><td>0.003</td><td>0.067</td><td>0.148</td><td>0.248</td><td>0.370</td><td>0.518</td><td>0.697</td></tr>
</table>
Evaluate f(0.6).</td><td>Understand</td><td>2</td></tr>
</table>

<table>
<tr><td>8</td><td>From the following table find y when x=1.35<table><tr><td>x</td><td>1</td><td>1.2</td><td>1.4</td><td>1.6</td><td>1.8</td><td>2</td></tr><tr><td>y</td><td>0.0</td><td>-0.112</td><td>-0.016</td><td>0.336</td><td>0.992</td><td>2</td></tr></table></td><td>Understand</td><td>2</td></tr>
<tr><td>9</td><td>Find f(22) from 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>f(x)</td><td>354</td><td>332</td><td>291</td><td>260</td><td>231</td><td>204</td></tr></table></td><td>Understand</td><td>2</td></tr>
<tr><td>10</td><td>Fit the cubic spline for the data<table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>f(x)</td><td>1</td><td>2</td><td>9</td><td>28</td></tr></table></td><td>Understand</td><td>2</td></tr>
<tr><td colspan="4">UNIT-III
FINITE DIFFERENCE METHOD AND APPLICATIONS</td></tr>
<tr><td colspan="4">Part - A (Short Answer Questions)</td></tr>
<tr><td>1</td><td>Define forward difference.</td><td>Remember</td><td>3</td></tr>
<tr><td>2</td><td>Define backward difference.</td><td>Remember</td><td>3</td></tr>
<tr><td>3</td><td>Define central difference.</td><td>Remember</td><td>3</td></tr>
<tr><td>4</td><td>Explain interpolating parabolas.</td><td>Remember</td><td>3</td></tr>
<tr><td>5</td><td>Explain derivation of differentiation formulae using Taylor series.</td><td>Remember</td><td>3</td></tr>
<tr><td>6</td><td>Explain boundary condition.</td><td>Remember</td><td>3</td></tr>
<tr><td>7</td><td>What is beam deflection?</td><td>Remember</td><td>3</td></tr>
<tr><td>8</td><td>What are characteristic value problems?</td><td>Remember</td><td>3</td></tr>
<tr><td>9</td><td>What is the solution of characteristic value problem?</td><td>Understand</td><td>3</td></tr>
<tr><td>10</td><td>Explain finite difference method.</td><td>Remember</td><td>3</td></tr>
<tr><td colspan="4">Part – B (Long Answer Questions)</td></tr>
<tr><td>1</td><td>Evaluate (i) $\Delta \tan^{-1} x$ (ii) $\Delta\,(e^{x} \log 2x)$</td><td>Understand</td><td>3</td></tr>
<tr><td>2</td><td>The following data gives the melting points of an alloy to lead and zinc<table><tr><td>x</td><td>0.20</td><td>0.22</td><td>0.24</td><td>0.26</td><td>0.28</td><td>0.30</td></tr><tr><td>f(x)</td><td>1.6596</td><td>1.6698</td><td>1.6804</td><td>1.6912</td><td>1.7024</td><td>1.7139</td></tr></table>Find the melting point of the alloy containing 54% of lead</td><td>Apply</td><td>3</td></tr>
<tr><td>3</td><td>Calculate $y'(1), y'(1.03)$ for the function y=f(x) given in the table<table><tr><td>x</td><td>0.96</td><td>0.98</td><td>1.00</td><td>1.02</td><td>1.04</td></tr><tr><td>y(x)</td><td>1.8025</td><td>1.7939</td><td>1.7851</td><td>1.7763</td><td>1.7673</td></tr></table></td><td>Apply</td><td>3</td></tr>
<tr><td>4</td><td>From the following table determine f (0.23) and f (0.29)<table><tr><td>x</td><td>0.20</td><td>0.22</td><td>0.24</td><td>0.26</td><td>0.28</td><td>0.30</td></tr><tr><td>f(x)</td><td>1.6596</td><td>1.6698</td><td>1.6804</td><td>1.6912</td><td>1.7024</td><td>1.7139</td></tr></table></td><td>Apply</td><td>3</td></tr>
<tr><td>5</td><td>Given the following table of values of x and y:<table><tr><td>x</td><td>0.35</td><td>0.40</td><td>0.45</td><td>0.50</td><td>0.55</td><td>0.60</td><td>0.65</td></tr><tr><td>y</td><td>1.0000</td><td>1.0247</td><td>1.0488</td><td>1.0723</td><td>1.0954</td><td>1.1180</td><td>1.1401</td></tr></table>Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at i) x=1.00 ii) x=1.25.</td><td>Apply</td><td>3</td></tr>
<tr><td>6</td><td>Approximate the derivative of the function f(x) = e^{-x} sin(x) at the point x = 1.0 using the centred divided-difference formula and Richardson</td><td>Understand</td><td>3</td></tr>
</table>

<table>
<tr><td></td><td>extrapolation starting with h = 0.5 and continuing using ε_{step} = 0.0001.</td><td></td><td></td></tr>
<tr><td>7</td><td>Describe Richardson extrapolation in derivative computation</td><td>Remember</td><td>3</td></tr>
<tr><td>8</td><td>Find the solutions of
$(u_x)^2+(u_y)^2=1$
in a neighborhood of the curve $y=\frac{x^2}{2}$ satisfying the conditions
$u(x,\frac{x^2}{2})=0,\quad u_y(x,\frac{x^2}{2})>0$
Leave your answer in parametric form</td><td>Understand</td><td>3</td></tr>
<tr><td>9</td><td>Solve the following Cauchy problem
$u_x+u_y^2+u_z^2=1$
$u(0,y,z)=y.z$</td><td>Understand</td><td>3</td></tr>
<tr><td>10</td><td>Find the solution of the following equation
$f_t+xf_x+3t^2f_y=0$
$f(x,y,0)=x^2+y^2$</td><td>Understand</td><td>3</td></tr>
<tr><td colspan="4">Part – C (Problem Solving and Critical Thinking)</td></tr>
<tr><td>1</td><td>Evaluate (i) $\Delta^2\left(\frac{5x+12}{x^2+5x+16}\right)$</td><td>Understand</td><td>3</td></tr>
<tr><td>2</td><td>Find $y^1(0)$ and $y^{11}(0)$ from the following table:
<table>
<tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>y</td><td>4</td><td>8</td><td>15</td><td>7</td><td>6</td><td>2</td></tr>
</table></td><td>Apply</td><td>3</td></tr>
<tr><td>3</td><td>Find the first and second derivatives of f(x) at x=1.5 if
<table>
<tr><td>x</td><td>1.5</td><td>2.0</td><td>2.5</td><td>3.0</td><td>3.5</td><td>4.0</td></tr>
<tr><td>f(x)</td><td>3.375</td><td>7.000</td><td>13.625</td><td>24.000</td><td>38.875</td><td>59.000</td></tr>
</table></td><td>Apply</td><td>3</td></tr>
<tr><td>4</td><td>Solve the initial value problem $y' = -2xy^2$, $y(0) = 1$ for y at x = 1 with step length 0.2 using Taylor series method of order four.</td><td>Understand</td><td>3</td></tr>
<tr><td>5</td><td>From the following table find the values of $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at x=2.03.
<table>
<tr><td>x</td><td>1.96</td><td>1.98</td><td>2.00</td><td>2.02</td><td>2.04</td></tr>
<tr><td>y</td><td>0.7825</td><td>0.7739</td><td>0.7651</td><td>0.7563</td><td>0.7473</td></tr>
</table></td><td>Apply</td><td>3</td></tr>
<tr><td>6</td><td>Approximate the derivative of the function f(x) = e^{-x} sin(x) at the point x = 1.0 use the backward divided-difference formula and Richardson extrapolation starting with h = 0.5 and continuing using ε_{step} = 0.0001.</td><td>Understand</td><td>3</td></tr>
<tr><td>7</td><td>From the following table determine y(1925) and y(1955)
<table>
<tr><td>x</td><td>1921</td><td>1931</td><td>1941</td><td>1951</td><td>1961</td></tr>
<tr><td>y(x)</td><td>46000</td><td>66000</td><td>81000</td><td>93000</td><td>101000</td></tr>
</table></td><td>Understand</td><td>3</td></tr>
<tr><td>8</td><td>Solve the initial value problem
$\frac{1}{2}u_x^2-u_y=-\frac{x^2}{2},$
$u(x,0)=x$
You will find that the solution blows up in finite time. Explain this in terms of the</td><td>Understand</td><td>3</td></tr>
</table>

	characteristics for this equation.		
9	Solve the following Cauchy problem $u_x + u_y + u_z^3 = x + y + z$ $u(x, y, 0) = xy$	Understand	3
10	Solve the following PDE for f(x,y,t) $f_t + xf_x + 3t^2 f_y = 0$ $f(x, y, 0) = x^2 + y^2$	Understand	3

UNIT-IV
NUMERICAL DIFFERENTIATION AND INTEGRATION

Part - A (Short Answer Questions)

1	Define difference methods on undetermined coefficients .	Remember	4
2	Define optimum choice of step length	Remember	4
3	Explain partial differentiation	Remember	4
4	Explain numerical integration.	Remember	4
5	Explain trapezoidal method in double integration.	Remember	4
6	What is Lagrange interpolation method.	Remember	4
7	Explain reduced integration method.	Remember	4
8	Explain composite integration method.	Remember	4
9	What is Gauss-Legendre are point formula?	Understand	4
10	Explain simpson's method in double integration.	Remember	4

Part – B (Long Answer Questions)

1	A differentiation rule of the form $hf'(x_2) = \alpha_0 f(x_0) + \alpha_1 f(x_1) + \alpha_2 f(x_3) + \alpha_3 f(x_4)$ w where $x_J = x_0 + Jh, J = 0,1,2,3,4$ is given determine the values of $\alpha_0, \alpha_1, \alpha_2$ and α_3 so that the rule is exact for a polynomial of degree u.	Understand	4
2	Using four point formula $f'(x_2) = \frac{1}{64}\{-2f(x_1) - 3f(x_2) + 6f(x_3) - f(x_4)\} + TE + RE$ where $x_J = x_0 + Jh_1 J = 1,2,3,4$ determine the form of TE and RE determine the total error.	Apply	4
3	A differentiation rule of the form $hf'(x_2) = \alpha_0 f(x_0) + \alpha_1 f(x_1) + \alpha_2 f(x_3) + \alpha_3 f(x_4)$ w where $x_J = x_0 + Jh, J = 0,1,2,3,4$ is given determine the values of $\alpha_0, \alpha_1, \alpha_2$ and α_3 so that the rule is exact for a polynomial of degree u and also obtain expression for the round-off error in calculating $f'(x_2)$.	Apply	4
4	Find the Jacobian matrix for the system of equations $f_1(x, y) = x^3 + xy^2 - y^3 = 0;\ f_2(x, y) = xy + 5x + 6y = 0$ at (1,2) and (1/2, 1).	Apply	4
5	If f(x) has a minimum in the interval $x_{n-1} \le x \le x_{n+1}$ and $x_k = x_0 + kh$ show that the interpolation of f(x) by a polynomial of second degree yields the approximation $f_n - \frac{1}{8}\left\{\frac{(f_{n+1} - f_{n-1})}{f_{n+1} - 2f_n + f_{n-1}}\right\}$ for this minimum value	Apply	4

	of f(x).		
6	Find the approximate value of $I=\int_0^1 \frac{dx}{1+x}$ using trapezoidal rule and obtain a bound for the errors.	Understand	4
7	Using optimum choice of step length method $f'(x_0)=\frac{-3f(x_0)+4f(x_1)-f(x_2)}{2h}+\frac{h^2}{3}f'''(g)r_0 < g < x_2$ determine the optimal value of h using the criteria $\lvert RE\rvert=\lvert TE\rvert$ $\lvert RE\rvert+\lvert TE\rvert=$ minimum.	Understand	4
8	Determine $a,b,c \in \int_0^h f(x)dx = h\left[af(0)+bf\left(\frac{h}{3}\right)+cf(h)\right]$ is exact for polynomials of as high order as possible and determine the order of the truncation error.	Understand	4
9	Using four point formula $f'(x_2)=\frac{1}{64}\{-2f(x_1)-3f(x_2)+6f(x_3)-f(x_4)\}+TE+RE$ where $x_J=x_0+Jh_1J=1,2,3,4$ determine the form of TE and RE.	Understand	4
10	Evaluate $\int_0^1 \frac{dx}{2x^2+2x+1}$ using Radau three point formula	Understand	4
Part – C (Problem Solving and Critical Thinking)			
1	A differentiation rule of the form $hf'(x_2)=\alpha_0 f(x_0)+\alpha_1 f(x_1)+\alpha_2 f(x_3)+\alpha_3 f(x_4)$ w where $x_J=x_0+Jh, J=0,1,2,3,4$ is given determine the values of $\alpha_0,\alpha_1,\alpha_2$ and α_3 so that the rule is exact for a polynomial of degree u and also find the error term.	Understand	4
2	A differentiation rule of the form $hf'(x_2)=\alpha_0 f(x_0)+\alpha_1 f(x_1)+\alpha_2 f(x_3)+\alpha_3 f(x_4)$ w where $x_J=x_0+Jh, J=0,1,2,3,4$ is given determine the values of $\alpha_0,\alpha_1,\alpha_2$ and α_3 so that the rule is exact for a polynomial of degree u and calculate $f'(0.3)$ using five place values of $f(x)=\sin x$ with h =0.1.	Apply	4
3	Using optimum choice of step length method $f'(x_0)=\frac{-3f(x_0)+4f(x_1)-f(x_2)}{2h}+\frac{h^2}{3}f'''(g)r_0 < g < x_2$ determine the optimal value of h using the criteria $\lvert RE\rvert=\lvert TE\rvert$.	Apply	4
4	Using optimum choice of step length method $f'(x_0)=\frac{-3f(x_0)+4f(x_1)-f(x_2)}{2h}+\frac{h^2}{3}f'''(g)r_0 < g < x_2$ determine the optimal value of h using the criteria $\lvert RE\rvert=\lvert TE\rvert$ and determine	Understand	4

	$f'(2.0)$ from the following tabulated values $f(x) = \log x$. $\begin{array}{\|c\|c\|c\|c\|c\|} \hline x & 2.0 & 2.01 & 2.02 & 2.06 \\ \hline f(x) & 0.6931 & 0.6981 & 0.7031 & 0.7227 \\ \hline \end{array}$		
5	Using four point formula $f'(x_2) = \frac{1}{64}\{-2f(x_1) - 3f(x_2) + 6f(x_3) - f(x_4)\} + TE + RE$ where $x_J = x_0 + Jh_1 J = 1,2,3,4$ determine the form of TE and RE obtain the optimum step length satisfying $\|TE\| = \|RE\|$.	Apply	3
6	Find the Jacobian matrix for the system of equations $f_1(x,y) = x^2 + y^2 - x = 0$; $f_2(x,y) = x^2 - y^2 - y = 0$ at (1, 1) using $\left(\frac{\partial f}{\partial x}\right)_{(x_i + y_J)} = \frac{f_{i+J} - f_{i+J}}{2h}$ and $\left(\frac{\partial f}{\partial y}\right)_{(x_i, y_J)} = \frac{f_{i,J+1} - f_{i,J-1}}{2k}$ with h = k=1.	Understand	4
7	Find the Jacobian matrix for the system of equations $f_1(x,y) = x^2 - y^2 + xy = 0$; $f_2(x,y) = 3x^2 + 5y^2 + x = 0$ at (1,2) and (1/2, 1).	Understand	4
8	$I = \int_0^1 \frac{xinx}{x} dx$ simpson's rule.	Understand	4
9	Evaluate the integral $I = \int_1^2 \frac{2xdx}{1+x^4}$ using the Gauss-Legendre are point formula.	Understand	4
10	Evaluate $\int_0^\infty \frac{e^{-x}}{1+x^2} dx$ using the Gauss-Legendre 2 point formula.	Understand	4

UNIT-V
ORDINARY DIFFERENTIAL EQUATION

Part - A (Short Answer Questions)

1	Define ordinary differential equation	Remember	5
2	Explain Euler's method	Remember	5
3	Explain backward Euler's method	Remember	5
4	Explain mid-point method.	Remember	5
5	Explain single step method.	Remember	5
6	What is Taylor's series method.	Remember	5
7	Define boundary value problem.	Remember	5
8	How many types of boundary value problems are there. What are they?	Remember	5
9	What is the difference between Euler's method and backward Euler's method .	Understand	5
10	What is the difference between mid-point method and single step method.	Remember	5

Part – B (Long Answer Questions)

1	Use the Euler method to solve numerically the initial value problem $u^1 = -2u^2 t, u(0) = 1$ with h = 0.2 on the interval [0, 1].	Understand	5
2	Solve $y^1 = -y^2, y(1) = 1$ using mid-point method with h = 0.1 to get y(1.2).	Apply	5

<table>
<tr><td>3</td><td>Solve the initial value problem $u^1 = -2u^2 t, u(0) = 1$ with h = 0.2 on the interval [0, 0.4] using backward Euler method.</td><td>Apply</td><td>5</td></tr>
<tr><td>4</td><td>Find single step method for the differential equation $y^1 = f(t,y)$ which produce exact results for $y(t) = a + be^{-t}$ for $y(t) = a + b\cos t + c\sin t$.</td><td>Apply</td><td>5</td></tr>
<tr><td>5</td><td>Given the initial value problem $u^1 = u^2 + t^2, u(0) = 0$. Determine first three non-zero terms in the Taylors series for u(t) and hence obtain the value for u(1).</td><td>Apply</td><td>5</td></tr>
<tr><td>6</td><td>Using midpoint method find y(0.8) given $\frac{dy}{dx} = \sqrt{x+y}, y(0.4) = 0.41$ with h = 0.2.</td><td>Understand</td><td>5</td></tr>
<tr><td>7</td><td>Using backward Euler method find y(1, 3) given that $y' = x^2 + y^2, y(1) = 2$ with step size h = 0.3.</td><td>Understand</td><td>5</td></tr>
<tr><td>8</td><td>Given that $y' = xy, y(0) = 1$ using midpoint method compute y(0.3) with h = 0.3.</td><td>Understand</td><td>5</td></tr>
<tr><td>9</td><td>Using the shooting method solve the first boundary value problem $u'' = u + 1, 0 < x < 1$ and $u(0) = 0, u(1) = e - 1$ use the Euler method with h = 0.25 to solve the resulting system of first order initial value problems. Compare the solution with the exact solution $u(x) = e^x - 1$.</td><td>Understand</td><td>5</td></tr>
<tr><td>10</td><td>Use shooting method solve $u'' = u' + 2u, 0 < x < 1$ and $u'(0) = 1, u'(1) = \frac{1}{3}\left(2e^2 + \frac{1}{e}\right)$. Calculate the solution of the IVP analytically. The exact solution is $u(x) = \frac{1}{3}\left(e^{2x} - \frac{1}{e^x}\right)$.</td><td>Understand</td><td>5</td></tr>
<tr><td colspan="4">Part – C (Problem Solving and Critical Thinking)</td></tr>
<tr><td>1</td><td>Solve $y^1 = t + y, y(1) = 0$ using the backward Euler method with h = 0.1 to get y(1.2)</td><td>Understand</td><td>5</td></tr>
<tr><td>2</td><td>Solve the initial value problem $y^1 = \frac{t}{y}, y(0) = 1$ using Euler method with h = 0.2 to get y(0.2).</td><td>Apply</td><td>5</td></tr>
<tr><td>3</td><td>Find single step method for the differential equation $y^1 = f(t,y)$ which produce exact results for $y(t) = a + be^{-t}$.</td><td>Apply</td><td>5</td></tr>
<tr><td>4</td><td>Given the initial value problem $u^1 = u^2 + t^2, u(0) = 0$. Determine first three non-zero terms in the Taylors series for u(t).</td><td>Understand</td><td>5</td></tr>
<tr><td>5</td><td>Find the three term Taylors series solution for the third order initial value problem $w''' + ww'' = 0, w(0) = 0, w'(0) = 0, w''(0) = 0$ find the bound on the error for $t \in [0, 0.2]$.</td><td>Apply</td><td>5</td></tr>
<tr><td>6</td><td>Find the values of y(0.2) and u(0.2) for the systems of equations $y' = u, y(0) = 1$ and $u' = -4y - 2u, u(0) = 1$ using Euler's method.</td><td>Understand</td><td>5</td></tr>
<tr><td>7</td><td>In a computation with Euler method the following results are obtained with various step sizes. Compute a better estimate by extrapolation.<table><tr><td>h</td><td>$\frac{1}{4}$</td><td>$\frac{1}{8}$</td><td>$\frac{1}{16}$</td></tr></table></td><td>Understand</td><td>5</td></tr>
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<tr><td></td><td><table><tr><td>u</td><td>2.4414</td><td>2.5657</td><td>2.6379</td></tr></table></td><td></td><td></td></tr>
<tr><td>8</td><td>Given the equation $y' = x + \sin y, y(0) = 1$ show that it is sufficient to use Euler method with step size h = 0.2 to compute y(0.2).</td><td>Understand</td><td>5</td></tr>
<tr><td>9</td><td>Use shooting method to solve the mixed boundary value problem $u'' = 4u - 4xe^x, 0 < x < 1$ and $u(0) - u'(0) = -1, u(1) + u'(1) = -e$ use the Taylor's series method $u_{J+1} = u_J + hu_J^1 + \frac{h^2}{2}u_J^{11} + \frac{h^3}{6}u_J^{111}$,
$u_{J+1}^1 = u_J^1 + hu_J^{11} + \frac{h^2}{2}u_J^{111}$ to solve initial value problem take h = 0.25.
Compare with the exact solution $u(x) = xe^x(1-x)$.</td><td>Understand</td><td>5</td></tr>
<tr><td>10</td><td>Using shooting method solve $u'' = 4(u-1), 0 < x < 1$ and u(0) = 2, u(1) = 1+e^2 use Euler method with $h = \frac{1}{3}$.</td><td>Understand</td><td>5</td></tr>
</table>

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