EASWARI ENGINEERING COLLEGE
Ramapuram, Chennai – 600 089

MA 2264 – Numerical Methods
Question Bank

Part – A

UNIT-I

1. If g(x) is continuous in [a, b], then under what condition the iterative method x = g(x) has a unique solution in [a, b] ?
2. Compare Gauss – Jacobi and Gauss – Seidel methods for solving linear systems of the form AX = B.
3. Find the dominant Eigen value of $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ by Power methods.
4. Using Newton's method find the root between 0 and 1 of $x^3=6x-4$, performing 2 iterations.
5. Solve the linear system 4x-3y = 11, 3x+2y = 4 by Guass Jordan method.
6. State the condition for convergence of gauss-Seidel method.
7. What is the condition for solving f(x) = 0 by Iterative method ?
8. Compare Gaussian elimination and Gauss-Jordon methods in solving the linear system Ax = B.
9. If g(x) is continuous in [a,b], then under what condition the interative method x = g(x) has a unique solution in [a, b] ?
10. Solve 3x + y = 2, x+3y = -2 by Gauss Seidel iteration method.

UNIT-II

1. Construct a linear interpolating polynomial given the points (x_0, y_0) and (x_1, y_1).

2. Given (x_0, y_0) (x_1, y_1) (x_2, y_2) write the Lagrange's interpolation formula.

3. Show that $\Delta \frac{1}{a} = -\frac{1}{abcd}$.

4. Obtain the divided difference table for the given data

x	:	0	2	3	4
f(x)	:	4	26	58	112

5. Define cubic- Spline interpolation.

6. Determine the cubic spline interpolation for f(0) =0, f(1) =1, f(2) =2.

7. Write down the Inverse Interpolation formula.

8. Define Divided Difference.

9. Find the second Divided difference with arguments a, b, c if f(x)=$\frac{1}{x}$.

10. State Newton's forward and Backward difference formula.

UNIT-III

1. Evaluate $\int_{-2}^{2} e - x/2$ dx by Gauss 2pt formula.

2. State simpson's $\frac{1}{3} rd$ and $\frac{3}{8} th$ Rule for Numerical integration

3. Given f_{00}, f_{01}, f_{02}, f_{10}, f_{11}, f_{12}, f_{20}, f_{21}, f_{22}, define trapezoidal rule for double integration to evaluate $I = \iint f(x, y)dxdy$.

4. Write the formula for $\frac{dy}{dx}$ at x = x_0 using forward difference operator.

5. How will you divide the range for finding $\int_{b}^{b} ydx$ by Simpson's $\frac{3}{8} th$ rule ?

6. State the Three Point Guassian Quadrature formula.

7. What is Romberg's Integration? How does it improve the accuracy of integration?

8. Evaluate $\int_0^1 y dx$ from the table by Trapezoidal rule

x	:	0	0.25	0.5	0.75	1
y	:	1	0.9412	0.8	0.64	0.5

9. State the order of truncation error in numerical integration by Trapezoidal rule and Simpson's rule.

10. What are the errors in Trapezoidal and Simpson's rule of numerical integration ?

UNIT-IV

1. Solve $\frac{dy}{dx} = 1 - y$ given y(0) – 0 for y(.1) using modified Euler's method.

2. State Adam's Bashforth Predictor-Corrector formulae to solve the equation y' = f(x, Y) with given starting values.

3. Solve $\frac{dy}{dx}$ = x + y , y(0) = 1 to find y(0.2) using Euler's method

4. List the merits and demerits of Taylor Series method.

5. Why do you call Adam's method as a Multi-step method ?

6. Write down the formula to solve 2nd order differential equation using Runge-Kutta method of 4^{th} order.

7. How do you apply Runge-Kutta method of order form to solve $y^{''} = f(x, y, y^{1}), y(x_0) = y_0 and y^{'}(x_0) = y_0^{'}$.

8. Compare the Milne's predictor-corrector and Adam- Bashforth predictor corrector methods for solving ordinary differential equations.
9. Write Milne's Predictor-Corrector formula.
10. In solving $\frac{dy}{dx} = f(x,y), y(x_0) = y_0$. Write down Taylor series for $y(x_1)$

UNIT-V

1. Give the Crank-Nicholson difference shceme to solve the parabolic differential equation.
2. Name the methods used for solving one-dimensional heat equation numerically.
3. Express Laplace equation using finite differences
4. Obtain finite difference scheme to solve $u_{xx} + u_{yy} = 0$.
5. Write down Crank-Nicholson difference scheme to solve $u_{xx} = a\, u_t$ when $k = h^2$.
6. Write down the diagonal five point formula to solve the equation $u_{xx} + u_{yy} = 0$.
7. Write down the Implicit formula to solve one dimensional heat flow equation $u_{xx} = a\, u_t$.
8. What is the order of convergence of Crank-Nicolson method for solving parabolic partial differential equation $u_i - \alpha^2 u_{xx} = 0$, $0<x<l$, $0<t<T$, subject to $u(0,t)=u(l,t)$, $0<t<T$ and $u(x,0) = f(x)$, $0<x<l$?
9. Write down the finite difference scheme for solving the Poisson equation $\nabla^2 u = f(x,y)$ on $R = \{(x,y) \mid a<x<b, c<y<d\}$ with $u(x,y) = g(x,y)$ for $(x,y) \in S$ where S denotes the boundary of R.

10.Write the standard five points formula to solve the Laplace equation

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0.$$

Part –B

UNIT-I

1. Solve by Gauss elimination method 3x+4y+5z=18, 2x-y+8z=13, 5x-2y+7z=20.
2. Solve by Gauss-Seidel method 28x+4y-z=32, x+3y+10z=24, 2x+17y+4z=35.
3. Using Newton Raphson method, find the root between 0 and 1 of $x^2 = 6x - 4$ correct to 4 decimal places.
4. Find the real root of the equation $x^3 - 2x - 5 = 0$ by the method of false position, correct to thre decimal places.
5. Determine the largest eigen values and the corresponding eigen vectors of the matrix A = $\begin{pmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{pmatrix}$ using the power method.
6. Solve by Jacobi's iteration method, the equations :

   20x + y - 2z = 17

   3x + 20y - z = -18

   20z + 2x – 3y = 25
7. using Gauss –Jordan method find the inverse of the matrix

$$\begin{pmatrix} 2 & 1 & 1 \\ 3 & 2 & 3 \\ 1 & 4 & 9 \end{pmatrix}$$

UNIT-II

1. Find y = f(x) of least degree passing through the points (-1, -21), (1, 15), (2, 12) and (3, 3).
2. From the following table, evaluate f(3.8) using Newton backward interpolation formula.

x	:	0	1	2	3	4
y	:	1.00	1.50	2.20	3.10	4.60

3. From the following table, estimate the value of y(46) and y(63) Using Newtond's difference formula.

X	45	50	55	60	65
Y	114.84	96.16	83.32	74.48	68.48

4. Find the cubic polynomial f(x) for the following data by Newton's divided difference formula and hence determine f(2) :

x	:	0	1	3	4
y	:	1	4	40	85

5. obtain the root of f(x) = 0 by Lagrange Inverse Interpolation given that f(30) = -30, f(34) = -13, f(38) = 3, f(42) = 18.
6. Find f(x) as a polynomial in x for the following data by Newton's divided difference formula.

x	:	-4	-1	0	2	5
f(x)	:	1245	33	5	9	1335

UNIT-III

1. Find y’ , y’’ at x = 1.5 given

x	:	1.5	2.0	2.5	3.0	3.5	4.0
y	:	3.375	7.0	13.625	24.0	38.875	59

2. Evaluate $\int_1^2 \frac{dx}{x}$ using Gausian quadrature three point formula.
3. Evaluate $\iint e^{x+y} dxdy$ using Trapezoidal and Simpson

   Rule taking h=0.5.
4. .Evaluate $\iint \frac{2xydxdy}{(1+x^2)(1+y^2)}$ by Trapezoidal rule with h = k = 0.25.
5. 63.Find the value of sec31 from the following data :

$\theta°$	:	31	32	33	34
$\tan\theta$	:	0.6008	0.6249	0.6494	0.6745

6. 64.Using Simpson’s $\frac{3}{8}$th rule evaluate $\int_0^6 \frac{dx}{1+x^2}$, by dividing the range into 6 equal parts.
7. 65.Find the maximum and minimum vale of y tabulated below :

x	:	-2	-1	0	1	2	3	4
y	:	2	-0.25	0	-0.25	2	15.75	56

UNIT-IV

1. Using Taylor’s series solve $\frac{dy}{dx}$ = $x^2 + y^2$, y(0)=1 for y(.1).
2. Solve y’’ + xy’ + y = 0, y’(0)=0 for y(.1) using R-K method.
3. By applying R-K method find y(.1) given y’ = y-x, y(0) = 2.
4. Find y(.8) by Milne’s method, given y’ = y – x^2 y(0)=1 y(.2)=1.4682 y(.6)=1.7373.

5. Using Taylor's series method, obtain the value of y at x = 0.2 correct to four decimal places, if y satisfies the equation $\frac{\partial^2 x}{\partial x^2} = xy$given that $\frac{dy}{dx}$ = 1 and

   y = 1 when x = 0.

6. Using Adam's method find y(0.4) given $\frac{dy}{dx} = \frac{1}{2}xy$, y(0) = 1, y(0.1)=1.01, y(0.2) = 1.022, y(0.3) = 1.023.

7. Consider y^{11}-2y^1 + 2y = e^{2t} sin t with y (0) = -0.4 y^1 (0) = -0.6 find y (0.1) (Using taylor series method) y (0.2), (Runge kutta method) .

8. Using Modified Euler method find y when x = 0.1 given that y(0)=1 and $\frac{dy}{dx} = x^2 + y.$

9. Determine the value of y(0.4) using Milne's predictor and corrector method given y' = xy + y^2, y(0) = 1, y(0.1) = 1.1167, y(0.2) = 1.2767, y(0.3) = 1.5023.

10. Given $\frac{dy}{dx} = x^2(1+y)$, y(1) = 1, y(1.1) = 1.233, y(1.2) = 1.548, y(1.3)=1.979 evaluate y(1.4) by Adams-Bashforth method.

UNIT-V

1. Solve u_{xx} + u_{yy} = 0 over the square mesh of side 4 units satisfying the following boundary conditions :
   1) u(0, y) = 0 for 0≤y≤4
   2) u(4, y) = 12 + y for 0≤y≤4
   3) u(x, 0) = 3x for 0≤y≤4
   4) u(x, 4) = x^2 for 0≤y≤4.

2.. Solve numerically $4u_{xx} = u_{tt}$ with the boundary condition u(0,t)=0, u(4,t)=0 and the initial conditions u_t (x,0)=0 and u(x,0)=x(4-x), taking h = 1.

3. Solve $u_t = u_{xx}$ subject to u(0,t)=0, u(1,t)=0 and u(x,0)=sinπ x, 0<x<1 (do upto 5 times steps), taking h = 0.2.

4. Solve $\nabla^2 u = 8x^2 y^2$ for square mesh given u = 0 on the 4 boundaries dividing the square into 16 sub squares of length one unit as show in figure

	U_1	U_2	U_1
	U_2	U_3	U_2
	U_1	U_2	U_1

5. Solve the Poisson equation $\nabla^2 u = -10(x^2 + y^2 + 10)$ over square sides x = 0, x = 3, y = 0, y = 3 with u = 0 on the boundary with unit mess-length.

6. Derive explicit scheme to solve parabolic equation $u_{xx} = \frac{1}{c^2} u_t$.

7. Solve $y_{tt} = y_{xx}$ up to t = 0.5 with a spacing of 0.1 subject to y(0,t)=0, y(1,t)=0, y_t(x,0)=0 and y(x,0)=10+x(1-x).

8. Solve $u_{xx} = a\, u_t$ given u(0, t) = 0 = u(4, t) , u(x, 0) = x(4-x). Assume h=1. Find the values of u upto t=5.

Format No: **Issue No :** **Issue Date :**

EASWARI ENGINEERING COLLEGE CHENNAI-89
DEPARTMENT OF MATHEMATICS
QUESTION BANK

SUBJECT CODE	**: MA-2264**
NAME OF THE SUBJECT	**: NUMERICAL METHODS**
REGULATION	**: 2008**
COURSE / BRANCH	**: B.E./B.TECH** **CSE,IT&ECE**
SEMESTER	**: VI SEMESTER**
ACADEMIC YEAR	**: JAN2015-APR 2016**
STAFF INCHARGE	**:S.ARULMOZHI**
PREPARED BY:	**APPROVED BY:**
	HOD/MATHS
S.ARULMOZHI	

Format No:
Issue No :
Issue Date :

EASWARI ENGINEERING COLLEGE , CHENNAI - 89
DEPARTMENT OF MATHEMATCS

Lesson plan

Subject Code : MA 2264
Subject Title : NUMERICAL METHODS
Course/Branch : BE/BTECH/CSE,IT,ECE.
Semester : VI
Academic Year : 2015 - 2016.
Faculty Name : **S.ARULMOZHI**

LECTURE: 45
TUTORIAL :15
BEYOND THE SYLLABUS:5
TOTAL:65

TOPIC NO	NAME OF THE TOPIC	NO.OF HOURS	REFERENCE BOOK	PAGE NO
OBJECTIVE: On completion of the unit the students are understand effectively the concept of the roots of nonlinear (algebraic or transcendental) equations, solutions of large system of linear equations and eigen value problem of a matrix can be obtained numerically where analytical methods fail to give solution.				
UNIT-I **SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS**				
1.	Introduction to Numerical solution of Algebraic and Transcendental Equation.	1	T2	29
2.	Simple Iterative method.	1	T2	15
3	Newton-Raphson method for single variable.	1	T2	17
4.	Solution of a linear system by Gaussian elimination Method.	1	T2	30
5.	Gauss-Jordan Method	1	T2	45

6.	Gauss-Jacobi Method	1	T2	40
7.	Inverse of a matrix by Gauss Jordan method.	1	T2	47-49
8	Eigen value of a matrix by power Method .	1	T2	54-64
10	Eigen value of a matrix Method and by Jacobi method of symmetric matrix.	1	T2	54-64
11.	Tutorials.	3		
12	Applications of Eigen value problem.	1		
	TOTAL HOURS	13		
UNIT-II INTERPOLATION AND APPROXIMATION				
OBJECTIVE: At the end of the unit the students would be acquainted with the basic concepts ,When huge amounts of experimental data are involved, the methods discussed on interpolation will be useful in constructing approximate polynomial to represent the data and to find the intermediate values.				
1.	Finite differences,forward,bacward central differences, interpolation.	1	T2	84
2.	Newton forward difference formulae	2	T2	84-87
3.	Backward difference formulae	2	T2	84-87
4.	Newton’s divided difference formulae	1	T2	105-109
5.	Lagrange’s polynomial	1	T2	100-103
6.	Cubic spline method	2	T2	112-113
7.	Tutorials	3		
8	Applications of Interpolation and Approximation.	1		

	TOTAL HOURS	13		
UNIT-III NUMERICAL DIFFERENTIATION AND INTEGRATION				
OBJECTIVE: On completion of the unit the students are understand effectively the concept of the numerical differentiation and integration find application when the function in the analytical form is too complicated or the huge amounts of data are given such as series of measurements, observations or some other empirical information. I				
1.	Numerical Differentiation – Newton's forward & backward formula.	1	T2	122-128
2.	Newton's formulae & divided difference.	1	T2	128
3.	Simpson's1/3 rd and 3/8 rule.	1	T2	137
4.	Trapezoidal Rule.	1	T2	136
5.	Gaussian quadrature – two point .and three point formulae.	1	T2	8.33
6.	Three point formulae.	1	T2	
7.	Romberg's Method.	1	T2	142
8.	Double integrals – Trapezoidal rule	1	T2	143
9.	Double integrals Simpson's rule	1	T2	143
10.	Tutorials	3		
	Applications of Numerical Differention and Integration	1		
	TOTAL HOURS	13		

UNIT-IV **INITIAL VALUE PROBLEMS FOR ORDINARY DIFFRENTIAL EQUATIONS**				
1.	Introduction to Numerical Solution of ordinary differential equation.	1	T2	149
2.	Taylor series method.	2	T2	150
3.	Euler’s method	2	T2	152
4.	Runge kutta method first and second order.	2	T2	162
6.	Milne’s predictor corrector method.	1	T2	165
7.	Adams predictor corrector method.	1	T2	169
8.	Tutorials	3		
	Applications of Initial value problem.	1		
	TOTAL HOURS	13		
UNIT-V **BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS**				
1.	Finite difference solution for second order ordinary differential equation.	1	T2	177
2.	Finite difference solution for one demensiaonal heat equation – explicit method.	1	T2	183
3.	Implicit method.	1	T2	188
4.	One dimensiaonal wave equation.	2	T2	190
5.	Laplace equation.	2	T2	199-200
6.	Poisson Equation.	2	T2	199-200
7.	Tutorials.	3		
8.	Applications of ODE & PDE.	1		
	Total Hours	13		

TEXT BOOKS:

T1: Veerarajan.T and Ramachandran.T ,"Numerical Methods With Programming In C"Second Edition.TataMc Graw –Hill Publishing.co.
Ltd.

T2: Sankara Rao.K," Numerical Methods for scientists and Engineers"-3rd Edition

Printice Hall of India Pvt Ltd,New Delhi,(2007).

PREPARED BY: **APPROVED BY:**