SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Department of Applied Mathematics			LP: MA18182
M.E/M.Tech	: CAD/ICE/Mechatronics	Regulation: 2018	Rev. No: 00
Sub. Code / Sub. Name	: MA18182/ Advanced Numerical Methods		Date: 05.01.21
Unit I	: ALGEBRAIC EQUATION		

Unit Syllabus: Systems of linear equations: Gauss Elimination method, pivoting techniques, Thomas algorithm for tridiagonal system – Gauss Seidel, SOR iteration methods - Systems of nonlinear equations: Fixed point iterations, Newton Raphson Method, Graffe's root squaring method, Eigen value problems: power method, inverse power method, Faddeev – Leverrier Method.

Objective: To introduce the concept of numerical solution of algebraic equation.

Session No *	Topics to be covered	Ref	Teaching Aids
1	Introduction- Systems of linear equations-Gauss Elimination method	1 – Ch.2; Pg.37– 41	LCD
2	pivoting techniques	1 – Ch.2; Pg.37-41	LCD
3	Thomas algorithm for tridiagonal system	1 – Ch.2; Pg.55-57 &2-Ch.1;pp.10-12	LCD
4	Tutorial class	1 – Ch.2; Pg.55-57 &2-Ch.1;pp.10-12	LCD/BB
5	Gauss Seidal method	1 – Ch.2; Pg.63 – 66	LCD
6	Gauss Seidel method	1 – Ch.2; Pg.63-66 &2-Ch.1-2-Ch.1-pp.17-18	LCD
7	SOR iteration methods	1 – Ch.2; Pg.67-74 & 2-ch.1-pp.17-20	LCD
8	Tutorial class	1 – Ch.2; Pg.67-74 & 2-ch.1-pp.17-20	LCD/BB
9	Systems of nonlinear equations: Fixed point iterations	1 – Ch.3-pp.152-153 & 2-Ch.pp.64-66;	LCD
10	Newton Method, Graffe's root squaring method	1 – Ch.3; Pg.154-156& 2-Ch.3-pp.73-75 Pg.2.47 – 2.72	LCD
11	Eigenvalue problems: power method, inverse power method	1 – Ch.2; pp.82-88 &2-Ch.2-pp.32-34	LCD
12	Faddeev – Leverrier Method.	1 – Ch.2; Pg.87-89 &2-Ch.2-pp.32-34	LCD/BB
Content beyond syllabus covered (if any):			

*** Session duration: 50 minutes**

Sub. Code / Sub. Name: **MA18182/ Advanced Numerical Methods**
Unit II : ORDINARY DIFFERENTIAL EQUATIONS

Unit Syllabus: Runge Kutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep method, solution of stiff ODEs, shooting method, BVP: Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

Objective: To know how to apply numerical methods to solve ordinary differential equations..

Session No *	Topics to be covered	Ref	Teaching Aids
13	Runge Kutta Methods I and II order for system of IVPs,	1 – Ch.6;Pg. 333-340 & 2- Ch.5-pp.167-172	LCD
14	Runge Kutta Methods III and IV order for system of IVPs,	1 – Ch.6;Pg. 333-340 & 2- Ch.5-pp.167-172	LCD
15	Stability analysis of R.K. methods	1 – Ch.6;Pg. 350-355 & 2- Ch.5-pp.178-185	LCD
16	Adams-Bashforth multistep method	1 – Ch.6;Pg. 385-388 & 2- Ch.5-pp.157-160	LCD
17	Tutorial class	1 – Ch.6;Pg. 385-388 & 2- Ch.5-pp.157-160	LCD/BB
18	solution of stiff ODEs	2- Ch.5-pp.187-188	LCD
19	shooting method	1 – Ch.6;Pg. 417-419 2- Ch.6-pp.260-264	LCD
20	BVP: Finite difference method	2- Ch.6-pp.218-225	LCD/BB
21	orthogonal collocation method	2- Ch.6-pp.229-238	LCD
22	orthogonal collocation with finite element method	2- Ch.6-pp.246-250	LCD
23	Galerkin finite element method.	2- Ch.6-pp.252-259	LCD
24	Tutorial class	2- Ch.6-pp.252-259	LCD/BB
	CAT-I		

Content beyond syllabus covered (if any):

*** Session duration: 50 mins**

Sub. Code / Sub. Name: **MA18182/ Advanced Numerical Methods**

Unit III : FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATION

Unit Syllabus:. Parabolic equations: explicit and implicit finite difference methods, weighted average approximation - Dirichlet and Neumann conditions – Two dimensional parabolic equations – ADI method; First order hyperbolic equations – method of characteristics, different explicit and implicit methods; numerical stability analysis, method of lines – Wave equation: Explicit scheme- Stability of above schemes

Objective: To know how to apply numerical methods to solve parabolic and hyperbolic PDE

Session No *	Topics to be covered	Ref	Teaching Aids
25	Parabolic equations: explicit and implicit finite difference methods	4 – Ch.2.pp.14-25;	LCD
26	weighted average approximation	4 – Ch.2.pp.14-25;	LCD
27	Dirichlet and Neumann conditions	4 – Ch.1; Pg.5-6	LCD
28	Tutorial class	4 – Ch.2.pp.14-25;	LCD/BB
29	Two dimensional parabolic equations – ADI method	4 – Ch.2; Pg.41-45	LCD
30	.First order hyperbolic equations – method of characteristics	4 – Ch.3; Pg.79-84	LCD
31	different explicit and implicit methods;	4 – Ch.3.pp.69-91;	LCD
32	Tutorial class	4 – Ch.3.pp.69-91;	LCD/BB
33	numerical stability analysis, method of lines	4 – Ch.2.pp.25-48;	LCD
34	Wave equation: Explicit scheme	4 – Ch.3; Pg.69-73	LCD
35	Stability Analysis of above schemes	4 – Ch.3; Pg.69-91	LCD
36	Tutorial class	4 – Ch.3; Pg.69-91	LCD/BB
Content beyond syllabus covered (if any): Nil			

* Session duration: 50 mins

Sub. Code / Sub. Name: **MA18182 / ADVANCED NUMERICAL METHODS**

Unit IV : FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS

Unit Syllabus: Laplace and Poisson's equations in a rectangular region: Five point finite difference schemes, Leibmann's iterative methods, Dirichlet and Neumann conditions – Laplace equation in polar coordinates: finite difference schemes – approximation of derivatives near a curved boundary while using a square mesh.

Objective: To know how to apply numerical methods to solve elliptic PDE

Session No *	Topics to be covered	Ref	Teaching Aids
37	Introduction-Elliptic equations-Laplace equation	4 – Ch.4; Pg.103-108	LCD
38	Poisson's equation	4 – Ch.4; Pg.103-108	LCD
39	Standard five point and diagonal five point formula	4 – Ch.4; Pg.103-108	LCD
40	.Leibmann's iterative methods	3-Ch.12-pp.713-720	LCD/BB
41	Tutorial class	3-Ch.12-pp.713-720	LCD
42	Dirichlet and Neumann conditions	4 – Ch.4; Pg.103-108	LCD
43	Laplace equation in polar coordinates	4 – Ch.4; Pg.110-115	LCD
44	.finite difference schemes	4 – Ch.4; Pg.110-115	LCD
45	Tutorial class	4 – Ch.4; Pg.110-115	LCD/BB
46	approximation of derivatives near a curved boundary while using a square mesh	4 – Ch.4; Pg.99-108	LCD
47	Extra problems	4 – Ch.4; Pg.99-108	LCD
48	Tutorial class	4 – Ch.4; Pg.99-108	LCD/BB
Content beyond syllabus covered (if any):			

*** Session duration: 50 mins**

Sub. Code / Sub. Name: **MA18182 / ADVANCED NUMERICAL METHODS**

Unit V : FINITE ELEMENT METHOD

Unit Syllabus: Partial differential equations – Finite element method - orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

Objective:. To know how to apply Finite element method to solve PDE

Session No *	Topics to be covered	Ref	Teaching Aids
49	Introduction to PDE	2 – Ch.7; Pg.281-282	LCD
50	.Finite element method	4 – Ch.4; Pg.119-120	LCD
51	orthogonal collocation method	2 – Ch.7; Pg.297-300	LCD/BB
52	More Problems	4 – Ch.4; Pg.149-150	LCD
53	Tutorial class	4 – Ch.4; Pg.149-150	LCD
54	orthogonal collocation with finite element method	2 – Ch.7; Pg.302-306	LCD
55	More problems	2 – Ch.7; Pg.302-306	LCD
56	Tutorial class	2 – Ch.7; Pg.302-306	LCD/BB
57	Galerkin finite element method.	4 – Ch.4; Pg.122-135	LCD
58	More problems	4 – Ch.4; Pg.122-135	LCD/BB
59	More problems	2 – Ch.7; Pg.307-316	LCD
60	Tutorial class	2 – Ch.7; Pg.307-316	LCD
	Continuous Assessment Test-II		
Content beyond syllabus covered (if any): Nil			

*** Session duration: 50 mins**

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REFERENCES:

1. Saumyen Guha and Rajesh Srivastava, “Numerical methods for Engineering and Science”, Oxford Higher Education, New Delhi, 2010.
2. Gupta S.K., “Numerical Methods for Engineers”, New Age Publishers, 1995
3. Burden, R.L., and Faires, J.D., “Numerical Analysis – Theory and Applications”, Cengage Learning, India Edition, New Delhi, 2009.
4. Jain M. K., Iyengar S. R., Kanchi M. B., Jain , “Computational Methods for Partial Differential Equations”, New Age Publishers,1993.
5. Morton K.W. and Mayers D.F., “Numerical solution of partial differential equations”, Cambridge University press, Cambridge, 2002.

	Prepared by	**Approved by**
Signature	B. Saravanan	
Name	Dr.B.Saravanan	Dr.R.Muthucumaraswamy
Designation	Assistant Professor	Professor and Head
Date	5/01/2021	5/01/2021
Remarks *:		
Remarks *:		

* If the same lesson plan is followed in the subsequent semester/year it should be mentioned and signed by the Faculty and the HOD