DEPARTMENT OF MATHEMATICS
FACULTY OF ENGINERING AND TECHNOLOGY
SRM UNIVERSITY

UMA15402 – NUMERICAL ANALYSIS

LECTURE SCHEME / PLAN

The objective is to equip the students of Science and Humanities, the knowledge of Mathematics and its applications so as to enable them to apply them for solving real world problems.

The list of instructions (provided below) may be followed by a faculty relating to his/her own schedule includes warm-up period, controlled/free practice, and the respective feedback of the classes who handle. The lesson plan has been formulated based on high quality learning outcomes and the expected outcomes are as follows.

Each subject must have a minimum of 60 hours, which in turn, 45 hours for lecture and rest of the hours for tutorials. The faculty has to pay more attention in insisting the students to have 95% class attendance.

UNIT I: DIRECT AND ITERATIVE METHODS			
Lecture No	**Lecture Schedule**	**Learning outcomes**	**Cumulative hours**
L 1.1	Warm-up session/Motivation about the previous semester and their performance.	• Students will be motivated • Students will get an idea/advantages of Direct and Iterative methods to solve system of equations • One applies the knowledge in solving Problems. • Learners will understand the concept of finding Eigen values and their corresponding Eigen vectors numerically. • Students will get a knowledge of solving the system of equations by one of the easiest techniques	**1**
L1.2	Direct Method: Guass Elimination method -Problems		**2**
L.1.3	Direct Method: Guass Elimination method -Problems		**3, 4**
L.1.4	Error analysis in Guass Elimination method		**5**
L.1.5	Iterative Methods: Guass Jacobi method-Problems		**6**
L.1.6	Iterative Methods: Guass Seidel method-Problems		**7**
L.1.7	Convergence conditions in Iterative Methods		**8**
L.1.8	Iterative methods: Eigen value problems by Power method		**9,10**
L.1.9	Iterative methods: Eigen value problems by Power method		**11,12**
UNIT II: NUMERICAL DIFFERENTIATION AND INTEGRATION			
L.2.1	Lagrange's Interpolation formula for unequal intervals- Problems	• Learners will understand the basic	**15**

<table>
<tr><td>L.2.2</td><td>Inverse Interpolation: Lagrange's inverse formula - Problems</td><td rowspan="5">principles of operators
Knowledge in understanding the differences for future topics
Recognize and visualize the methods of finding intermediate values of a given function from a given set of tabular values of that function.
To learn the idea of finding the actual function of the given data
Understanding the difference between Forward and Backward differences and divided differences
Students get an idea of finding derivatives of a given function from a given set of tabular values at the origin, near the origin ,at the end point and near the end point
To relate the Lagrange's and inverse Lagrange's methods and understands to find x for a given y</td><td>16</td></tr>
<tr><td>L.2.3</td><td>Finding the actual polynomial of the given numerical data by Lagrange method -Problems</td><td>17,18,19</td></tr>
<tr><td>L.2.4</td><td>Introduction to First and Higher order differences. Forward and backward differences and operators</td><td>20</td></tr>
<tr><td>L.2.5</td><td>Introduction to Interpolation. Newton-Gregory Forward and Backward interpolation formulae for equally spaced intervals and their applications, Errors in interpolation, Numerical problems</td><td>21</td></tr>
<tr><td>L.2.6</td><td>Introduction : Newton's forward and backward Differences formulae to compute first and higher order derivative - Problems.</td><td>22</td></tr>
<tr><td colspan="4">CYCLE TEST – I : DATE:</td></tr>
<tr><td>L2.7</td><td>Numerical Integration-Trapezoidal rule and its applications</td><td rowspan="3">Learners understand the concept of numerical integration of a definite integral for a given function from a given set of tabular values .
Students able to solve problems themselves</td><td>23</td></tr>
<tr><td>L.2.8</td><td>Simpson's one third rule - Problems
Problems based on Simpson's three eighth rule</td><td>24</td></tr>
<tr><td>L.2.9</td><td>Tutorial</td><td>25</td></tr>
<tr><td colspan="4">UNIT III: POLYNOMIAL APPROXIMATION</td></tr>
<tr><td>L.3.1</td><td>Norms of functions</td><td rowspan="5">Gets an idea of this rule for the kind of problems applicable
Students able to solve problems themselves</td><td>26, 27,28</td></tr>
<tr><td>L.3.2</td><td>Best approximations: Least squares polynomial approximations</td><td>29</td></tr>
<tr><td>L.3.3</td><td>Approximations with Chebyshev polynomials</td><td>30</td></tr>
<tr><td>L.3.4</td><td>Piecewise linear approximations</td><td>31</td></tr>
<tr><td>L.3.5</td><td>Cubic Spline approximations</td><td>32</td></tr>
<tr><td colspan="4">UNIT IV: NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS</td></tr>
</table>

L.4.1	Numerical Solutions of ODE by Taylor's series method - Problems	• Provides deeper understanding of solving ordinary differential equations by different types of methods. • Understands the flexibility of Euler's method • Accuracy is more than the previous methods • This provides an idea of the best among the previous three methods	**33, 34**
L.4.2	Euler's method - Problems		**35**
L.4.3	Improved Euler's method - Problems		**36**
L.4.4	Modified Euler's method - Problems		**37**
CYCLE TEST – II :		**DATE:**	
L.4.5	Runge-Kutta method of Fourth order - Problems	• Test and evaluate that this method is the best of the aforesaid methods. • Predicts the solution of a given problem and confirm it with its corrector value. • Understands the advantage of this method over Milne's method . • Understands the advantage of this method. • Students able to solve problems themselves	**38, 39**
L.4.6	Milne's predictor corrector method - Problems		**40, 41**
L.4.7	Adam-Bashforth predictor corrector method - Problems		**42**
L.4.8	Stability considerations- Linear Two point BVPs: Finite difference method		
L.4.9	Tutorial		**43**
UNIT V: NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS			
L.5.1	Classification of II order PDE	• Able to classify different kinds of partial differential equations of second order • Able to acquire the knowledge of Difference Quotients. • One acquires enhanced knowledge of solving Laplace equation numerically. • One acquires enhanced knowledge of solving Poisson's equation. • Acquires the problem-solving skills of one dimensional heat equation numerically by finite difference scheme. • Identifies the problem where this method is applicable in comparison with Bender Schmidt method • One applies the knowledge of solving Two dimensional wave equation by finite difference scheme. • Students able to solve problems themselves	**44**
L.5.2	Difference Quotients		**45**
L.5.3	Numerical solution of Laplace equations: Leibmann's Iterative process – Problems.		**46, 47**
L.5.4	Numerical solution of Poisson's equations – Problems.		**48, 49**
L.5.5	Numerical solution of parabolic equations Bender Schmidt method - Problems		**50, 51**
L.5.6	Numerical solution of parabolic equations: Crank-Nicholson's method Problems		**52, 53**
L.5.7	Numerical solution of hyperbolic equations - Problems		**54, 55**
L.5.8	Tutorial		**56**
MODEL EXAM		**20.03.2017**	
LAST WORKING DAY :			

TEXT BOOKS

1. Kandasamy P, Thilagavathy. K and G. Gunawathy, Numerical Methods, S.Chand & Sons, 3rd Revised Edition, 2013. **Unit I:** Chapter 4: Sec 4.2.1, 4.7, 4.8, 4.9, Chapter 13: Sec 13.1; **Unit II:**Chapter 6: Sec 6.2, 6.3, 6.4, Chapter 8: Sec 8.7, Chapter 9: Sec 9.2, 9.3,9.8, 9.9, 9.10; **Unit IV:** Chapter 11: Sec 11.5, 11.9, 11.12, 11.17, 11.18;**Unit V:** Chapter 12: Sec 12.5, 12.9, 12.10
2. Balagurusamy. E, Numerical Methods, Tata Mcgraw Hill Publishing Company, 3rd Edition, 2000. **Unit I:** Chapter 14: Sec 14.6; **Unit III:** Chapter 9: Sec 9.2, 9.3, 9.8, 9.9, Chapter 10: Sec 10.4; **Unit IV:** Chapter 13: Sec 13.9, Chapter 14: Sec 14.3.

REFERENCES

1. Isaacson E. and Keller, H.B., "Analysis of Numerical Methods" Dover Publication, 1994.
2. Philips G.M and Taylor P.J., "Theory and Applications of Numerical Analysis", Academic Press, 1996.
3. Jain M.K, "Numerical Methods for Scientific and Engineering computation", 3rd Edition, New Age International, 1999.
4. Conte S.D. and Carl de Boor, "Elementary Numerical Analysis", 3rd Edition, Tata McGraw-Hill Publishing Company. 2004.
5. Atkinson K.E., "An Introduction to Numerical Analysis", Wiley & Sons, 2nd Edition, 1989.
6. Brian Bradie., "A Friendly Introduction to Numerical Analysis", 1st Edition, Pearson Education, New Delhi, 2007.

WEB BASED RESOURCES

http://www.the-science-lab.com/Math/ http://botw.org/top/Science/Math/
http://dir.yahoo.com/Science/Mathematics/ http://www.cms.caltech.edu/

Internal Marks Total: 50

Internal Marks split up: Cycle Test 1 : 10 Marks
Cycle Test 2 : 10 Marks Surprise Test : 5 marks
Model Exam : 20 Marks Attendance : 5 marks