DEPARTMENT OF MATHEMATICS
FACULTY OF ENGINERING AND TECHNOLOGY
SRM UNIVERSITY

MA1025 – NUMERICAL METHODS AND ITS APPLICATIONS

SEMESTER: V **ACADEMIC YEAR: 2015-16**

LECTURE SCHEME / PLAN

The objective is to equip the students of Engineering and Technology, 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 56 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: CURVE FITTING & NUMERICAL SOLUTIONS OF EQUATIONS			
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	**1**
L1.2	Introduction to curve fitting and its applications/ uses. Curve fitting by the method of least squares.	Students will get an idea/advantages of curve fitting and problem solving techniques	**2**
L.1.3	Fitting a parabola and its applications.	One applies the knowledge in solving Problems.	**3, 4**
L.1.4	To find out the best fit for a given numerical data	A learner will be able to compare straight line and parabola.	**5**
L.1.5	Calculation of sum of squares of the residuals. Error calculation - Problems	Student will understand the concept of fitting a curve more effectively	**6**
L.1.6	Fitting an exponential curve $y=ae^{bx}$ - problems	Learner will learn the transforming technique to convert complicated curve into a simpler curve and solve the problems by aforesaid techniques	**7**
L.1.7	Fitting a curve of the form $y=ab^x$ Fitting a curve of the form $y=ax^b$ Solving numerical problems	Will get an idea about fitting of an exponential curve. He will be able to compare different types of curves	**8**
L.1.8	Introduction: Solving linear algebraic and transcendental equations by various methods (Direct /Iterative methods) Newton-Raphson method. Solving	To be familiar with the methods fundamental phenomena.	**9,10**

	numerical problems		
L.1.9	Direct method : Gauss elimination method - Problems	Students will get a knowledge of solving the system of equations by one of the easiest techniques	**11**
L.1.10	Finding the inverse of a given matrix by Gauss elimination method - Problems	Learner will understand the concept of finding inverse of a given matrix by another simplest way.	**12**
L.1.11	Iterative methods: Gauss Jacobi method. Gauss Seidel method - Problems	One applies the knowledge of solving the system of equations numerically to real world problems	**13, 14**
UNIT II: FINITE DIFFERENCES & INTERPOLATION			
L.2.1	Introduction to First and Higher order differences. Forward and backward differences and operators	Learners will understand the basic principles of operators	**15**
L.2.2	Difference between the operators. Relation between the operators, Properties of operators	Knowledge in understanding the differences for future topics	**16**
L.2.3	Introduction to Interpolation. Newton-Gregory Forward and Backward interpolation formulae for equally spaced intervals and their applications, Numerical problems	Recognize and visualize the methods of finding intermediate values of a given function from a given set of tabular values of that function.	**17,18,19**
L.2.4	Fitting a polynomial to the given data by the above methods and hence finding an intermediate value of the given data. Numerical problems	To learn the idea of finding the actual function of the given data	**20**
CYCLE TEST – I :			**DATE: 27.07.2015**
L.2.5	Newton's interpolation formulae- Divided differences- Divided Difference formula for unequal intervals and its applications.	Understanding the difference between Forward and Backward differences and divided differences	**21**
L.2.6	Lagrange's Interpolation formula for unequal intervals- Problems	A knowledge of the methods of Newton and Lagrange and understands to find unknown y for a given x	**22**
L2.7	Finding the actual polynomial of the given numerical data by Lagrange method, Newton's divided difference method -Problems	Understands the concept more clearly and gets an idea in applying different types of methods to find an unknown intermediate value	**23**
L.2.8	Inverse Interpolation: Lagrange's inverse formula - Problems	To relate the Lagrange's and inverse Lagrange's methods and understands to find x for a given y	**24**
L.2.9	Tutorial	Students able to solve problems themselves	**25**
UNIT III: NUMERICAL DIFFERENTIATION AND INTEGRATION			
L.3.1	Introduction: Newton's forward and backward Differences formulae to compute first and higher order derivative - Problems.	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	**26, 27,28**

L.3.2	Numerical Integration-Trapezoidal rule and its applications	Learners understand the concept of numerical integration of a definite integral for a given function from a given set of tabular values.	**29**
L.3.3	Simpson's one third rule - Problems	Able to compare this rule with the previous rule and understands the advantages of Simpson's rule.	**30**
L.3.4	Problems based on Simpson's three eighth rule	Gets an idea of this rule for the kind of problems applicable	**31**
L.3.5	Tutorial	Students able to solve problems themselves	**32**
UNIT IV: NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS			
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.	**33, 34**
L.4.2	Euler's method - Problems	Understands the flexibility of Euler's method	**35**
L.4.3	Improved Euler's method - Problems	Accuracy is more than the previous methods	**36**
L.4.4	Modified Euler's method - Problems	This provides an idea of the best among the previous three methods	**37**
CYCLE TEST – II :			**DATE: 24.08.15**
L.4.5	Runge-Kutta method of Fourth order - Problems	Test and evaluate that this method is the best of the aforesaid methods.	**38, 39**
L.4.6	Milne's predictor corrector method - Problems	Predicts the solution of a given problem and confirm it with its corrector value.	**40, 41**
L.4.7	Adam-Bashforth predictor corrector method - Problems	Understands the advantage of this method over Milne's method.	**42**
L.4.8	Tutorial	Students able to solve problems themselves	**43**
SURPRISE TEST			
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	**44**
L.5.2	Difference Quotients	Able to acquire the knowledge of Difference Quotients.	**45**
L.5.3	Numerical solution of Laplace equations: Leibmann's Iterative process – Problems.	One acquires enhanced knowledge of solving Laplace equation numerically.	**46, 47**
L.5.4	Numerical solution of Poisson's equations – Problems.	One acquires enhanced knowledge of solving Poisson's equation.	**48, 49**
L.5.5	Numerical solution of parabolic equations Bender Schmidt method - Problems	Acquires the problem-solving skills of one dimensional heat equation numerically by finite difference scheme.	**50, 51**

L.5.6	Numerical solution of parabolic equations: Crank-Nicholson's method Problems	Identifies the problem where this method is applicable in comparison with Bender Schmidt method	**52, 53**
L.5.7	Numerical solution of hyperbolic equations - Problems	One applies the knowledge of solving Two dimensional wave equation by finite difference scheme.	**54, 55**
L.5.8	Tutorial	Students able to solve problems themselves	**56**
MODEL EXAM		**12.10.2015 (Duration: 3 Hours)**	
LAST WORKING DAY : 06.11.2015			

TEXT BOOK:

- Dr. M.K.Venkataraman, Numerical Methods in Science and Engineering, National Publishing Co., 2005
- B.S.Grewal, Numerical Methods in Engineering and Science, (42th Edition), Khanna Publishers 2012.

REFERENCES

- S. S. Sastry, Introductory methods of Numerical Analysis, Prentice Hall of India, New Delhi, 2005.
- E. Balagurusamy, Computer oriented statistical & numerical methods-Tata McGraw Hill, New Delhi, 2000.
- M. K. Jain, S. R. K. Iyengar and R. L. Jain, Numerical methods for scientific & Engineering Computation, Wiley Eastern Lt., 4th edition, 2003
- M. K. Jain, Numerical solution on Differential equations, Wiley, New York, 2nd edition (Reprint) 2002.
- P.Kandasamy et. al., Numerical methods, S. Chand & Co., New Delhi, 2003.

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 : 10 Marks
Cycle Test : 10 Marks — Surprise Test: 5 marks
Model Exam : 20 Marks — Attendance : 5 marks

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