# DEPARTMENT OF MATHEMATICS
# FACULTY OF SCIENCE AND HUMANITIES
# SRM UNIVERSITY

| 15MA206 | NUMERICAL METHODS | L | T | P | C |
|---|---|---|---|---|---|
| | | 4 | 0 | 0 | 4 |
| *Co-requisite:* | NOT APPLICABLE | | | | |
| *Prerequisite:* | 15 MA102. | | | | |
| *Data Book / Codes/Standards* | NA | | | | |
| *Course Category* | B CORE MATHEMATICS | | | | |
| *Course designed by* | Department of Mathematics | | | | |
| *Approval* | -- Academic Council Meeting -- , 2016 | | | | |

| **PURPOSE** | To acquire analytical ability in solving mathematical problems numerically as applied to the respective branches of Engineering. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | |
|---|---|---|---|
| At the end of the course, student will be able to | | | |
| **1** | To familiarise with numerical solution of equations | **a** | **e** |
| **2** | To get exposed to finite differences and interpolation | **a** | **e** |
| **3** | To be thorough with the numerical Differentiation and integration | **a** | **e** |
| **4** | To find numerical solutions of ordinary differential equations | **a** | **e** |
| **5** | To find numerical solutions of partial differential equations | **a** | **e** |

| Session | Description of Topic | Contact Hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I – CURVE FITTING AND NUMERICAL SOLUTION OF EQUATIONS** | **14** | | | |
| 1. | Introduction – Method of Least Squares – Curve fitting. | 2 | C,I | 1 | 1 – 7 |
| 2. | Fitting a straight line –Calculation of the sum of the squares of the residuals. | 1 | C,I | 1 | 1 – 7 |
| 3. | Fitting a parabola – Calculation of the sum of the squares of the residuals. | 2 | C,I | 1 | 1 – 7 |
| 4. | Solution of Algebraic and Transcendental equations Newton-Raphson method. | 1 | C,I | 1 | 1 – 7 |
| 5. | Bisection method and its applications. | 1 | C,I | 1 | 1 – 7 |
| 6. | Problems using Method of false position. | 1 | C,I | 1 | 1 – 7 |
| 7. | Solution of system of equations Direct Method - Gauss Elimination method. | 1 | C,I | 1 | 1 – 7 |
| 8. | Iterative Methods - Gauss Jacobi method, Gauss Seidel method. | 2 | C,I | 1 | 1 – 7 |
| 9. | Finding the Eigen values by Power method. | 2 | C,I | 1 | 1 – 7 |
| 10. | More Problems in Power method. | 1 | C,I | 1 | 1 – 7 |
| Cycle Test – I | | | | | 01.08.2016 |
| | **UNIT II – FINITE DIFFERENCES AND INTERPOLATION** | **12** | | | |
| 11. | Introduction – First and Higher order differences – Forward differences and backward differences (only definitions without proof). | 2 | C | 2 | 1 – 7 |
| 12. | Central Differences – Shifting operator E – Relations between the operators (only definitions without proof). | 2 | C | 2 | 1 – 7 |
| 13. | Interpolation – Newton-Gregory Forward and Backward Interpolation formulae. | 2 | C,I | 2 | 1 – 7 |

| | | | | | |
|---|---|---|---|---|---|
| 14. | Additional problems using Newton-Gregory Forward and Backward Interpolation formulae. | 2 | C,I | 2 | 1 – 7 |
| 15. | Divided differences – Newton's Divided difference formula. | 2 | C,I | 2 | 1 – 7 |
| 16. | Lagrange's Interpolation formula – Inverse interpolation. | 2 | C,I | 2 | 1 – 7 |
| | **UNIT III – NUMERICAL DIFFERENTIATION AND INTEGRATION** | **10** | | | |
| 17. | Introduction to Numerical Differentiation. | 1 | C | 3 | 1 – 7 |
| 18. | Numerical Differentiation - Newton's forward and backward differences formulae to compute first and higher order derivatives. | 2 | C,I | 3 | 1 – 7 |
| 19. | Applications of Newton's forward and backward differences formulae to compute first and higher order derivatives. | 2 | C,I | 3 | 1 – 7 |
| 20. | Introduction - Numerical Integration | 1 | C,I | 3 | 1 – 7 |
| 21. | Trapezoidal rule – Simpson's one third rule and Simpson's three eighth rules. | 2 | C,I | 3 | 1 – 7 |
| 22. | More problems using Trapezoidal rule – Simpson's one third rule and Simpson's three eighth rules. | 2 | C,I | 3 | 1 – 7 |
| Cycle Test – II | | | | | 01.09.2016 |
| | **UNIT IV – NUMERICAL SOLUTIONS OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS** | **12** | | | |
| 23. | Introduction, Solution by Taylor's series method. | 2 | C,I | 4 | 1 – 7 |
| 24. | Solutions of I order simultaneous differential equations by Taylor's series method. | 1 | C,I | 4 | 1 – 7 |
| 25. | Euler's method and its applications. | 1 | C,I | 4 | 1 – 7 |
| 26. | Problems in Improved and modified Euler methods. | 2 | C,I | 4 | 1 – 7 |
| 27. | Solution by Runge-Kutta method of fourth order (No proof). | 2 | C,I | 4 | 1 – 7 |
| 28. | Additional problems using Runge-Kutta method of fourth order. | 1 | C,I | 4 | 1 – 7 |
| 29. | Predictor-Corrector Methods - Milne-Thomson Method. | 2 | C,I | 4 | 1 – 7 |
| 30. | Predictor-Corrector Methods - Adam's Bashforth method. | 1 | C,I | 4 | 1 – 7 |
| | **UNIT V – NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS** | **12** | | | |
| 31. | Introduction - Solutions of Elliptic Equations. | 1 | C,I | 5 | 1 – 7 |
| 32. | Solutions of Laplace Equations by Leibmann's Iterative process. | 2 | C,I | 5 | 1 – 7 |
| 33. | Solutions of Poisson Equations. | 1 | C,I | 5 | 1 – 7 |
| 34. | Solutions of Parabolic equations by Bendre-Smidth formula. | 2 | C,I | 5 | 1 – 7 |
| 35. | Solutions of Parabolic equations by Crank-Nicolson formula. | 2 | C,I | 5 | 1 – 7 |
| 36. | Solutions of Hyperbolic equations by Explicit formula. | 2 | C,I | 5 | 1 – 7 |
| 37. | More problems in Hyperbolic equations using Explicit formula. | 2 | C,I | 5 | 1 – 7 |
| | Total Contact Hours | **60** | | | |
| | Model Examination | **20.10.2016** | | | |
| | Last working day | **04.11.2016** | | | |

| LEARNING RESOURCES: | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | B.S. Grewal, Numerical Methods in engineering and science, Khanna Publishers, 42nd edition, 2012. |
| 2. | Dr. M.K. Venkataraman, Numerical Methods in Science and Engineering, National Publishing Co., 2005. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | S.S. Sastry, Introductory Methods of Numerical Analysis, 4th edition, 2005. |
| 4. | E. Balagurusamy, Computer Oriented Statistical and Numerical Methods – Tata McGraw Hill., 2000. |
| 5. | M.K.Jain, SRK Iyengar and R.L.Jain, Numerical Methods for Scientific and Engineering Computation, Wiley Eastern Ltd., 4th edition, 2003. |
| 6. | M.K.Jain, Numerical Solution of Differential Equations, 2nd edition (Reprint), 2002. |
| 7. | P.Kandasamy etal., Numerical Methods, S.Chand & Co., New Delhi, 2003. |

| **Course nature** | | **Theory** | | | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz/Assignment | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage :** | | **50%** |


**Dr. M. Mageswari**

Assistant Professor (S.G)

Course Coordinator

Email: mageswari.m@ktr.srmuniv.ac.in

Tel: +91-44-27417000 Ext: 2706

**Dr. A. Govindarajan** 11/8/16

Professor & Head

Department of Mathematics

Email: hod.maths@ktr.srmuniv.ac.in

Tel: +91-44-27417000 Ext: 2701