INSTITUTE	**FACULTY OF TECHNOLOGY**
PROGRAM	**BACHELOR OF TECHNOLOGY (MECHANICAL ENGINEERING)**
SEMESTER	**4**
COURSE TITLE	**COMPLEX VARIABLE & NUMERICAL ANALYSIS**
COURSE CODE	**01MA1401**
COURSE CREDITS	**5**

Objective:

1 The subject aims to make the learner able to apply the knowledge of the Application of various Numerical Analysis methods in Engineering and real-world problems.

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Course Outcomes: After completion of this course, student will be able to:

1 Calculate solutions of algebraic and transcendental equations by numerical methods

2 Apply methods of interpolation and curve fitting for prediction.

3 Employ ordinary differential equation and numerical integration in engineering problems

4 Use numerical methods and tools in the engineering problem-solving process.

5 Analyze limit, continuity and differentiation of functions of complex variables and use Cauchy's integral theorem and formula to compute line integrals.

Pre-requisite of course: Differentiation, Integration, algebraic equation

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	2	0	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Error Approximation and Roots of Equations** Approximations and errors in computation, Approximate numbers, significant figures, rounding off numbers,, types of errors and basic sources of errors in numerical computation, Bisection method, Method of false position, Secant method,, Newton- Raphson method,, Rate of convergence, Dominant Eigenvalues and Eigenvector of matrix by Power methods.	8

Contents : Unit	Topics	Contact Hours
2	**Numerical Integration** Newton – cotes quadrature formula, trapezoidal rule, Simpson's rules,, Weddle's rule,, error bounds, estimates of these rules,, Gaussian quadrature formula	6
3	**Numerical Solution of Ordinary Differential Equation** Taylor series, Picard's method, Euler's and modified Euler, Runge - Kutta method of 2nd and 4th order, Milne's predictor-corrector methods	8
4	**Solution of System of Linear Equations Using Numerical Techniques** Gauss elimination, Gauss elimination with partial pivoting, Gauss Jordan and LU-factorization methods, Indirect methods: Gauss-Seidel and Jacobi's methods	7
5	**Complex Variable** De Moivre's Theorem, Roots of a complex number, Logarithmic function and complex exponent function, Limit, Continuity and Differentiability of complex function, Analytic functions, Cauchy-Riemann equations, Necessary and Sufficient condition for analyticity, Properties of Analytic function, Laplace equationHarmonic Conjugate functions,, Line Integral (contour integral) and its properties, Cauchy-Goursat Theorem, , Cauchy Integral Formula, Liouville Theorem (without proof), Maximum Modulus Theorem (without proof)	9
6	**Interpolation and Curve Fitting:** Finite Differences, Forward, Backward and Central operators, Interpolation by polynomials: Newton's forward, Backward interpolation formula,, Gauss & Stirling's central difference formula,, Newton's divided and Lagrange's formula for unequal intervals, Least squares method, Fitting of Linear, Quadratic, Exponential and Logarithmic curves.	4
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Interpolation and Curve Fitting** LAB 1, LAB 2, LAB 3	2
2	**Applications of Numerical Methods by Excel/ Interpolation and curve fitting** LAB 1, LAB 2	2
3	**Theory and Example on roots of equations** LAB 1, LAB 2	4
4	**Theory and Example on Numerical Integration** LAB 1	2

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
5	**Theory and Example on Interpolation and curve fitting.** Theory and Example on Interpolation and curve fitting., Example on curve fitting.	4
6	**Theory and Example on Numerical solution of ordinary differential equation** Theory and Example on Numerical solution of ordinary differential equation, Example on Numerical solution of ordinary differential equation	4
7	**Theory and Example on system of linear equation** Theory and Example on system of linear equation, Example on system of linear equation	4
8	**Solution of System of Linear Equations Using Gauss elimination, Gauss elimination with partial pivoting, Gauss Jordan method** LAB 1, LAB 2, LAB 3	2
9	**Solution of System of Linear Equations Using LU-factorization methods, Indirect methods: Gauss-Seidel and Jacobi's methods** LAB 1, LAB 2, LAB 3	2
10	**Roots of a complex number, Logarithmic function and complex exponent function, Limit, Continuity and Differentiability of complex function, Analytic functions** LAB 1, LAB 2, LAB 3	2
11	**Complex Integration: Line Integral (contour integral) and its properties, Cauchy-Goursat Theorem, Cauchy Integral Formula** LAB 1, LAB 2, LAB 3	2
12	**Application of Numerical Methods by using Excel** LAB 1, LAB 2, LAB 3	2
Total Hours		**32**

Textbook :

1 Numerical Methods for Engineers, S. C. Chapra and R. P. Canale, Tata McGraw Hill, 2003

2 Numerical Methods in Engineering & Science with Programs in C, C++ & MATLAB , B.S. Grewal, Khanna publishers, 2013

References:

1 Elementary Numerical Analysis- An Algorithmic Approach, Elementary Numerical Analysis- An Algorithmic Approach, S. D. Conte and Carl de Boor, McGraw-Hill,, 1980

2 Introduction to Numerical Analysis , Introduction to Numerical Analysis , C. E. Froberg, Addison-Wesley, 1981

3 Higher Engineering Mathematics, Higher Engineering Mathematics, B.S.Grewal, Khanna publishers, 2009

4 Applied Numerical Analysis, Applied Numerical Analysis, C. F. Gerald and P. O. Wheatley, Addison-Wesley, Singapore, 1998

References:

5 Complex Variables and Applications, Complex Variables and Applications, R. V. Chaurchill, McGraw-Hill,, 1990

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
15.00	15.00	40.00	15.00	10.00	5.00

Instructional Method:

1 At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.

2 Lectures will be taken in class room with the use of multi-media presentations, black board – mix of both

3 Attendance is compulsory in lectures and laboratory which carries a 5% component of the overall evaluation.

4 Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval. It carries a weightage of 5%.

5 Minimum two internal exams will be conducted and average of two will be considered as a part of 15% overall evaluation

Supplementary Resources:

1 http://numericalmethods.eng.usf.edu/

2 http://mathworld.wolfram.com/