Bachelor of Technology

Mechanical/ Automobile and Civil Engineering

Subject Code: 01MA1401

Complex Variable & Numerical Analysis

B.Tech. Year – II (Sem IV)

Objective of the Course:

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.

Credit Earned: 05

Course outcomes:

After successful completion of the course, it is expected that students will be able to,

1. Compute solutions of algebraic and transcendental equations by numerical methods.
2. Apply methods of interpolation and curve fitting for prediction.
3. Student able to apply 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.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA (M)	CSE (I)	Viva (V)	Term Work (TW)	
03	02	00	05	50	30	20	25	25	150

Detailed Syllabus

Sr No.	Title of the unit	Number of hours
1	**Error Approximation and Roots of Equations**	**08**
	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.	
2	**Numerical Integration**	**06**
	Newton – cotes quadrature formula, trapezoidal rule, Simpson's rules, Weddle's rule, error bounds, and estimates of these rules, Gaussian quadrature formula.	
3	**Interpolation and Curve Fitting:**	**10**
	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	**Numerical Solution of Ordinary Differential Equation**	**08**
	Taylor series, Picard's method, Euler's and modified Euler, Runge - Kutta method of 2^{nd} and 4^{th} order, Milne's predictor-corrector methods	
5	**Solution of System of Linear Equations Using Numerical Techniques**	**07**
	Gauss elimination, Gauss elimination with partial pivoting, Gauss Jordan and LU-factorization methods, Indirect methods: Gauss-Seidel and Jacobi's methods	
6	**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 equation, Harmonic Conjugate functions, Complex Integration: Line Integral (contour integral) and its properties, Cauchy-Goursat Theorem, Cauchy Integral Formula, Liouville Theorem (without proof), Maximum Modulus Theorem (without proof).	**08**
7	**Applications of Numerical Methods by Excel:**	**To be covered in Tutorial hours**
	Some basic EXCEL commands, solution of equations using EXCEL for Bisection Method, Secant Method and Newton Raphson Method.	
	Total	**47**

List of Tutorials:

1.Theory and Example on roots of equations.
2.Theory and Example on Numerical Integration.
3.Theory and Example on Interpolation and curve fitting.
4.Theory and Example on Numerical solution of ordinary differential equation
5.Theory and Example on system of linear equation.

Suggested Theory Distribution

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

Remember	Understand	Apply	Analyze	Evaluate	Create
15%	15%	40%	15%	10%	05%

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

Suggested Text books / Reference books:

1. Erwin Kreyszig: Advanced Engineering Mathematics, 8th Ed., John Wiley & Sons, India,1999.
2. S. D. Conte and Carl de Boor, Elementary Numerical Analysis- An Algorithmic Approach (3rd Edition), McGraw-Hill, 1980.
3. C. E. Froberg, Introduction to Numerical Analysis (2nd Edition), Addison-Wesley, 1981
4. C. F. Gerald and P. O. Wheatley, Applied Numerical Analysis (5th Edition), Addison-Wesley, Singapore, 1998.
5. S. C. Chapra and R. P. Canale, Numerical Methods for Engineers, Tata McGraw Hill, 2003.
6. R. V. Churchill and J. W. Brown, Complex Variables and Applications (7th Edition), McGraw-Hill, 2003.

List of Open Base Software/learning websites:

1. http://numericalmethods.eng.usf.edu
2. http://mathworld.wolfram.com/
3. http://en.wikipedia.org/wiki/Mat