GUJARAT TECHNOLOGICAL UNIVERSITY

MATHEMATICS-4
SUBJECT CODE: 2140001
B.E. 4th SEMESTER

Type of course: Engineering Mathematics

Prerequisites: The students are required to have a reasonable mastery over multivariable calculus, differential equations and Linear algebra.

Rationale:
Mathematics is a language of Science and Engineering.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	2	0	5	70	20	10	30	0	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Complex Numbers and Functions: Limits of Functions, Continuity, Differentiability, Analytic functions Cauchy-Riemann Equations, Necessary and Sufficient condition for analyticity, Properties of Analytic Functions, Laplace Equation, Harmonic Functions, Finding Harmonic Conjugate functions Exponential, Trigonometric, Hyperbolic functions and its properties. Multiple valued function and its branches: Logarithmic function and Complex Exponent function	10	24
2	Complex Integration: Curves, Line Integrals (contour integral) and its properties. Line integrals of single valued functions, Line integrals of multiple valued functions (by choosing suitable branches). Cauchy-Goursat Theorem, Cauchy Integral Formula, Liouville Theorem, Fundamental Theorem of Algebra, Maximum Modulus Theorems	04	10
3	Power Series: Convergence (Ordinary, Uniform, Absolute) of power series, Taylor and Laurent Theorems, Laurent series expansions. Zeros of analytic functions. Singularities of analytic functions and their classification Residues: Residue Theorem, Rouche's Theorem, Argument Principle	05	12
4	Applications of Contour Integration: Evaluation of various types of definite real integrals using contour integration method	02	5
5	Conformal Mapping and its applications: Mappings by elementary functions, Mobius transformations, Schwarz-Christoffel transformation	03	7

6	Interpolation: Interpolation by polynomials, divided differences, error of the interpolating polynomial	04	10
7	Numerical integration: Composite rules, error formulae, Gaussian integration	03	7
8	Linear algebraic equation: Solution of a system of linear equations: implementation of Gaussian elimination and Gauss-Seidel methods, partial pivoting	03	7
9	Roots of equation: Solution of a nonlinear equation: Bisection and Secant methods, Newton's method, rate of convergence, Power method for computation of Eigen values.	03	7
10	Ordinary differential equations: Numerical solution of ordinary differential equations, Euler and Runge Kutta methods	02	4

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
10%	15%	20%	20%	35%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

Reference Books:

1. R. V. Churchill and J. W. Brown, Complex Variables and Applications (7th Edition), McGraw-Hill (2003)
2. J. M. Howie, Complex Analysis, Springer-Verlag(2004)
3. M. J. Ablowitz and A.S. Fokas, Complex Variables-Introduction and Applications, Cambridge University Press, 1998 (Indian Edition)
4. E. Kreyszig, Advanced Engineering Mathematics(8th Edition), John Wiley (1999)
5. S. D. Conte and Carl de Boor, Elementary Numerical Analysis-An Algorithmic Approach (3rd Edition), McGraw-Hill, 1980
6. C.E. Froberg, Introduction to Numerical Analysis (2nd Edition), Addison-Wesley,1981
7. Gerald C. F. and Wheatley,P.O., Applied Numerical Analysis (Fifth Edition), Addison-Wesley, Singapore, 1998.
8. Chapra S.C, Canale, R P, Numerical Methods for Engineers **,** Tata McGraw Hill, 2003

Course Outcome:

After learning the course the students should be able to:

- evaluate exponential, trigonometric and hyperbolic functions of a complex number
- define continuity, differentiability, analyticity of a function using limits. Determine where a function is continuous/discontinuous, differentiable/non-differentiable, analytic/not analytic or entire/not entire.
- determine whether a real-valued function is harmonic or not. Find the harmonic conjugate of a harmonic function.

- understand the properties of Analytic function.
- evaluate a contour integral with an integrand which have singularities lying inside or outside the simple closed contour.
- recognize and apply the Cauchy's integral formula and the generalized Cauchy's integral formula.
- classify zeros and singularities of an analytic function.
- find the Laurent series of a rational function.
- write a trigonometric integral over $[0, 2\pi]$ as a contour integral and evaluate using the residue theorem.
- distinguish between conformal and non conformal mappings.
- find fixed and critical point of Bilinear Transformation.
- calculate Finite Differences of tabulated data.
- find an approximate solution of algebraic equations using appropriate method.
- find an eigen value using appropriate iterative method.
- find an approximate solution of Ordinary Differential Equations using appropriate iterative method.

List of Open Source Software/learning website:

http://ocw.mit.edu/resources/res-18-008-calculus-revisited-complex-variables-differential-equations-and-linear-algebra-fall-2011/part-i/
http://nptel.ac.in/courses/111105038/
http://nptel.ac.in/courses/111104030/
http://nptel.ac.in/courses/111107063/
http://nptel.ac.in/courses/111101003/

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.