COURSE CONTENT

NUMERICAL METHODS AND COMPLEX VARIABLES								
III/IV Semester: ECE/EEE								
CourseCode	**Category**	**Hours/ Week**			**Credits**	**MaximumMarks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
2530003	**Foundation**	3	0	0	3	40	60	100
Contact Classes: 48	**TutorialClasses:Nil**	**Practical Classes:Nil**				**Total Classes:48**		
Prerequisites: Mathematics courses of first year of study**.**								

Course Overview:

Numerical methods are techniques used to approximate mathematical processes that cannot be solved analytically, like integrals, differential equations and nonlinear equations. Complex analysis provides easy methods for computing rigid integrals. Numerical methods are paramount in modern product engineering and scientific research. Complex analysis is applicable in two-dimensional fluid flow and Laplace transforms.

CourseObjectives:

1. Various numerical methods to find roots of polynomial and transcendental equations and to estimate the value for the given data using interpolation.
2. Evaluation of derivatives and integrals using numerical techniques and solving ordinary differential equations of first order using numerical techniques.
3. The Fourier series Expansion and Fourier Transforms.
4. Differentiation and integration of complex valued functions.
5. Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem and Expansion of complex functions using Taylor's and Laurent's series.

Course Outcomes: After Completion of the Course, Students should be able to

1. Find the root of a given Algebraic and transcendental equations and estimate the value for given data using interpolation.
2. Apply the concept of numerical integration and differentiation to the real-world problems and find the solutions for a given first order ODE's.
3. Understand the various Properties of curves through Fourier series expansions.
4. The complex function with reference to their analyticity, integration using Cauchy's integral and residue theorems.
5. Apply the Cauchy's residue theorem for various integrals and write the Taylor's and Laurent's series expansions for complex function.

UNIT-I: Numerical Methods-I

Solution of polynomial and transcendental equations: Bisection method, Iteration Method, Newton-Raphson method and Regula-Falsi method. Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae, Lagrange's method of interpolation.

UNIT-II: Numerical Methods-II

Numerical integration: Trapezoidal rule and Simpson's $1/3^{rd}$ and $3/8^{th}$ rules.

Ordinary differential equations: Taylor's series, Picard's method, Euler method, Runge-Kutta method of fourth order for first order ODE

UNIT-III: Fourier series and Fourier Transforms
Fourier series – Dirichlet's Conditions – Half-range Fourier series – Fourier Transforms: Fourier Integral Theorem (Only statements), Fourier Sine and Cosine transforms (Elementary illustrations)

UNIT-IV: Complex Differentiation
Limit, Continuity and Differentiation of Complex functions. Cauchy-Riemann equations (without proof), Milne Thomson methods, analytic functions, harmonic functions, finding harmonic conjugate, Elementary analytic function (exponential, trigonometric, logarithm) and their properties.

UNIT-V: Complex Integration
Line integrals, Cauchy's theorem, Cauchy's Integral formula, zeros of analytic functions, singularities, Taylor's series, Laurent's series, Residues, Cauchy Residue theorem and their properties (all theorems without proof).

TEXTBOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI, 4th Edition, 2005.

REFERENCEBOOKS:

1. Murray R. Spiegel, Ph.D., Seymour Lipschutz, Ph.D., John J. Schiller, Ph.D., Dennis Spellman, Ph.D., Complex Variables (Schaum's outline).
2. M. K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computations, New Age International Publishers.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. J. W. Brown and R.V. Churchill, Complex Variables and Applications, 7th Edition, MC-Graw Hill, 2004.

ELECTRONIC RESOURCES:

1. **https://www.youtube.com/watch?v=rneLD0PINQE**
2. **https://www.youtube.com/watch?v=jbqT0iDNEz0&list=PLeIE3weEKo4bHS8wxVASCR2GxNbg3QASw**
3. **https://www.youtube.com/watch?v=q6LnRouvdws&t=7s**
4. **https://www.youtube.com/watch?v=tk0Ix_za8Ew**
5. **https://www.youtube.com/watch?v=zd6o3wOSu_0**

MATERIALS ONLINE:

1. Course template
2. Question bank
3. Definitions and terminology
4. Assignments
5. Model question paper–I
6. Model question paper–II
7. Lecture notes