Course Code: **MATH322**
Course Title: **Complex Analysis**
Credit Hours: **(3 0 3)**

Course Objectives:

The objectives of this course are:

a) To understand basic theory of algebraic and geometric structures of the complex numbers.
b) To understand the concepts of analyticity, Cauchy-Riemann relations and harmonic functions are then introduced with some applications in fluid dynamics.
c) To learn Complex integration and complex power series.
d) To learn the classification of isolated singularities and examine the theory and illustrate the applications of the calculus of residues in the evaluation of integrals.

Reading list:

1. D.G. Zill, P.D. Shanahan, "A First course in Complex Analysis with Applications", 2nd edition, Jones and Bartlett Publishers, 2008.
2. J. W. Brown, R.V. Churchill, "Complex variables and applications", 9th edition, McGrawHill, 2013.
3. R.A. Silverman, "Complex Analysis with Applications", Dover,2010.
4. E.B.Saff, A.D. Snider, "Fundamentals of Complex Analysis with Applications to Science and Engineering", 3rd edition, Prentice Hall,2003.

Lecture-wise distribution of the Contents

Lecture #	Topic
L1-L3	Introduction to the course, Complex Numbers and Their Properties, Complex Plane, Polar Form of Complex Numbers, Powers and Roots, Sets of Points in the Complex Plane,
L4-L6	Complex Functions, Complex Functions as Mappings, Linear Mappings, Special Power Functions, Reciprocal Function, differences between real and complex functions
L7-L9	Limits and Continuity, Complex functions as vector fields
L10-L12	Differentiability and Analyticity
L13-L14	Cauchy-Riemann Equations
L15-L16	Harmonic Functions, Applications: Orthogonal families, Gradient fields, Complex potentials and ideal fluids, Heat flow
L17-L19	Elementary functions: Exponential and Logarithmic Functions, Complex Powers, Trigonometric and Hyperbolic Functions, Inverse Trigonometric and Hyperbolic Functions
L20-L23	Real Integrals, Complex Integrals
L24	**MID EXAM**
L25-L26	Cauchy-Goursat Theorem
L27	Independence of Path
L28-L30	Cauchy's Integral Formula, Cauchy's Integral Formula for derivatives,

L31-L33	Consequences of Cauchy's Integral Formula: Cauchy's Inequality, Liouville's theorem, Fundamental theorem of algebra,Morera's theorem,Maximum Modulus theorem.
L34-L36	Sequences and series, Taylor series, Laurent series, zeros and poles
L37-L38	Residues and Residue theorem
L39	Evaluation of Real Trigonometric integrals
L40	Evaluation of Real improper integrals
L41	Integration along a Branch cut
L42-L43	Miscellaneous integrals
L44-L45	The Argument Principle and Roche's theorem
L46-L48	Summing infinite series