

**Hong Kong Baptist University**  
**Faculty of Science**  
**Department of Mathematics**

**Title (Units):** MATH3720 COMPLEX ANALYSIS (3,3,0)

**Course Aims:** This course provides an up-to-date introduction to the basic theory of analytic functions of one complex variable. Residue Theorem and its applications to the evaluation of integrals and sums will be one of the main objectives. Also conformal mappings and their applications will be discussed.

**Prerequisite:** MATH 1111-2

**Prepared by:** C.S. Tong

**Learning Outcomes (LOs):**

Upon successful completion of this course, students should be:

No.	Learning Outcomes (LOs)
	<b>Knowledge</b>
1	Able to understand the basic facts of complex analysis
2	Able to understand the concept and theory of analytic functions
3	Able to understand Cauchy's Theorem
4	Able to understand conformal mappings and their applications
	<b>Skills</b>
5	Able to evaluate integrals by Residue Theorem
6	Able to evaluate infinite sums by Residue Theorem
7	Able to use complex analysis to investigate the stability of real polynomials
8	Able to employ conformal maps to determine images of curves and sets under complex mappings
	<b>Attitude</b>
9	Able to appreciate the power of abstraction in mathematics

**Assessment:**

No.	Assessment Methods	Weighting	Remarks
1	Continuous Assessment (assignments and test)	20%	Test and continuous assessment are designed to measure how well the students have learned the basic concepts and fundamental theory of complex analysis and their applications.
2	Final Examination	80%	Final Examination is designed to see how far students have achieved their intended learning outcomes. Questions will both test the students' understanding of the fundamental theory as well as assess the student's versatility in complex analysis.

**Learning Outcomes and Weighting:**

Content	LO No.	Teaching (in hours)
I. Complex Numbers and their Geometrical Representation	1	2
II. Analytic Functions	1-2, 9	6
III. Cauchy's Theorem	1, 3, 9	10
IV. Series Representation of Analytic Functions	1-2	6
V. Calculus of Residues	5-7, 9	10
VI. Conformal Mappings	4, 8-9	6

**Textbook:** J. Bak and D.J. Newman, Complex Analysis, Springer-Verlag, 1993.

**References:** John B. Conway, Functions of one Complex Variable, Springer-Verlag, 1978.  
W.R. Derrick, Introductory Complex Analysis and Application, Academic Press, 1983.  
S.D. Fisher, Complex Variables, 2<sup>nd</sup> Ed., Dover Publications Inc. 1999.  
T.O. Moore, Complex Analysis, World Scientific, 1991.  
R.A. Silverman, Introductory Complex Analysis, Prentice-Hall, 1974.  
T.W. Gamelin, Complex Analysis, Springer, 2001.

**Course Content in Outline:**

	<u>Topic</u>	<u>Hours</u>
I.	Complex Numbers and their Geometrical Representation A. Basic properties of complex numbers B. Geometrical representation of complex numbers C. Polar form of complex numbers	2
II.	Analytic Functions A. Some elementary functions B. Some elementary topological properties of the complex plane C. Analytic functions D. Cauchy-Riemann equations	6
III.	Cauchy's Theorem A. Contour integrals B. Cauchy's theorem C. Cauchy's integral formula D. Maximum modulus theorem and harmonic functions	10
IV.	Series Representation of Analytic Functions A. Convergent series of analytic functions B. Power series and Taylor's theorem C. Laurent's series and classification of singularities	6
V.	Calculus of Residues A. Calculation of residues B. The residue theorem C. Evaluation of definite integrals and improper integrals D. Evaluation and estimation of sums	10
VI.	Conformal Mappings A. Definition and basic properties B. Fractional linear transformation (Möbius transformation) C. Some applications	6