COURSE SYLLABUS FORM

American University of Beirut
Faculty of Arts and Sciences
Department Mathematics

Course Number and Title: Math 304, Complex Analysis

1. Course Learning Outcomes

- Apply the theory of convergence to analyze sequences and infinite series of functions.
- Use the Cauchy theory of complex integration to obtain the power series representation of functions and several of its applications (Liouville's theorem, Fundamental Theorem of Algebra,..)
- Compute residues and use them to evaluate real integrals.
- Outline a proof of the homotopy version of Cauchy's integral theorem.
- Outline a proof of the Riemann mapping theorem
- Determine explicit conformal maps between given regions and the open unit disk.
- Use the maximum modulus principle for analytic functions to prove Schwarz's Lemma and Hadamard's three circle theorem.
- Use Schwarz's Lemma to estimate values of mapping functions and their derivatives.
- Compute the curvature of a given Riemannian metric.
- Determine the path of shortest non-Euclidean length between two points in the open unit disk or in the upper half-plane.
- Calculate the sum of the angles of a non-Euclidean triangle.
- Outline a proof of Picard's theorem using Riemannian metrics.
- Solve the equations of Laplace and Poisson in the disk.
- Compute Green's function for a given region.
- Use the maximum principle for subharmonic functions to prove Hadamard's three circle theorem.
- Determine the infinite product representation of an entire function.
- Locate the zeros of a particular entire function.

2. Resources Available to Students

Textbooks: Real And Complex Analysis, by W. Rudin.
Complex Analysis, the Geometric View point, by S. Krantz.

Supplementary reading: Problems & Theorems in Analysis, by G.Polya & G. Szego.
Theory of Functions, by E.C.Titchmarsh
Complex Analysis, by L. Ahlfors
Modern Analysis, by E.T.Whittaker & G.N. Watson

3. Grading Criteria

Two quizzes, 25% each
Final exam, 25%
Homework assignments and paper, 25%

4. Schedule

Week 1
Topics: The Theory of Convergence

Week 2
Topics: Fundamental properties of analytic functions.

Week 3
Topics: The Theory of residues

Week 4
Topics: Linear transformations

Week 5
Topics: Elementary conformal mappings

Week 6
Topics: The maximum modulus principle

Week 7
Topics: Schwarz's lemma

Week 8
Topics: The Riemann mapping theorem

Week 9
Topics: Harmonic Functions

Week 10
Topics: Green's Function

Week 11
Topics: Non-Euclidean Geometry

Week 12
Topics: Riemannian metrics

Week 13
Topics: Curvature

Week 14
Topics: Picard's theorem

Week 15
Topics Entire Functions