Introduction to Complex Functions.EE, 201.1.0071,
BGU Spring 2020

Lecturers: A. Poliakovsky, D. Kerner, J.Strauss,

Office hours https://www.math.bgu.ac.il/en/teaching/hours

The site of the course: on Moodle (primary), *https : //www.math.bgu.ac.il/ ∼ kernerdm* (secondary)

The structure of the final grade

There will be about 12 homeworks (for selftraining).
The final mark is computed as: 100% final exam.
The final exams are: Moed A (21.07.2020) , Moed B (10.08.2020).

The textbooks:

- Ahlfors, *Complex analysis.*
- Nehari, *Conformal mapping.*
- J.Bak, D.J.Newman, *Complex Analysis.*
- D,Alpay, *A Complex Analysis problem book.*

The program of the course (the order of the topics is approximate and will be adjusted during the semester)

(1) Complex numbers, open and closed sets in $\mathbb{C}$, (path) connectedness. The extended complex plane (Riemann sphere), $\bar{\mathbb{C}}$. e^z and De Moivre formula.

(2) Functions of a complex variable, continuity and real-differentiability. Complex-differentiability and Cauchy-Riemann equations. Functions analytic in a domain. Basic properties of the complex derivative.

(3) Power series. Review of convergence of functions, uniform convergence on compacts. Radius of convergence of a power series. Differentiation of power series. Analytic functions. Taylor series for e^z, $sin(z)$, $cos(z)$.

(4) Curvilinear (complex) integrals. The Cauchy-Goursat theorem. The Cauchy integral formula. Morera's theorem.

Uniform convergence of analytic functions on a compact set. The maximum principle. Liouville's theorem. The Laplace transform as a analytic function on a half-plane.

(5) Laurent series. Annulus of convergence, existence of Laurent series expansions.

(6) Zeroes and singularities. Order of a zero and a pole. Classification of singularities. Principal singularities, the Casorati-Weierstrass theorem. The Riemann sphere and a meromorphic function.

The residue theorem. Computations of integrals.

(7) The Argument Principle. The maximum principle. Rouché's theorem. The open mapping theorem. Hurewicz's theorem.

(8) Harmonic functions. The harmonic conjugate. The average and maximum principles for harmonic functions. Finding harmonic functions satisfying boundary conditions (e.g. on a strip).

(9) Conformal maps. Branches of log. Schwarz' lemma.

(10) Stereographic projection.

Möbius transformations. Criteria for fixing the unit disk and the upper half plane. Statement of the Riemann mapping theorem. Examples of conformal maps.

Schwarz-Christoffel transformations. Applications to harmonic functions (electrostatic potential with boundary conditions). The punctured disk is not conformally equivalent to an annulus.