School of Mathematics

MA2325 — Complex analysis 2010-11
(SF Mathematics, SF Theoretical Physics, optional JS&SS Two-subject Moderatorship)

Lecturer: Prof. Derek Kitson

Requirements/prerequisites: MA1122

Duration: 11 weeks

Number of lectures per week: 3

Assessment: Regular assignments.

ECTS credits: 5

End-of-year Examination: 2-hour end of year examination

Description: Aims to introduce complex variable theory and reach the residue theorem, applications of that to integral evaluation. See `http://www.maths.tcd.ie/~dk/MA2325.html`

- Complex numbers.
- Analytic functions.
- Complex integration.
- Power series.
- Residue theorem and applications.

Recommended Reading:

- Complex variables and applications, J.W. Brown, R.V. Churchill. McGraw-Hill, 2003.
- Complex analysis, L.V. Ahlfors. McGraw-Hill, 1979.
- Complex function theory, D. Sarason. Oxford University Press, 2007.
- Complex analysis, T.W. Gamelin. Springer, 2001.
- Functions of one complex variable, J.B. Conway. Springer-Verlag, 1984.

Learning Outcomes: On successful completion of this module, students will be able to:

- Manipulate and calculate with complex numbers, complex functions (polynomials, rational functions, exponential and trigonometric functions) and multi-valued functions (argument, logarithm and square root).
- Identify subsets of the complex plane and their geometric and topological properties (open, closed, connected, bounded, convex, star-shaped etc).

- Determine if a sequence of complex numbers is convergent, compute the limit of a given sequence and apply the Cauchy criterion.
- Define the limit of a complex function at a point and apply properties of limits. Compute the limit of a complex function at a point and determine whether a given complex function is continuous.
- Define the derivative of a complex function, state and prove properties of the derivative and compute the derivative of a given complex function. Derive the Cauchy-Riemann equations for a complex differentiable function and identify whether a function is complex differentiable at a point.
- Determine if an infinite series of complex numbers is convergent. Describe the convergence properties of a complex power series, derive formulae for and compute the radius of convergence.
- Identify and construct examples of paths satisfying prescribed properties. Evaluate complex path integrals and state and prove properties of such integrals. Define the index function for a path, describe its properties and evaluate winding numbers.
- State and prove versions of Cauchy's theorem and its consequences including Cauchy's integral formula, the power series representation for analytic functions, Liouville's theorem and the Fundamental Theorem of Algebra.
- Find Taylor and Laurent series for a complex function, compute residues and apply the residue theorem to evaluate integrals.

November 7, 2011