

# 2101 (Analysis 3: Complex Analysis)

<i>Year:</i>	2014–2015
<i>Code:</i>	MATH2101
<i>Level:</i>	Intermediate
<i>Value:</i>	Half unit (= 7.5 ECTS credits)
<i>Term:</i>	1
<i>Structure:</i>	3 hour lectures and 1 hour problem class per week. Weekly assessed coursework.
<i>Assessment:</i>	90% examination, 10% coursework
<i>Normal Pre-requisites:</i>	MATH1101, (MATH1102 recommended)
<i>Lecturer:</i>	Dr I Petridis
<i>Problem class teacher:</i>	Dr I Petridis

## *Course Description and Objectives*

This is a course on complex functions. The treatment is rigorous. Starting from complex numbers, we study some of the most celebrated theorems in analysis, for example, Cauchy's theorem and Cauchy's integral formulae, the theorem of residues and Laurent's theorem. The course lends itself to various applications to real analysis, for example, evaluation of definite integrals and finding the number of zeros of a complex polynomial in a region.

## *Recommended Texts*

Relevant books are: (i) Stein, E. and Shakarchi, R., *Complex analysis* (Princeton Lectures in Analysis); (ii) Priestley, H. A., *Introduction to complex analysis* (Oxford); (iii) Stewart, I. and Tall, D., *Complex Analysis* (CUP); (iv) Churchill, J. W. and Brown, R., *Complex Variables and Applications* (McGraw-Hill Higher Education, 8<sup>th</sup> edition).

## *Detailed Syllabus*

### **The complex numbers and topology in $\mathbb{C}$**

Review of complex numbers. Neighbourhoods, open and closed sets. Convergence of sequences.

### **Functions on the complex plane**

Continuous, holomorphic functions, Cauchy–Riemann equations, and power series. Harmonic functions.

Elementary functions  $e^z$ ,  $\sin z$ ,  $\cos z$ ,  $\log z$ ,  $z^\alpha$  and conformal mapping. Linear fractional transformations.

### **Cauchy's Theorem and its applications**

Integration along curves. Goursat's theorem, Cauchy's theorem in the disc, Cauchy's integral formulas. Taylor's theorem, Laurent's theorem, Liouville's theorem, Morera's theorem. The Fundamental theorem of algebra, Schwarz reflection principle.

### **Meromorphic functions**

Zeros, poles, residue theorem, standard examples of integrals with consideration of the needs of methods courses, the argument principle, Rouché's theorem, Casorati–Weierstrass' theorem, the identity theorem. Maximum modulus principle.