

# GM01 (Advanced Modelling Mathematical Techniques)

*Year:* 2017–2018  
*Code:* MATHGM01  
*Level:* Masters  
*Value:* 15 UCL credits (= 7.5 ECTS credits)  
*Term:* 1  
*Structure:* 3 hour lectures per week  
*Assessment:* 100% examination  
*Lecturers:* Dr S Timoshin and Prof NR McDonald

## *Course Description and Objectives*

This module aims to ensure that students possess knowledge of the analytical techniques used in mathematical modelling.

## *Recommended Texts*

- (i) Hinch, *Perturbation methods*, Cambridge Texts in Applied Mathematics.
- (ii) Kevorkian & Cole, *Perturbation methods in applied mathematics*, Applied Mathematical Sciences, Springer.
- (iii) Bender & Orszag, *Advanced mathematical methods for scientists and engineers*, Asymptotic Methods and Perturbation Theory: v.1, Springer.
- (iv) Churchill and Brown, *Complex variables and applications*, McGraw-Hill.
- (v) Nehari, *Introduction to complex analysis*, Allyn and Bacon.
- (vi) I. Karatzas and S. Shreve, *Brownian motion and Stochastic Calculus*, Graduate texts in Mathematics, Springer.

## *Detailed Syllabus*

- Perturbation Methods. Introduction to modelling concepts, dimensional analysis, perturbation techniques, matched asymptotics.
- Introduction to Stochastic Analysis. Brownian motion, hitting problems, PDEs and SDEs.
- Application of Complex Variables. Conformal mapping and applications. A selection from:
  - (a) Hodograph and potential-plane techniques
  - (b) Schwartz functions and vortex equilibria
  - (c) Hele-Shaw free boundary problems
  - (d) Two-dimensional freezing/melting problems