MATH0011 (Mathematical Methods 2)

Year:	2019–2020
Code:	MATH0011
Old code:	MATH1402
Level:	4 (UG)
Normal student group(s):	UG: Year 1 Mathematics degrees
Value:	15 credits (= 7.5 ECTS credits)
Term:	2
Structure:	3 hour lectures and 1 hour problem class per week. Small group tutorials. Weekly assessed coursework.
Assessment:	The final weighted mark for the module is given by: 5% programming exercises. 15% programming project. 5% assessed homework vector calculus. 75% unseen exam, with one mandatory exercise on the programming part. In order to pass the module you must have at least 40% in both the examination and the final weighted mark.
Normal Pre-requisites:	MATH0010 (previously MATH1401)
Lecturer:	Dr M Towers and Prof HJ Wilson
Problem class teacher:	Dr SN Timoshin

Course Description and Objectives

This module consists of two parts. First an introduction to programming for the mathematical sciences (4 weeks) and then an introduction to multivariable calculus (5 weeks). Programming is becoming an increasingly important tool for a mathematician both in industry and in research. In view of this some elements of basic scientific computation should be part of any modern undergraduate curriculum in Mathematics. Multivariable calculus on the other hand is of fundamental importance in a variety of fields of pure and applied mathematics such as electromagnetism, fluid mechanics, differential geometry, integration theory etc. The aim of the rest part is to introduce the students to the ideas of computer programming and its uses in scientific computing for science and applications. The programming language Python will be considered in the course, but the underlying principles are general. They should learn how to write accurate programs for the computational solution of mathematical problems. The aim of the second part is to introduce the students to the ideas of calculus of several variables and to develop their understanding of functions of several variables, their derivatives and integrals.

Recommended Texts

Recommended books: *Advanced Calculus* (Schaum Outline Series).
H.-P. Langtangen, A Primer on Scientific Programming with Python Springer Verlag.

Detailed Syllabus

- Week 1. Python, notebooks, reserved words, variables, types, arith- metic operators. Interactive programming, the program, basic output. Week 2. Strings, eval, exec. Data structures (lists, tuples, arrays). Basic constructions (loops, for, while, if-else). Week 3. Functions, main program, local and global variables, modules, input/output (also to les), error handling. Week 4. Array computing, random numbers, discrete di erentiation and integration, curve plotting. The project. Week 5: Review of partial derivatives, Tangent

planes, linear approxi- mation, di erentials, Chain rule. Week 6: Directional derivatives, Gradient, maximising directional deriva- tive, tangent planes to level surfaces, Taylor series. Maxima and min- ima of functions of more than one independent variable. Week 7: Double integrals, iterated integrals, cylinders, quadratic sur- faces, double integrals in polar coordinates Week 8: Triple integrals, cylindrical and spherical coordinates, integration in cylindrical and spherical coordinates. Jacobian, Change of variables in multiple integrals Week 9: Curves and velocity (no analysis of acceleration), Vector Fields, Line integrals. Scalar Potential. Independence of path, Green's Theorem.