MA1S11 Calculus Part
School of Mathematics, Trinity College
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Draft Lecture Material

David R. Wilkins

Welcome to the Calculus Portion of MA1S11

Mathematics for Scientists

Website for this portion of MA1S11:

`http://www.maths.tcd.ie/~dwilkins/Courses/MA1S11Calc/`

Textbooks

To buy or not to buy? That is the question

The "recommended book" for the study of calculus in MA1S11, MA1S12 and MA22S1 is the following:—

> *Calculus: Late Transcendentals*
> *Howard Anton, Irl Bivens, Stephen Davis.*
> *International Student Version.*
> *10th (or maybe 11th) edition.*
> *John Wiley and Sons*

The "Calculus" part of MA1S11 should cover approximately six to seven chapters of this book.

Prices in Hodges Figgis bookshop as of September 25, 2016:—

Anton Calculus Book with Wiley Plus Clode: €73.50
Anton Calculus eBook with Wiley Plus Clode: €54.50
Anton Elementary Linear Algebra: €80
Anton Calculus with Wiley Plus Code and Anton Elementary Linear Algebra €110

Be warned that that Calculus portion of MA1S11 may not track the "Anton" book particularly closely.

The intention is to construct a detailed syllabus that will follow on natural from the Irish Leaving Certificate Mathematics curriculum, beginning with a summary of important concepts and results, with more formal discussion of Leaving Certificate topics.

Provisional List of Topics

- Sets and Number Systems
- Infinite sequences and convergence
- Functions between sets
- Conic sections (ellipse, parabola, hyperbola)
- Formal discussion of limits and continuity
- Differentiation
- Areas and integrals
- Rules for integration

Tutorials

Tutorials start in the second week of teaching (i.e., next week). You will be allocated to one of eight groups.

Problems will be distributed at the start of each tutorial, to be completed within the tutorial and handed in at the end of the tutorial. Your solutions will be marked, and the marks will contribute to the result for the module.

If the time allocated to you is impossible, then visit the Mathematics Office in the School of Mathematics to seek to arrange an alternative tutorial.

Why Calculus?

Consider the following "partial differential equation" which has important applications in science:

$$i\hbar\frac{\partial\psi}{\partial t} = -\frac{\hbar^2}{2m}\left(\frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{\partial^2\psi}{\partial z^2}\right) + V\psi,$$

Whose equation?

Here

$$\psi = \psi(x, y, z, t), \quad V = V(x, y, z), \quad i = \sqrt{-1},$$

$$\begin{aligned} \frac{\partial \psi}{\partial x}(x, y, z, t) &= \lim_{h \to 0} \frac{\psi(x + h, y, z, t) - \psi(x, y, z, t)}{h} \\ &\vdots \\ \frac{\partial \psi}{\partial t}(x, y, z, t) &= \lim_{h \to 0} \frac{\psi(x, y, z, t + h) - \psi(x, y, z, t)}{h} \end{aligned}$$

$$\frac{\partial^2 \psi}{\partial x^2} = \frac{\partial}{\partial x}\left(\frac{\partial \psi}{\partial x}\right) \quad \text{etc.}$$

Computer Programming Languages and Algebra Systems

Introduction to use of Python and SageMath of symbolic computation etc.

https://www.python.org Python

https://anaconda.org/ Anaconda Python distribution for Windows and OSX, and cloud services for scientific computation using Python

https://cloud.sagemath.com/ SageMath Cloud, for the SageMath CAS cloud services (SageMath and Jupyter Notebooks)