School of Mathematics

Course 1S — Mathematics for Science students 1999-2000
(JF Mathematics as a whole subject within the Natural Science Moderatorships. JF Human Genetics. JF Computational Physics and Chemistry. JF Medicinal Chemistry.)

Lecturer: Dr. S. McMurry, Dr. B. Redmond, Dr. R. M. Timoney, Dr. N. H. Buttimore & Dr. T. G. Murphy

Requirements/prerequisites: None

Duration: 24 weeks

Number of lectures per week: 8 lectures per week including course 061 (1 lecture per week for part of the year; separate course description)

Assessment: Those taking the Chemistry, Mathematics and Physics combinatin take parts 1, 2 and 3 together with 061. Others take parts 1, 3 and 4 together with 061. The three main sections of the course will count equally towards the overall result for the course. Two end-of-term assignments assignment will each count for 10% of the marks for section 2. Practical work, assignments, tutorial work and 061 assignment results will count for 1/4 of the marks for section 3, with the paper counting for the remaining 3/4.

End-of-year Examination: Three 3-hour exams on each section, papers 1, 2, 3 and 4

Description:

Section 1 *Dr. S. McMurry*

- Differentiation of functions of one variable.

  Anton (Calculus): Chapters 2-3. Chapter 1, sections 1.1, 1.2, 1.4 assumed known.

- Antiderivatives and integration.

  Anton (Calculus): 7.1–7.5, 7.8.

- Trigonometric and hyperbolic functions, and the corresponding inverse functions; logarithmic function, exponential function.

  Anton (Calculus): 3.4 and Chapter 4. Also part of 7.6.

- Introduction to partial derivatives.

  Anton (Calculus): Part of 15.3

- Polynomials, sequences and series, including simple convergence tests.

  Anton (Calculus): 11.1–11.6, 11.8.

- Complex numbers.

There is a web page for this part of the course, which is updated during the year. The address is http://www.maths.tcd.ie/pub/coursework/1S1

Section 2 *Dr. B. Redmond*

Vectors and linear algebra, differential equations, and applications to physical examples. More detailed outline:

- Vectors, addition, scalar product, cross product, vector equation of a line in 3 dimensions, triple vector product, differentiation. (Anton (Calculus): 13.1–13.6)

  Parametric equations (Anton (Calculus): 1.7); cylindrical coordinates (Anton (Calculus): 13.8).

- Matrices, systems of linear equations, determinants. (Anton&Rorres: Chapters 1-2)

- Ordinary Differential Equations of first and second order. Linear differential equations with constant coefficients. Nonhomogeneous. (Kreysig: from Chapter 1-2)

- Applications/Examples: Simple Harmonic motion, with and without resistance. Electric circuits. Radiocative decay. Motion in a resisting 1-dmensional medium. (Anton (Calculus): Chapter 10, Kreysig: from Chapter 1–2)

Section 3 *Dr. R. M. Timoney*

- Introduction to computing
  Binary, octal and hexadecimal integers; storage of integers and floating point numbers in computers (via bits).

- Introduction to symbolic computing
  Use of a computer algebra system. Facilities of the system for elementary number theory and algebra. Elementary facilities for differentiation, integration and differential equations. Plotting and the mathematical basis. User defined functions.

  Anton (Calculus): 1.3, Chapter 5, exercises in Chapter 2–3, 7–10 marked CAS or 'graphing calculator'. Mathematica book Part 1 (less than what is in section 1.1–1.9).

- Differential Calculus
  Maxima and minima and plotting (with the aid of symbolic computation); parametric plots. Linear approximation, root finding using Newton's method.

  Anton (Calculus): Chapter 5 and 3.6.

- Integration
  The concept of a definite integral (area or Riemann sum). Elementary algorithms for computing definite integrals (trapezoidal and Simpson's rules). Fundamental Theorem of Calculus and antiderivatives Techniques of integration and standard applications (backed up by practical work using computer algebra).

  Anton (Calculus): 7.1, 7.5–7.7, 8.1–8.4, 8.6.

- An introduction to probability and statistics
  The notion of a probability on a sample space, mean and standard deviation for random variables, sample mean and sample variance, the normal distribution.

  Kreysig: 22.1–22.3, 22.5–22.6, 22.8.

There is a web page for this part of the course, which is updated during the year. The address is http://www.maths.tcd.ie/pub/coursework/1S3

Section 4 *Dr. N. H. Buttimore*

Vectors and linear algebra, differential equations, and applications to biological examples. More detailed outline:

- Vectors, addition, scalar product, cross product, vector equation of a line in 3 dimensions, triple vector product, differentiation. (Anton:13.1-13.6)
- Matrices, systems of linear equations, determinants. (Anton&Rorres: Chapters 1-2)
- Ordinary Differential Equations of first and second order. Linear differential equations with constant coefficients. Nonhomogeneous. (Kreysig: from Chapter 1-2)
- Applications/Examples: TO BE SPECIFIED Radiocative decay.

Essential Reference

1. Howard Anton, Calculus: a new horizon (6th edition), Wiley, 1998.

Recommended references

1. Howard Anton and Chris Rorres, Elementary Linear Algebra applications version, (7th edition) Wiley 1994.
2. Erwin Kreyszig, Advanced Engineering Mathematics, (7th edition) Wiley, 1993.
3. Kenneth A. Stroud, Engineering mathematics : programmes and problems, (4th edition) Macmillan, 1995.
4. S. Wolfram, Mathematica a system for doing mathematics by computer, Addison-Wesley (3rd edition) 1996, published by Wolfram Media and Cambridge University Press.
5. G. B. Thomas & R.L. Finney, Calculus and Analytic Geometry (9th edition), Addison Wesley, 1996.

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