School of Mathematics

Course 1S2 — Discrete Mathematics I for Scientists 2007–08 (JF Mathematics as a whole subject within the Science Moderatorships. JF Human Genetics. JF Computational Chemistry. JF Medicinal Chemistry. JF Physics & Chemistry of Advanced Materials.)

Lecturer: Dr. R. M. Timoney

Requirements/prerequisites: None

Duration: 24 weeks

Number of lectures per week: 4 hours per week, including 1 tutorial. One hour per week computer lab in first term. 2 hours lectures per week in first term, 3 lectures in second and third terms.

Assessment: Practical work, assignments, tutorial work and computer lab assignment results will count for 20% of the marks, There will be an examination at the end of the first term for 25% of the marks and a final examination in June counting for the remaining 55%.

End-of-year Examination: Three hour exam. Result is combined with results of 1S1.

Description: The topics are grouped here by subject areas, but the order will not be followed. Some of the topics listed below linear algebra will be covered before linear algebra is finished.

- *Linear algebra* This reference for this part of the course will be [AntonRorres]. For 2007–8 the syllabus will be approximately chapters 3, 1, 2, 4, 7, sections 9.1 and 9.3 and a selection of application topics from chapter 11 of [AntonRorres].
 - Vectors, geometric, norm, vector addition, dot product
 - Systems of linear equations and Gauss-Jordan elimination;
 - Matrices, inverses, diagonal, triangular, symmetric, trace;
 - Determinants, evaluation by row operations and Laplace expansion, properties, vector cross products, eigenvalues and eigenvectors
 - Introduction to vector spaces and linear transformations. Least squares fit via linear algebra.
 - Differential equations, system of first order linear equations, linear second order equations;
 - selected application in different branches of science.
- *Numbers.* Binary, octal and hexadecimal numbers and algorithms for converting between them.
- *Mathematica*. Introduction to the computer algebra (symbolic mathematics) system. Uses for calculus, graphing, matrix calculations. Exercises could include applications of ideas from Maths 1S1 (graphing, Newton's method, numerical integration via trapezoidal rule and Simpsons rule).

- Spreadsheets. A brief overview of what spreadsheets do.
- *Probability.* Basic concepts of probability; Sample means; Expectation and standard deviation for discrete random variables; Continuous random variables; Examples of common probability distributions (binomial, Poisson, normal) (sections 24.1–24.3, 24.5–24.8 of [Kreyszig]). This relies on improper integrals from Maths 1S1.

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/~richardt/1S2.

Essential Reference

[AntonRorres] Howard Anton & Chris Rorres, Elementary linear algebra : applications version. (Author Anton, Howard; 8th ed.; Publisher New York ; Chichester : John Wiley, 2000). [Hamilton 512.5 L32*7-2, S-LEN 512.5 L32*7-2]

Recommended references

- [Anton] Calculus : Howard Anton, Irl Bivens, Stephen Davis. (Author Anton, Howard; 8th ed; Publisher New York : Wiley, c2005). [Hamilton 515 P2*7, S-LEN 515 P2*7]
- [AntonBusby] Contemporary linear algebra / Howard Anton, Robert C. Busby. Author: Anton, Howard. Date: c2003. [Hamilton 512.5 P3, S-LEN 512.5 P3]
- [Kreyszig] Erwin Kreyszig, Advanced engineering mathematics (9th edition), Wiley, 2006 [Hamilton 510.24 L21*8, S-LEN 510.24 L21*8]

October 8, 2007