Aims

This course seeks to provide students of numerate disciplines in their first year in the university with a range of techniques in Algebra, Calculus and Probability which equip them to tackle problems in their own subject area. The course also provides a foundation in mathematics for more advanced courses in mathematics in later years.

Syllabus

**Prerequisite Maths:** Familiarity will be assumed with algebraic fractions, trigonometric functions and identities, solving and graphing quadratic equations. (0 lectures)

**Expressions and Equations:** Evaluation of an algebraic expression. Definition and evaluation of independent and dependent variables. Manipulating formulae and transposition. (2 lectures)

**Logarithms, Exponentials and Hyperbolic Functions:** Definitions and laws of logarithms (log) and exponentials (exp). Graphs of log and exp. Manipulation of expressions involving log and exp. Definition and drawing the graph of hyperbolic functions. Use of identities associated with hyperbolic functions. (3 lectures)

**Application of linear, log and exponential functions:** Applications of the straight line equation. Linear-linear graphs and linear interpolation. Reduction of algebraic equations. Linear graphs of logarithmic functions. Log-linear scales. Log-log scales. (3 lectures)


**Introduction to Integration:** Basic ideas and definitions. Anti-derivatives. Definite and indefinite integrals. Fundamental theorem of calculus. Area under a curve. Rules of integration and Table of Standard integrals. Infinite limits. (6 lectures)

**Data Handling and representation:** Data, data averages and variation of data. Elementary probability. Laws of Probability. Probability distributions. Engineering, science and economic applications. (6 lectures)

Teaching and Assessment

Contact Hours: 3 lectures and 1 tutorial per week
Assessment: 15% by class tests or other continuous assessment
85% by end of course 2-hour exam
Resit Type: exam
By the end of the course, students should be able to:

- Facility with solving and transposing formulae.
- Numerical Evaluation of an algebraic expression.
- Simplifying and solving expressions containing algebraic fractions.
- Understand the definition of logs and exponentials.
- Sketch/recognize graphs of logs and exponentials.
- Manipulate expressions containing logs and exponentials.
- Use log and exp in simple models of radioactive decay, cooling, population growth and chemical reactions.
- Recognize and work with hyperbolic functions.
- Plot linear data.
- Perform simple linear interpolation.
- Reduce non-linear equations to linear form for plotting.
- Plot log-linear and log-log data.
- Understand of meaning of differentiation.
- Ability to differentiate simple functions.
- Facility with product, quotient and chain rule.
- Carry out multiple derivatives.
- Sketch curves.
- Obtain maxima and minima.
- Solve simple related rate problems.
- Understanding of meaning of integration.
- Know the fundamental theorem of calculus.
- Know rules for evaluating simple integrals.
- Evaluate definite and indefinite integrals.
- Evaluate infinite integrals.
- Understand basic statistical notions (mean, mode, median, variance).
- Apply basic ideas in probability.
- Use probability density functions to determine probability of certain ranges.
- Perform calculations using normal distribution function and tables.
- Use attribute control charts to determine warning and action level on manufacturing processes.
- Apply probability to the clustering of rare events (e.g. aircraft near misses or multiple failures).
- Calculate the magnitude of a vector.
- Calculate angles between vectors using the scalar product.
- Calculate some simple areas using the vector product.
- Write down the equation of a line given a point on the line and direction vector for the line, or two points on the line.
- Determine whether two lines intersect and if they do, their point of intersection.
- Calculate the angle between intersecting lines.
- Calculate the distance from a point to a line.
- Calculate the shortest distance between two lines.
- Write down the equation of a plane given a point on the plane and a normal vector to the plane or three points on the plane.