Mathematics for Science (SFY-S-986)

Unit Leader Paul Gillard

Unit Aims

1. To develop further the mathematical skills and knowledge dealt with in Basic Quantitative Skills.

2. To integrate mathematical skills via content drawn from biological and chemical science.

Learning Outcomes

At the end of this unit, you should be able to:

1. Understand and recall the basic mathematical knowledge presented in the indicative content.

2. Present, interpret and analyse critically numerical, tabular, graphical and statistical data.

3. Perform scientific calculations and apply basic mathematical concepts to unfamiliar situations in a range of problem solving exercises.

4. Apply study skills in an effective manner to mathematical knowledge.

Teaching and Learning Pattern

There will be thirteen 2-hour teaching sessions for all students and twelve 1-hour tutorial sessions spread over 13 weeks. For tutorials students will be divided into small groups.

Student study hours are 150, of which 39 will be direct class contact, the remainder being private study.

Note that most sessions will have specified pre- and post-session tasks associated with them, and you are expected to carry out these tasks during your private study time.

PDP & Transferable Skills

During this unit, students should develop skills in the following areas:

- Numeracy skills.
- Plotting graphs.
- Interpretation of numerical, tabular, graphical and statistical data.
- Proficiency in scientific calculations.

Indicative Content

1. Mensuration

Areas of simple plane figures, circle, triangle, trapezium, parallelogram.
Volumes and surface areas of cuboids, spheres, cones, cylinders, prisms.
SI units for area and volume.

2. Further Algebra and Graphs

Transformation of formulae.
Solution quadratic equations by algebraic and graphical means.
Solution of simultaneous equations with two unknowns by algebraic and graphical means.
Exponential functions.
Graphs of $y = \log x$, $y = a^x$, $y = e^x$, $y = e^{-x}$ using experimental data, e.g. growth and decay curves.
Logarithms
Linearising non-linear functions
Use of log-linear and log-log graph papers

(Note: This section will transform the concepts of the sciences units into algebraic form. Particular emphasis will be placed on transposing algebraic equations previously encountered. Graphical work will concentrate on the presentation of experimental data).

3. Geometry and Trigonometry

Radian measure, area of sector of a circle.
Trigonometric ratios of acute angles
Trigonometric ratios for angles of any magnitude
Graphs of $y = \text{Sin A}$, $y = \text{Cos A}$, $y = \text{Tan A}$
Solution of triangles by the (a) Sine rule, and (b) Cosine rule.

(Note: This section will concentrate on providing illustrations of the use of simple trigonometry in science and technology).

4. Data Representation

Statistical Notation
Frequency Distribution/Histogram for grouped data
Cumulative frequency polygon
Line chart, Scatter diagram and cross diagram
Standard deviation for ungrouped and grouped data.

Weekly Teaching Programme

. The pace of the course will be related to how well the class is responding to the material, therefore some of the more advanced and/or later work may not be covered

Week 1 Mensuration: Areas of simple plane figures - triangle, circle, trapezium, parallelogram.
Volumes and surface areas of cuboids, spheres, cones, cylinders, prisms.

Week 2 Further Algebra: Transformation of formulae.

Week 3 Quadratic equations - algebraic and graphical solutions.
Simultaneous equations - algebraic and graphical solutions.

Week 4 Exponential functions.
Graphs of $y = \log x$, $y = a^x$, $y = e^x$, $y = e^{-x}$, using experimental data e.g. growth and decay curves.

Week 5 Logarithms.
Linearising non-linear functions .
Use of log-linear and log-log graph papers.

Week 6 Geometry and Trigonometry: Radian measure, area of sector of a circle.
Trigonometric ratios of acute angles.
Trigonometric ratios for angles of any magnitude.

Week 7 Solution of triangles by the (a) Sine Rule, (b) Cosine Rule.

Week 8 Differential Calculus: Functional notation, Gradient of a curve,
Differentiation of $y = a x^n$ by the general rule.

Week 9 Identification of maxima and minima.
Solution of problems involving rate of change.

Week 10 Practice session

Week 11 Practice session

Week 12 Data Representation: Statistical notation, Frequency distribution
Histogram of grouped data, Cumulative frequency polygon.

Week 13 Line chart, Scatter diagram, Cross diagram.
Standard deviation for ungrouped and grouped data.

Week 14/15 Review and revision
Examination week.

Assessment Method

40% - Coursework (Two in-class tests).

60% - End of unit 2-hour examination.

A student must achieve a minimum of 30% in each of the coursework and end of unit examination elements. The overall weighted unit pass mark is 40%.

Indicative Reading

Core Reading

Bird J.O and May A.J.C. Technicians Mathematics, Level 2, Longman (1994)

A level Mathematics CGP ISBN 1-84146-991 2

Background Reading

Greer A. and Taylor G.W. Mathematics for Technicians, Level 2
Stanley Thornes (1994)

Booth Foundation Mathematics, Addison Wesley (1991)

Monoll A.C. Mathematics for Biosciences, Ellis Horwood (1988)