Aims

The course aims to teach basic mathematics relevant to biology and chemistry. The material is highly applications-oriented and example calculations will be used widely.

Syllabus

Units and Scientific Notation: SI units; review of algebraic manipulation and powers; conversion between units; scientific notation, decimal places and significant figures. (3 lectures)

Ratio and Concentration: Fractions, percentages and ratio, concentration, molarity, dilutions. (4 lectures)

Linear Functions: Review of straight lines; best-fitting straight lines, applications including the Beer-Lambert Law. (3 lectures)

Chemical Kinetics: Law of Mass Action; equilibrium and dissociation constants; enzyme kinetics; Michaelis-Menten equation; Lineweaver-Burk plot. (2 lectures)

Power and Exponential Function: Power functions, exponential growth and decay; applications including growth of cell colonies and radioactive decay. (3 lectures)

Logarithms: Definition and manipulation of logarithms; pH values; Henderson-Hasselbalch equation; log and semi-log plots. (3 lectures)

Mathematics in Microbiology: Calculations for growth media; estimation of cell growth and biomass; modelling batch culture and continuous growth; control of microbial growth. (3 lectures)

Introduction to Statistics: Frequency tables, histograms; normal distribution; means, medians and modes; standard deviation and standard error. (6 lectures)

Rates of Change in Biology: Basic introduction to differentiation; use in simple differential equations; examples esp. from biochemistry; integration as reverse of differentiation. (3 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:

- Understand SI units and scientific notation, and their interpretation in terms of orders of magnitude.
- Carry out algebraic manipulation involving the power laws efficiently.
- Convert between different unit systems.
- Understand measures of accuracy and perform scientific calculations to specified levels of accuracy.
- Carry out calculations involving fractions, percentages and ratios.
- Understand concepts of concentration and volume, and perform dilution calculations.
- Calculate and use straight line functions and apply to a range of problems.
- Draw best fitting straight lines.
- Sketch and manipulate power functions and use in applications.
- Understand exponential growth and decay.
- Distinguish between exponential growth/decay and power laws.
- Apply exponential growth law to the growth of cell colonies and to problems about radioactive decay.
- Calculate and manipulate logarithms to base 10 and base $e$.
- Understand and interpret pH values.
- Interpret data plotted using log-log and semi-log plots.
- Understand basic biochemical concepts and use them in calculations for a variety of examples.
- Calculate enzyme kinetic rate formulae from given reaction schemes.
- Plot and interpret Michaelis-Menton kinetics and understand the key underlying concepts.
- Perform calculations of composition of solutions and growth media.
- Convert cell numbers under microscope into cell counts and thus into biomass.
- Use exponential and power law to study batch culture and continuous growth; understand the concept of the chemostat.
- Use exponential decay to study microbial death rates.
- Understand the normal distribution and its basic application in biology.
- Calculate mean, median and mode for given data, and interpret.
- Understand and calculate standard deviation and standard error.
- Differentiate and integrate very simple functions.
- Construct differential equations and solve in very simple cases.

Content: Aug 2013