OXFORD ADVANCED STUDIES PROGRAM

COURSE OUTLINE

MATHEMATICS

The variety of mathematics courses available enables students to work at their own pace, on topics of their choice. The aim of all courses is to broaden and enrich existing mathematical knowledge, so the teaching of new material is always preceded by a review of each student's current mathematical skills. Presentation of material is accompanied by worked examples and students then move onto applications and problem-solving exercises at an appropriate level. Group 'workshop' sessions and individual tutorials form the basis of the teaching. Students usually follow one or more of the following courses of study:

ALGEBRA

- Polynomials
- Factor and remainder theorems
- Linear and quadratic equations
- Rational functions and their graphs
- Inequalities
- Irrational and complex numbers
- Co-ordinate geometry: lines, circles and conic sections
- Logarithms

Example Problems

If $x = 1$ is a solution of the equation $2x^3 - x^2 - 2x + 1 = 0$

find the other two roots.

Hence or otherwise solve the inequality $2x^3 - x^2 - 2x + 1 \geq 0$

TRIGONOMETRY

- Elementary definition of trigonometric functions
- Graphs of the trigonometric functions
- Solution of triangles including sine and cosine rules
- Trigonometric formulas and equations

Example Problems

a) Prove the law of cosines

b) Prove the identity $\cos^4\theta - \sin^4\theta \equiv \cos 2\theta$

c) **PRE-CALCULUS (ADVANCED ALGEBRA)**

- Functions and graphs
- Domain and range of a function
- Composite functions, inverse functions
- Quadratic, cubic, exponential, logarithmic and trigonometric functions
- Sequences and series, including the Binomial expansion, and arithmetic and geometric progressions

Example Problems

1. Find the inverse of the function f(x) = ln (x+1)

2. If *p*, 6 and *q* form a geometric progression and *p*, 10 and *q* form an arithmetic progression, find the possible values of *p* and *q*.

CALCULUS AB

- Review of the concept of a function and its graph
- Limits and continuity
- Differentiation including the product, quotient and chain rules
- Elementary integration and its application to areas and volumes

Example Problems

1. Find the range of the function f(x) = $\frac{x}{\ln x}$

Show that the function f(x) = |x| is continuous at x = 0 but not differentiable.

CALCULUS BC

Students who wish to take Calculus BC should be familiar with the contents of a Calculus AB course. Otherwise, students should consider taking Calculus AB instead.

- The concept of a limit with its rigorous definition
- Parametric and implicit differentiation
- Integration by substitution, partial fractions, trigonometric identites and parts
- Differential equations
- Series expansions by Maclaurin
- Application of calculus to lengths of arc, and areas and volumes of revolutions

Example Problems

a) Solve the diferential equation $\frac{dy}{dx} = \frac{y^2}{x^2}$

Evaluate $\int_0^1 \frac{1}{(1+x^2)^2} dx$

PROBABILITY AND STATISTICS

- Elementary probability: definitions, simple formulas, and tree diagrams
- Probability distributions (continuous and discrete) with their means and variances
- The Binomial, Poisson, Geometric and Normal distributions
- Hypothesis testing
- Regression and correlation

Example Problem

In the manufacture of commercial carpet, small faults occur at random in the carpet at an average rate of 0.95 per 20 m^2.

Find the probability that in a randomly selected 20 m^2 area of carpet there are

- no faults.
- at most two faults.

The ground floor of a new office block has ten rooms. Each room has an area of 80 m^2 and has been carpeted using the same commercial carpet described above.

For any one of these rooms, determine the probability that the carpet in that room contains

- at leaast two faults.
- exactly three faults.
- at most five faults.

Find the probability that in exactly half of these ten rooms, the carpets will contain exactly three faults.

Course Aims

- To advance and enrich the existing mathematical knowledge of each student

Objectives

- To gain awareness of the importance of mathematical rigour
- To understand the underlying elegance and style of good mathematical literature
- To be able to abstract necessary information from real-life problems into a mathematical setting

Outcomes

- To be more self-sufficient mathematically
- To be prepared for future mathematical studies
- To better appreciate the nature of mathematics as a whole, and to have a more advanced, specialised understanding of the topics covered

Assessment Process

Students typically complete two or three problem sheets per week, and will be tested at least twice during the duration of the course. Final grades are mainly based on the two course tests, but performance in class, and in solving the problem sheets, is taken into account.

Grade breakdown

- 80% Tests
- 10% Problem sheets
- 5% Class Participation
- 5% Attendance

Assessment Criteria

DISTINCTION Grade A	Student demonstrates a near-complete understanding of the material presented in the course, and can use it to solve complex, structured mathematical problems. Student demonstrates a good capacity for the speedy and efficient assimilation of new mathematical material with little or no help. Student demonstrates significant potential for more advanced studies in mathematics.
CREDIT Grade B	Students demonstrates a good understanding of the ideas presented in the course, and can use their understanding to solve structured, worded mathematical problems
MERIT Grade C	Student demonstrates a satisfactory understanding of the ideas presented in the course, and can use their understanding to solve relevant, straightforward problems
PASS Grade D	Student demonstrates a basic understanding of most of the ideas presented in the course
FAIL	None of the criteria listed above satisfied

Recommended Introductory Reading:

Although there is no specific preparation or advanced reading required, students should carefully review their mathematical knowledge from appropriate textbooks.