# 1. INTRODUCTION

## 1.1 CONTEXT

Mathematics is a wide-ranging subject with many aspects. On the one hand, in its manifestations in terms of counting, measurement, pattern and geometry it permeates the natural and constructed world about us, and provides the basic language and techniques for handling many aspects of everyday and scientific life. On the other hand, it deals with abstractions, logical arguments, and fundamental ideas of truth and beauty, and so is an intellectual discipline and a source of aesthetic satisfaction. These features have caused it to be given names such as "the queen and the servant of the sciences". Its role in education reflects this dual nature: it is both practical and theoretical -- geared to applications and of intrinsic interest -- with the two elements firmly interlinked.

Mathematics has traditionally formed a substantial part of the education of young people in Ireland throughout their schooldays. Its value for further and higher education, for employment, and as a component of general education has been recognised by the community at large. Accordingly, it is of particular importance that the mathematical education offered to students should be appropriate to their abilities, needs and interests, and should fully and appositely reflect the broad nature of the subject and its potential for enhancing the students' development.

## 1.2 AIMS

It is intended that mathematics education would:

A. Contribute to the personal development of the students:
- helping them to acquire the mathematical knowledge, skills and understanding necessary for personal fulfilment;
- developing their modelling abilities, problem-solving skills, creative talents, and powers of communication;
- extending their ability to handle abstractions and generalisations, to recognise and present logical arguments, and to deal with different mathematical systems;
- fostering their appreciation of the creative and aesthetic aspects of mathematics, and their recognition and enjoyment of mathematics in the world around them;
- hence, enabling them to develop a positive attitude towards mathematics as an interesting and valuable subject of study;

B. Help to provide them with the mathematical knowledge, skills and understanding needed for life and work:
- promoting their confidence and competence in using the mathematical knowledge and skills required for everyday life, work and leisure;
- equipping them for the study of other subjects in school;
- preparing them for further education and vocational training;
- in particular, providing a basis for the further study of mathematics itself.

It should be noted that in catering for the needs of the students, the courses should also be producing suitably educated and skilled young people for the requirements of the country.

## 1.3 GENERAL OBJECTIVES

The teaching and learning of mathematics has been described as involving facts, skills, concepts (or "conceptual structures"), strategies, and -- stemming from these -- appreciation.

In terms of student outcomes, this can be formulated as follows. The students should be able to recall relevant facts. They should be able to demonstrate instrumental understanding ("knowing how") and necessary psychomotor skills. They should possess relational understanding ("knowing why"). They should be able to apply their knowledge in familiar and eventually in unfamiliar contexts; and they should develop analytical and creative powers in mathematics. Hence, they should develop appreciative attitudes to the subject and its uses. The aims listed in Section 1.2 can therefore be translated into general objectives as given below.

Fundamental objectives

A. Students should be able to recall basic facts; that is, they should be able to:
   - display knowledge of conventions such as terminology and notation;
   - recognise basic geometrical figures and graphical displays;
   - state important derived facts resulting from their studies.

   (Thus, they should have fundamental information readily available, to enhance understanding and aid application.)

B. They should be able to demonstrate instrumental understanding; hence they should know how (and when) to:
   - carry out routine computational procedures and other such algorithms;
   - perform measurements and constructions to an appropriate degree of accuracy;
   - present information appropriately in tabular, graphical and pictorial form, and read information presented in these forms;
   - use mathematical equipment such as calculators, rulers, setsquares, protractors, and compasses, as required for the above.

   (Thus, they should be equipped with the basic competencies needed for mathematical activities.)

C. They should have acquired relational understanding, i.e. understanding of concepts and conceptual structures, so that they can:
   - interpret mathematical statements;
   - interpret information presented in tabular, graphical and pictorial form;
   - recognise patterns, relationships and structures;
   - follow mathematical reasoning.

   (Thus, they should be able to see mathematics as an integrated, meaningful and logical discipline.)

D. They should be able to apply their knowledge of facts and skills; that is, they should be able when working in familiar types of context to:
   - translate information presented verbally into mathematical form;
   - select and use appropriate mathematical formulae or techniques in order to process the information;
   - draw relevant conclusions.

   (Thus, they should be able to use mathematics and recognise it as a powerful tool with wideranging areas of applicability.)

E. They should have developed the psychomotor and communicative skills necessary for the above.

F. They should appreciate mathematics as a result of being able to:
- use mathematical methods successfully;
- acknowledge the beauty of form, structure and pattern;
- recognise mathematics in their environment;
- apply mathematics successfully to common experience.

Other objectives

G. They should be able to analyse information, including information presented in unfamiliar contexts:
- formulate proofs;
- form suitable mathematical models;
- hence select appropriate strategies leading to the solution of problems.

H. They should be able to create mathematics for themselves:
- explore patterns;
- formulate conjectures;
- support, communicate and explain findings.

I. They should be aware of the history of mathematics and hence of its past, present and future role as part of our culture.

Note

Many attempts have been made to adapt the familiar Bloom taxonomy to suit mathematics education: in particular, to include a category corresponding to "carrying out routine procedures" ("doing sums" and so forth). The categories used above are intended, inter alia, to facilitate the design of suitably structured examination questions.

## 1.4 PRINCIPLES OF COURSE DESIGN

To implement all the aims and objectives appropriately, three courses were designed: one (the Higher course) at Higher level, and two (the Ordinary and Ordinary Alternative courses) at Ordinary level. The two Ordinary level courses are complementary to each other, catering for different populations with different interests, needs, and learning styles. The Ordinary Alternative course was introduced into schools in 1990, and is sanctioned for examination up to and including Summer 1994.

The following principles influenced the design of all courses.

A. They should provide continuation from and development of the courses offered in the Junior Cycle.

Hence, for the cohort of students proceeding from each Junior Cycle course, there should be clear avenues of progression. These should take account of the background, likely learning style, potential for devlopment, and future needs of the target group.

B. They should be implementable in the present circumstances and flexible as regards future development.

They should therefore be teachable, learnable and adaptable.

(a) They should be teachable, in that it should be possible to implement the courses with the resources available.
- The courses should be teachable in the time normally allocated to a subject in the Leaving Certificate programme.

Thus, they should not be unduly long.
- Requirements as regards equipment should not go beyond that normally found in, or easily acquired by, Irish schools.
- They should be teachable by the current teaching force. Hence, the aims and style of the courses should be ones that teachers support and can address with confidence, and the material should in general be familiar.

(b) They should be learnable, by virtue of being appropriate to the different cohorts of students for whom they are designed.
- Each course should start where the students in its target group are at the time, and should proceed to suitable levels of difficulty and abstraction.
- The approaches used should accommodate different abilities and learning styles.
- The material and methods should be of interest, so that students are motivated to learn.

(c) They should be adaptable -- designed so that they can serve different ends and also can evolve in future.
- A measure of choice can be provided, both within courses (by providing "options" while requiring coverage of basic and important material), and between courses (by recognising the need for different types of course).
- New material (in the "options") can be tried in the classroom and maybe later moved to the core, while material with lessening relevance can be phased out gradually.
- Appropriate responses can be made as resource provision changes (for example, allowing more emphasis on use of computers).

C. They should be applicable, preparing students for further and higher education as well as for the world of work and for leisure.
Where possible, the applications should be such that they can be made clear to the students (now, rather than in some undefined future), and hence ideally should be addressable at least to some extent within the course.

D. The mathematics they contain should be sound, important and interesting.
A broad range of appropriate aspects of mathematics should be included.

1.5 NOTE
The Computer Studies option, which has been listed with Mathematics in Rialacha agus Clár, is not addressed in this booklet; so provision described here does not affect the running of the option. It should be noted, however, that computers (equipped with appropriate software packages) may of course be used in the teaching and learning of Mathematics.