

by the committee. If the revised version is unsuccessful, no further resubmission will be allowed. The decisions of the committee will be communicated by email.

If, after your project has been approved, you wish to make minor changes to the title or description of your project, then you may apply to the Chairman of the Projects Committee for the appropriate permission.

### 3.5 The project proposal

The proposal should be at least 150 words, excluding references, and at most one A4 side. It must be typed, and should be sufficiently detailed for the members of the committee to judge whether the project is of appropriate depth and content and whether it will be possible to find a suitable assessor in the University. You should include details of the *main* references—books, papers, etc.—with full bibliographic details.

A common turn of phrase at the annual meeting where Projects Committee considers the proposals is “original contribution to the literature”. Few projects will produce original research, but there should be a flavour, topics, mindset or aim to the project that makes it distinct from anything in the literature. It should not be possible for a committee member to reference one or two chapters of a text or an article that essentially cover the same material as a proposal and in much the same style. However it would be reasonable to take material that only exists in sources, written in a technical and abstract style for professional mathematicians, and explain this material at a more undergraduate level, possibly illuminating the discussion by focusing on one or two examples. It would precisely be this exposition, and collation of the material from several sources, that made the piece original.

In deciding when to approve project proposals the committee will consider how closely the work will relate to existing courses available to the student in the Oxford Mathematics syllabus. Following the principle that a student may not gain credit twice for the same material, projects which relate too closely to courses the student has already taken, or is eligible to take in the future, will not be allowed. For this reason you must declare, on your project application, which courses you have previously taken.

**To ensure that you have included all the information required by the examiners and the committee the appropriate sections of the form should be checked and signed.** Here is an example proposal, with some comments:-

#### Approximation of Irrational numbers by Rationals BOE Extended Essay

### C.F. Gauss (Worcester)

If  $\alpha$  is a real irrational number then one can prove that there are infinitely many rational numbers  $a/q$  such that

$$\left| \alpha - \frac{a}{q} \right| \leq \frac{3}{q^2}.$$

A number of questions naturally arise. Can one replace the constant 3 by anything smaller? Can one replace  $q^2$  by  $q^3$ ? What happens for specific irrationals like  $\sqrt{2}$  or  $\pi$ ?

The essay will discuss such issues. It will give an exposition of the theorems of Liouville, Thue, and Apéry, and describe applications to transcendence problems and Diophantine equations. If time permits a complete proof of the finiteness of integer solutions of the Mordell equation  $y^3 = x^2 + k$  will be given. The latter will use results from the section B ‘Algebraic Number Theory course’.

### References

G.H. Hardy and E.M. Wright, An introduction to the theory of numbers, Sixth edition. (Oxford University Press, Oxford, 2008). [Chapter XI in particular]

L.J. Mordell, Diophantine equations, Pure and Applied Mathematics, Vol. 30 (Academic Press, London-New York 1969).

A. van der Poorten, A proof that Euler missed ... Apéry’s proof of the irrationality of  $\zeta(3)$ , Math. Intelligencer 1 (1978/79), no. 4, 195–203.

**Comments:** This is neatly typed, in Latex in fact. However the proposal is rather short, at around 100 words rather than the expected 150. The first paragraph introduces the problem to be discussed, and the second paragraph says more of what the essay would include. There isn’t much sense of why the problem is historically interesting or what the answers are to these further questions. The final sentence tries to set out the relationship to courses on the syllabus and this is useful. It would also have been useful to cite the references during the proposal.

Further details of the specific results of Liouville, Thue and Apéry would be helpful (again with references). Reference to specific theorems of Liouville etc. would allow the committee to pinpoint the level of difficulty for the project.

The three references are not presented in quite the correct style – the essay itself will have to do better! However they do contain the key information. Two of the sources cited are text books, but one is a (rather easy) research article.

The proposal however is weak in making clear its individuality. What is being discussed that isn't found in standard text books? It would be helpful to make clear the purpose of the cited research article. Some specific investigation relating to a specific irrational (as mentioned in the second paragraph) or some bringing up to date of where current knowledge stands, a review of recent papers or similar, would help extend the scope of the essay outside the canonical material of a standard text.

So the proposal is most of the way there to being adequate and agreeable, but most likely Projects Committee would in the first instance refer the proposal back asking for some of the above points to be addressed, seeking more detail, and seeking a clear sense of the individual aims of the project. This would not involve much delay (a few days) and would be intended as constructive criticism, on the basis of which the student can start the project with clearer aims in mind.

### **3.6 Supervision**

You will have six hours of supervision across Michaelmas and Hilary terms, and you will be able to decide with your supervisor how best to arrange the supervision meetings. At the meetings, you should expect to update your supervisor on the work you have done since the last meeting, and can highlight any difficulties you have encountered. Your supervisor will provide you with suggestions on how to overcome difficulties and may direct you to relevant literature. Your supervisor will read and comment on a draft of your extended essay but you should ensure that you give it to them in good time and not just prior to the submission deadline.

Supervisors are asked to keep a log of the amount and nature of project supervision that they give and this will be made available to the second assessor marking the essay. Your supervisor will be one of two assessors for the extended essay. Further information about the marking of essays can be found in section [8](#)

### **3.7 Format of the essay**

The examiners give credit for qualities such as content, accuracy, organisation, clarity and style. The final essay should be no longer than 7,500 words, and this usually equates to 25–30 pages. The word count may exclude any table of contents, all mathematical equations and symbols, diagrams, tables, bibliography and the texts of computer programs. However any preface, footnotes, and appendices must be included. Students will need to self-certify the word length of their essay, and must specify how the word-count was produced. Guidance on how to count words in