Department of Mathematical Sciences

MATH 302 History of Mathematics - 2nd Semester, 2011-2012

Objective: To illustrate the development of mathematical ideas.

Teaching arrangements: The module will include lectures, amounting to roughly three one hour sessions a week for eight to nine weeks, and covering different historical periods and different areas of mathematics, these to be complemented by individual supervisions. Each student will select a project to research and write up, *this to be chosen by Friday 2nd March and submitted no later than the first day of the examination period - see dates below.* Each student will speak, in weeks eleven/twelve, about his/her project for 20 - 25 minutes at a time to be agreed.

Assessment: 40 per cent of the assessment is linked with the four themed lecture segments, 10 per cent for each theme. Assessment methods will vary with the lecturer, but methods are likely to include class quizzes and possibly personalised take-home assignments. The project provides the remaining 60 marks, 50 for the written report and 10 for the oral presentation. There will be no final examination.

Lectures are on Mondays at 2 in Room MATH105 (Maths Building), Tuesdays at 11, also in Room MATH105, and Fridays at 12 in MATH106. There is one exception. The last lecture will be on Thursday 19 in the University Lecture Room Block Lecture Theatre D

The topics for the eight weeks before and the four after the Easter Vacation are as follows

Week 1				
	Monday 30 Jan	2 p.m.	Dr N. Backhouse	Ancient Mathematics
	Tuesday 31 Jan	11a.m.	Dr. N. Backhouse	Ancient Mathematics
	Friday 3 Feb	12p.m	Dr. N. Backhouse	Ancient Mathematics
Week 2				
	Monday 6 Feb	2 p.m.	Dr. A. Gorinov	Algebra
	Tuesday 7 Feb	11a.m.	Dr. A. Gorinov	Algebra
	Friday 10 Feb	12p.m.	Dr. A. Gorinov	Algebra
Week 3				
	Monday 13 Feb	2 p.m.	Prof. M. Rees	Analysis
	Tuesday 14 Feb	11a.m.	Prof. M. Rees	Analysis
	Friday 17 Feb	12p.m.	Prof. M. Rees	Analysis
Week 4				
	Monday 20 Feb	12p.m.	Prof. P. Giblin	Geometry
	Tuesday 21 Feb	11a.m.	Prof. P. Giblin	Geometry
	Friday 24 Feb	12p.m.	Prof. P. Giblin	Geometry

Projects must be chosen by Friday 2nd Mar

Week 5			
	Monday 27 Feb	2 p.m.	Library session CTC3 (Chadwick Building)
	Tuesday 28 Feb		No meeting
	Friday 2 Mar	12p.m.	Organisational meeting for presentations

Week 6				
	Monday 5 Mar	2 p.m.	Dr. N. Backhouse	Ancient Mathematics
	Tuesday 6 Mar	11a.m.	Dr. N. Backhouse	Ancient Mathematics
	Friday 9 Mar	12p.m.	Dr. N. Backhouse	Ancient Mathematics
Week 7				
	Monday 12 Mar	2 p.m.	Dr. A. Gorinov	Algebra
	Tuesday 13 Mar	11a.m.	Dr. A. Gorinov	Algebra
	Friday 16 Mar	12p.m.	Dr. A. Gorinov	Algebra
Week 8				
	Monday 19 Mar	2 p.m.	Prof. P. Giblin	Geometry
	Tuesday 20 Mar	11a.m.	Prof P. Giblin	Geometry
	Friday 23 Mar	12p.m.	Prof. P. Giblin	Geometry
Week 9				
	Monday 16 Apr	2 p.m.	Prof. M. Rees	Analysis
	Tuesday 17 Apr	11a.m.	Prof. M. Rees	Analysis
Non-standard time Lecture in ULRB D	Thursday 19 April	10a.m.	Prof. M. Rees	Analysis
Week 10				
	Monday 23 Apr	This week		
	Tuesday 24 Apr	See tutors and advice on written projects		
	Friday 27 Apr			

Week11-12, 30 Apr -11 May: Presentations, probably over both weeks

Projects (2 copies) submitted by Monday 21 May 5pm.

Any queries should be addressed to Prof. Mary Rees, Room 515, Mathematical Sciences Building, Tel: 0151 794 4063, email: maryrees@liv.ac.uk

Students will be expected to spend time on general reading about the History of Mathematics. A list of suggested books is attached: most of these have been placed on reserve in the Harold Cohen Library so that they may not be borrowed. **Out of consideration for others no books of general interest should normally be taken out on loan except for those specifically relating to one's approved project.**

MATH 302 -- Written Projects

50% of the marks for this module are allocated to the assessment of your project, so you should take this seriously.

Choice of topic

You may propose a project title yourself - this may relate to any area of Mathematics (Pure, Applied, Statistics, Computing). Lists of suggested titles, related to the four sections of the module, are attached, but you may also propose your own topic. Such topics might be the study of a particular mathematician, of a group of mathematicians in a particular country over a suitable period, or of the development
of some particular concept.

After preliminary reading and consultation you should approach a lecturer with the proposal to write a project on a certain topic. You should not start writing until permission to go ahead has been formally given. All choices must be registered with Prof. Rees by **Friday, 2nd March**; before permission is given she must be satisfied that some lecturer has agreed to supervise the project. No two students will be permitted to submit essays on identical or closely related topics.
It will normally be expected that the student meets with the supervisor for his or her topic once every one to two weeks during the relevant period. It is of course understood that the project should be the student's own unaided work.

Guidelines for writing a project

Essays should not ramble, but be clearly organised with (usually) a theme, an introductory paragraph, some division into sections and a conclusion. It is not intended to take off marks for incorrect grammar or punctuation, but it is expected that the essays are written in correct English. They may be hand-written (legibly in black ink so that they can be photo-copied!) or preferably typed or word-processed. The usual rules of presentation of mathematics should be followed: results should be stated explicitly and clearly rather than mentioned vaguely, and of course the mathematics should be correct. If you wish to present a detailed proof of a result try to present it in your own words rather than copying verbatim from a book. Present proofs in a way that makes it clear that you understand them and keep the notations consistent throughout. The lecturer will provide some references, but will expect the student to look for others. A list of all references consulted should be given at the end of the essay (author, publication and date). Dates in particular are important. Any quotes should be explicitly acknowledged and referenced.

Important note on web references Web links must be referenced. Information from Wikipedia must be verified at another source. Following consultation with the subject librarian, Zelda Chatten, we recommend Credo Reference
http://www.credoreference.com.ezproxy.liv.ac.uk/
for general historical information, and the Physical Sciences and Mathematics section of Oxford Reference Online
http://www.oxfordreference.com.ezproxy.liv.ac.uk/views/SUBJECT_SEARCH.html?subject=s19
for scientific and mathematical information.

Essays should be of the order of 6000 words. While some variation may be expected any essay of less than 3000 words will normally be regarded as inadequate, and no credit should be expected for any surplus over 9000 words. Students should beware of spending too much time on a project and writing over-long essays. Marks will be awarded primarily for the depth of understanding of the topic revealed in the essay, and the quality of exposition

Timetable of Important Deadlines

All decisions as to title and supervisor must be approved by **Friday, 2nd March**, at latest.

It will normally be expected at the student meets the supervisor every one or two weeks from then until the end of term.

Two copies of your Project must be handed in to the Pure Mathematics Office (Room 516) by **Monday 21 May 5 pm.** Elaborate bindings are not required, a simple plastic strip binder being the best.

Mark Scheme:

Content (Total of **50%**)

Introduction	**5**
Historical Setting	**10**
Technical understanding of Mathematics	**15**
Clarity of explanation	**10**
Sources	**5**
Readability	**5**
Maximum Mark	**50**

Sanctions!

Any homework assignment must be handed in by the due date. For a homework worth five points ,5% will be deducted for each weekday that it is late. Homework, which is more than 5 days late, unless there are documented mitigating circumstances, will not be marked. Any class quizzes missed will lead to a loss of marks unless there are documented mitigating circumstances

Any delay past Friday, 2nd March, in selecting a project will incur five points loss immediately and five further points for each week's delay. The late submissions of projects will be penalised at 5% for each weekday it is late and if a project is more than 5 days late, it will be given a mark of 0.

Sanctions may normally be waived only on production of a doctor's certificate covering the relevant period.

MATH 302 -- Oral Presentations

Your oral presentation is worth a maximum of 10 marks.

The dates and times of all the presentations will be agreed after the organisational session in Week 5, and it is hoped that you will act as audience to others of the talks on the same morning as yours, at least. At this meeting you will also be asked to indicate whether you intend to use OHP or laptop and data projector for your presentation. Your talk should last a minimum of twenty minutes and a maximum of twenty-five. The timetable of talks, together with rooms, will be available as soon as possible after the organisational meeting in week 5.

A well-structured talk has a clear introduction, makes one or two points simply and has a positive conclusion. As this is a course on the History of Mathematics your topic should be placed in an appropriate historical context and show understanding of the mathematical ideas discussed. There will not be time for extended proofs but there should be room for clear definitions and statements of theorems, illustrated by well chosen examples. Credit will be given for holding the

attention of your audience and even involving them, though that can be wasteful of time if carelessly handled! The final five minutes can be used partly for taking one or two questions.

It is a common mistake to put too much on a transparency, or on the slide of an electronic presentation. A few headings in large letters or a well-designed diagram are better than many lines of text. Photocopied print is usually too small unless enlarged by the photocopier. In producing transparencies on the photocopier it is essential that the correct type of transparency be used. So get help from one of us: don't try to make them without assistance. Your final slide of the presentation should give your major sources correctly referenced

Be in the room for your talk in good time, ready to start. Marks will be deducted if you dry up before the twenty minutes and there will be a strict cut-off at twenty-five. Don't come only for your own presentation, but support your colleagues, by listening to as many others as you can find time for. Ideally your talk should be addressed to your colleagues present and not to the staff. You might even learn more from these talks than from the lectures given earlier!

Mark Scheme:

Content (Total of **60%**)

Introduction --	**5**
Historical Setting --	**15**
Mathematics, or an indication of what Maths is in the written project --	**25**
Sources --	**5**
Summary --	**5**
Positive ending --	**5**

Delivery (Total of **40%**)

Use of aids, blackboard, etc –	**20**
Verbal presentation (clarity, fluidity) –	**10**
Contact with audience --	**10**

World Wide Web

There is now a great deal of information on mathematicians on the web. A good place to start is either at a very good site at Trinity College, Dublin:
http://www.maths.tcd.ie/pub/HistMath/Links.html#Biographies
or the MacTutor History of Mathematics archive at St Andrews:
http://www-groups.dcs.st-and.ac.uk/~history/index.html
also accessible via the Trinity College site. Another useful site is

http://wos.mimas.ac.uk/

If you acquire any information from such a source full referencing is required, just as for any information acquired from books or journals.

Referencing

There is no unique good way of giving a reference - you should decide for yourself the most appropriate method for you. But it is essential always to give author and title of book, with publisher and date of publicattion or title of journal with volume number and pages and date. It might be appropriate also to comment on the references as to how relevant they are to the project. These are matters to discuss with your supervisor in good time.

Ancient Mathematics – a selection of possible project titles

1) Some ancient number systems and their applications.

2) Discuss Eudoxus' definition of proportion and how it overcame the problems caused by the discovery of incommensurables.

3) Give an account of the "Method" and "Exhaustion" techniques of Archimedes.

4) Give some examples of the results and proofs given by Archimedes using spirals. Show how Archimedes uses spirals to bisect a general angle and to square a circle of arbitrary radius. Give a modern proof of the result on the length of the subtangent.

5) Zeno's paradoxes and how they influenced mathematics through the centuries.

6) Some Greek construction problems and their modern algebraic solutions.

7) Pythagoras' Theorem: Its origins, proofs and applications.

8) Indian Mathematics – Trigonometry and series approximations.

Some possible project titles in Algebra.

1. The development of complex numbers from the time of Cardano to the time when they became generally accepted by mathematicians.

2. The construction of regular polygons. Show who developed the theory and give constructions for the regular pentagon and 17-gon.

3. Algebra and the Arabs.

4. The story of the solution of algebraic equations of degrees 4 and 5, up to Abel

5. Algebraic equations over finite fields (possible contributions to discuss: Diophantes,Gauss,Galois).

6. A survey of Amicable Numbers from Pythagoras to Euler (Escott, Scripta Math 12 (1946)).

7. Jordan Normal Form (T. Hawkins, Arc. Hist. Exact Sci. 17 (1877)).

8. Quadratic forms and their Classification (possible contributions to discuss: Descartes, Euler).

9. Linear Differential Equations.

10. A topic in the development of group theory e.g. permutation groups (possible contributions to discuss: Cauchy, Galois, Jordan.

11. Vector spaces, and linear maps.

12. Division algebras, including the quaternions and the Cayley numbers.

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13. Clifford and Grassmann algebras. (John C. Baez, The Octonions, Bull. Amer. Math. Soc 42 (2005) p 213) (A possible supervisor for this topic is Dr. Backhouse.)

Some possible project titles in Analysis

1. Numbers: real, rational, integer

2. The development of calculus. Different periods are possible: the early workers such as Roberval, Tonnicelli, Barrow, Kepler, or Newton, Leibnitz, or some comparison

3. Complex numbers in analysis.

4. Riemann surfaces

5. Ordinary Differential Equations

6. Calculus of Variations

7. Infinite series

8. The Wave Equation, Fourier series and partial differential equations

9. Functions

10. The History of Dynamical Systems

Some possible project titles in Geometry

General Topics:

Euclidean geometry and the parallel postulate The development of non-euclidean geometry The development of projective geometry The development of differential geometry, seen through the history of map projections.

1. The origins of projective geometry in the theory of perspective.

2. The work of Poncelet in projective geometry.

3. Hilbert's work on the foundations of geometry

4. Models of non-euclidean geometry.

5. Plane curves of degree more than 2, in the work of Newton and various 19th century mathematicians.

6. Map projections prior to the development of calculus.

7. The impact of calculus on the development of map projections.

8. Lambert's work on conformal map projections.

9. Lambert's work on area-presenving map projections.

10. Gauss's work on map projections leading to the differential geometry of surfaces.

11. The determination of latitude and longitude.

12. 20th century map projections.

Some possible project titles in Statistics.

1. The application of probability to gambling: from 17th century gaming tables, to modern day spread betting.

2. Bayesian statistics: charting the legacy of Rev. Thomas Bayes.

3. The rise of hypothesis testing: Student's t-test and onwards.

4. The history of randomized clinical trials.

5. The statistical contribution to epidemiology.

6. The rise of statistical process control and its contribution to our modern world.

7. How the progress of statistics followed the rise of the computer.

General Reading List

The following Books are general introductions to the History of Mathematics and are very useful as a first introduction to the subject. There are often multiple copies and various editions in the Harold Cohen (QA21 etc). Some are in the Short Loan Collection and some are in the Education Library. The * ones are especially relevant to this module as a source of reference and ideas. Special note on Kline: this book can

be bought second-hand or on a "printed to order basis". There are three volumes priced at £12 or £ 13 each at Amazon and at Oxford University Press.

It is worth looking for second-hand copies of these and other books. Amazon is an obvious place to look: http://www.amazon.co.uk

* **BOYER, Carl Benjamin**. A history of mathematics by Carl B. Boyer. 1968. Wiley, New York. Short Loan QA21.B79

CAJORI, Florian. A history of mathematics by Florian Cajori. 2nd. ed. rev. l. 1926. Macmillan, New York. QA21.C13.

* **EVES, Howard.**An introduction to the history of mathematics 3rd 4th ed. 1969 Holt, Rinehart & Winston, New York. Short Loan QA21.E91.3 Harold Cohen Library QA21.E91.4

KATZ, Victor J. A history of mathematics: an introduction. 1993. Harper-Collins, New York. Harold Cohen Library QA21.K11

* **KLINE, Morris** .Mathematical thought from ancient to modern times 1972. Oxford University Press, New York. QA21.K61 Education Library EDUC T510.9 KLI

SCOTT, Joseph Frederick. A history of mathematics, from antiquity to the beginning of the nineteenth century. 1960. Taylor & Francis, London. QA21.S42.2

SMITH, David Eugene. History of mathematics 1923-1925 (various printings Ginn, Boston. Short Loan QA21.S64 v.1 , v.2 QA21.S64 V1

STRUIK, Dirk Jan A concise history of mathematics 1962. Bell, London. QA21.S92

YOUNG, Laurence Chisholm. Mathematicians and their times: history of mathematics and mathematics of history 1981. North-Holland, Amsterdam. QA21.Y71

Encyclopaedia of Mathematics. An updated and annotated translation of the Soviet Encyclopaedia. Kluwer, 1991. QA5.E51

Some Books Related to the History of Algebra

J.Fauvel and J. Gray, The History of Mathematics: A Reader, MacMillan (1987) QA21.F24

J. Gray, Linear differential equations and group theory from Riemann to Poincare QA372.G77

M.Kline, Mathematical Thought from ancient to

modern times, vols 1-3 OUP (1972)

L. Novy, Origins of Modern Algebra QA155.N94

B.L.van der Waerden, A History of Algebra, Springer 1985 QA151.v21

Some books on Statistics and Probabilty

Stigler, SM. Statistics on the Table: The History of Statistical Concepts and Methods. (1999), Harvard University Press

Stigler, SM. The History of Statistics: The Measurement of Uncertainty before 1900. (1990), Harvard University Press

Stolley, PD and Lasky, T. Investigating Disease Patterns: Science of Epidemiology. (1996), WH Freeman

McMichael, T. Human Frontiers, Environments and Disease: Past Patterns, Uncertain Futures. (2001), Cambridge University Press

Gigerenzer, G, et al. The Empire of Chance: How Probability Changed Scioence
and Everyday Life. (1990), Cambridge University Press

David, FN. Games, Gods and Gambling: A History of Probability and Statistical Ideas. (1962) Dover Publications

Bernstein, P. Against the Gods: the Remarkable Story of Risk. (1996), Wiley

Berry, DA Statistics: A Bayesian Perspective. (1996), Duxbury Press