Department of Mathematics & Statistics
Concordia University

MATH 648A (MAST 654AA)
Topics in the History of Mathematics
Fall 2016

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Class Hours: Tuesdays, 18:00-20:15, LB 921-4.

Required Text: *A History of Mathematics*, Carl B. Boyer and Uta C. Merzbach (3rd Edition, Wiley).

Supplementary Text: 1. A. Koestler: *The Sleepwalkers: A History of Man's Changing Vision of the Universe,* Penguin paperbacks, 1990.
2. Roger L. Cooke, *The History of Mathematics: A Brief Course*, 3rd Edition, Wiley (2012) ISBN: 978-1-118-21756-6.

Evaluation: Weekly presentations: Mathematical: 20%; Historical: 20%.
Final Presentations Mathematical: 30%; Historical: 30%.

Content: The content will be drawn from the list of topics below. The course will be based on active participation by all students enrolled. Weekly readings and exercises will be assigned and presented by students in alternation with background topics introduced by the instructor. Roughly equal time will be devoted to the history of specific mathematicians and the mathematical results they discovered. Each student will choose a topic from those listed below for a brief presentation (20-30 mins.) during the weekly sessions, plus a longer one (30-40 mins.) near the end of the semester. This will be the basis for evaluation and grading (see below).

1. Mathematics in the ancient world: (Weeks 1 - 3) (Four student presentations)
Mesopotamian, Egyptian, Indian, Chinese and Greek mathematics before the 3rd century AD.
1.1. Mesopotamian and Chinese proofs of Pythagoras' theorem,
1.2 Ancient methods of calculation, bases, notion of zero.
1.3. Euclidean geometry, the Platonic solids; planar geometry, Ptolemy's theorem; Menelaus' theorem
1.4 Astronomy and the planetary system
1.5 Arithmetic, prime numbers, Diophantine equations,
1.6 Zeno's paradox.

2. Mediaeval Persia and the Islamic world: (Week 4) Mathematics in the Islamic world, from the 8th to the 12th century. (Two student presentations)
2.1. The birth of algebra Al Kharizmi)
2.2. Omar Khayyam: roots, cubics and geometrical proofs in algebra.

3. Renaissance algebra: Solution of algebraic equations of third and fourth degrees (Week 5)
(Two student presentations)
3.1. Cardano
3.2 . Ferrari and Tartaglia

4. Astronomy and the planetary system in the 17th century (Weeks 6-7)
(Two student presentations)
4.1 Ptolomeic planetary system (ergocentric)
4.2. Copernicus
4.3. Tacho Brahe and Kepler
4.4. Galileo

5. The age of enlightenment. (Weeks 8-9) (Four student presentations)
5.1. Coordinate charts and the algebraization of geometry (Descartes)
5.2 The birth of infinitesimal calculus and the laws of motion (Newton, Leibnitz) 5.3. Differential equations and dynamics (Newton, Euler, Lagrange)
5.4. The birth of probability theory (Bernoulli)**.**

6. The age of revolution; the birth of new ideas: (Weeks 10-11) (Four student presentations)
6.1. Dynamics and differential equations (Euler, Lagrange, Hamilton, Jacobi, Cauchy, Weierstrass);
6.2. Birth of modern analysis; the notion of rigour (Weierstrass)
6.3. Complex analysis (Abel, Jacobi, Weierstrass, Riemann)
6.4. Non-Euclidean geometry (Gauss, Lobachevski, Riemann, Klein)
6.5. Group theory (Abel, Galois, Lie, Klein, Frobenius, Burnside, Schur)
6.6. Number theory (Gauss, Dedekind, Hadamard, de la Vallée Poussin, Riemann).

7. Mathematical adventures and dramas: (Selected presentation topics from the Renaissance to early 20th century) (Weeks 12-13) (Four student presentations)
7.1. Mathematical jousting matches: Tartaglia, Ferrari, Cardano. (16th cent.)
7.2. Romantic genius, illness, revolution and dueling:
7.2.2. Abel
7.2.3. Galois.
7.3. Sophie Kovalevskaya. (19th cent.)
7.4. From an Indian village to Cambridge: Ramanujan. (Early 20th cent.)

8. Further presentation topics: highlights from the end of the millennium: (as time permits)
(Four student presentations)
8.1. Qualitative dynamics (Poincare);
8.2. Hilbert spaces and operator theory (Hilbert)
8.3. Physics as geometry (Einstein),
8.4. The meeting of algebra and topology (Lefschetz, Alexander)
8.5. The foundations of mathematics logic (Russell, Whitehead)
8.6 Logic and the limits to knowledge Gödel);
8.7. Man made thinking machines (Von Neumann; Turing)
8.8. Randomness as a science (Wiener, Kolmogorov)
8.9. Games, strategies and entropy (Shannon, Von Neumann, Nash).