2014

MATH 125-03 Mathematical Perspectives: The Mathematics of Calendars and Timekeeping

Daniel Otero

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MATH 125-03 Mathematical Perspectives: The Mathematics of Calendars and Timekeeping – Fall 2014

Course Content: This course is an exploration of how mathematics permeates one of the most important features of life: how we manage and control the passage of time. You will come to realize how mathematics has come to serve as an invaluable tool for timekeeping, from ancient times to the present. We will study the fundamental astronomical phenomena that form the foundations of all timekeeping and we will survey the diverse and fascinating ways in which human cultures have chosen different mathematical models for reckoning times, dates, and periods. Of particular interest to us will be the diversity of mathematical solutions to the problems of timekeeping that have been devised by people of different cultures and ages.

Time & Place: MWF 2:00 - 2:50pm; SMH G27.
Instructor: Daniel E. Otero
Office Hours: MWF 1:00 - 2:00, T 1:00 - 4:00; or by appointment at my office (Hinkle 104).
Phone: (513) 745-2012 (voicemail available)
Email: otero@xavier.edu (In addition, you may contact me through the Canvas Inbox feature.)


Calculator: A TI-83 or -84 model graphing calculator is standard equipment for all mathematics courses at Xavier, and will be necessary for the computations we will be performing in this course.

Grading: A scale based on a total of 500 pts. A combination of

- homework activities assigned almost every week, distributed in class, then collected for grading [100 pts = (overall percentage based on best 5 of 7 activities @ 20 pts)];
- two research papers, one due Wed, Oct 8, on some topic of your choice having to do with the history of clocks or the technology of timekeeping; a second due Mon, Nov 24 (suggested topics listed below) [100 pts = 2 @ 50 pts];
- Midterm Test 1 (Sep 26) [100 pts];
- Midterm Test 2 (Oct 31) [100 pts]; and
- Midterm Test 3 (Dec 5) [100 pts].

will form the basis of your grade. Late work will be accepted, but will not likely be graded in a timely manner (and possibly, not at all!). Your score on the final exam (scheduled for 2:00-3:50 pm on Wed, Dec 17) will replace the lowest of the five scores itemized above. No extra credit work will be assigned.

GRADING SCALE:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Range</th>
<th>Description</th>
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<tbody>
<tr>
<td>A</td>
<td>92.5 – 100.0</td>
<td>Exceptional</td>
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<tr>
<td>A−</td>
<td>90.0 – 92.5</td>
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<td>B+</td>
<td>87.5 – 90.0</td>
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<tr>
<td>B</td>
<td>82.5 – 87.5</td>
<td>Good</td>
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<tr>
<td>B−</td>
<td>80.0 – 82.5</td>
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<tr>
<td>C+</td>
<td>77.5 – 80.0</td>
<td>Satisfactory</td>
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<td>C</td>
<td>72.5 – 77.5</td>
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<tr>
<td>C−</td>
<td>70.0 – 72.5</td>
<td>Minimum passing</td>
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<td>D</td>
<td>60.0 – 70.0</td>
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<tr>
<td>F</td>
<td>0.0 – 60.0</td>
<td>Failure</td>
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The Department of Mathematics & Computer Science has adopted this Statement of Grading Standards which you should review.

Papers: Research papers should conform to the following guidelines, listed in order of importance, and will be evaluated against these criteria:

- The paper should present a comprehensively researched discussion of your topic, which should explore ideas beyond anything already dealt with in our classroom discussions; if your focus is biographical, then some significant accomplishments of that individual having to do with astronomy, dating, chronology, or time keeping must be thoroughly discussed [18 pts].
- It should be presented in a clear and coherent writing style, using correct spelling, proper punctuation, and good grammar [12 pts].
- It should contain a bibliography with at least three sources, not counting your textbook. At least two of your sources must be published in print (not web-based). Your paper should include citations as either footnotes or endnotes; any standard bibliographic style is acceptable [12 pts].
- The body of the paper is to be 4-8 pages long, typed or word-processed (in a 10 or 12 point font), double-spaced, with 1 inch margins. In addition, include a separate, unnumbered cover page, follow the body with a bibliography page, and a final blank page for my comments [8 pts].

Here is a list of topics from which you may choose to write your papers. But do not view this as an exhaustive list; feel free to suggest topics of your own to me. In any case, your choices need to be ratified by Prof. Otero; do not begin work on your papers until you have checked with him on your choice of topic!

- the evolution of Babylonian sexagesimal numeration
- History of the Hindu-Arabic numerals and the invention of zero
- Stonehenge, ancient observatory?
- Machu Picchu and the Intihuatana stone: Incan observatory?
- The Khmer temple of Angkor Wat and its astronomical features
- the Antikythera device
- The standardization of time in the modern world: Universal Time and the development of world time zones
- History of millennial movements and their connections with calendars
- the Y2K "bug"
- What is time? Survey what philosophers have said about the nature of time.

Biographies also make for good papers; you may want to study the careers of these individuals; make their contributions to the development of calendars the focus of your research:

- the Greek astronomers Meton and Euctemon of Athens, Calippus of Cyzicus, and Hipparchus of Nicea
- Ptolemy III Euergetes, calendar reformer and patron of the sciences
- Claudius Ptolemy's Almagest and Geographica
- Dionysius Exiguus, inventor of the Christian era
- Aryabhata, Hindu mathematician and astronomer
- the Venerable Bede
- Abu-Rayhan Al-Biruni, Arabic astronomer and mathematician
- Luigi Lilio (Aloysius Lilius) and Christopher Clavius, authors of the Gregorian reform
- Johann Adam Schall von Bell, Jesuit scientist and missionary to China
- Johannes Kepler and the birth of modern astronomy
- Joseph Justus Scaliger
- John Harrison and the accurate determination of longitude
- Auguste Compte, Pierre Sylvain Marechal and Philippe-Francois Nazaire Fabre (d'Eglantine), revolutionary calendarists
• Carl Friedrich Gauss and the Easter computus
• Moses Bruines Cotsworth, calendar reformer
• Elisabeth Achelis, calendar reformer

You can do no worse than beginning your research by consulting the excellent index and bibliography in E.G. Richards' book. Wikipedia is also a good place to begin, but beware not to use only internet resources (see the guidelines above).

Attendance: Attendance is mandatory and participation in class is expected. If you must miss a test due to an emergency, I must be notified on or before the day of the absence. No arrangements for missed work will be made otherwise!

Reading: More than in most mathematics courses, this one will require a fair amount of reading and writing. The course material includes a large number of specialized terms used in timekeeping, and it is important that you become familiar with this jargon, so that we can discuss the underlying ideas intelligently in the classroom. Please be diligent with the reading assignments.

Valuable Internet Resources:

• Time and Its Discontents <www.primitivism.com/time.htm>
• Calendar Studies <www.hermetic.ch/cal_stud.htm>
• Astronomical Timekeeping <www.maa.mhn.de/Scholar/times.html> <curious.astro.cornell.edu/timekeeping.php>
• Calendopedia (Mike Astbury) <www.calendopedia.com>
• Calendar applet at Calendrical Calculations <emr.cs.iit.edu/home/reingold/calendar-book/third-edition/>
• Lunisolar Calendar proposal <pburch.net/lunarcal.html>
• Weeks and Months <gkindia.com/holidays/weekdays.htm>
• National Maritime Museum (UK) <www.nmm.ac.uk/explore/astronomy-and-time/>
• US Naval Observatory <aa.usno.navy.mil/faq/docs/calendars.php>
• Philosophy of Time <www.iep.utm.edu/t/time.htm>
• Egyptian dates (Egyptian Alexandrian calendar dates and their corresponding Julian equivalents during the era 332BC - AD14; also includes much good information regarding the nature of this calendar) <www.tyndale.cam.ac.uk/Egypt/ptolemies/chron/egyptian/chron_eg_intro.htm>