The Physics and Philosophy of Time
HON 250-02 — Spring 2010 — ERAU — Reynolds

Part I: Calendars, months, weeks, days, and seconds

1. READ:

   - Selections from "How Time is measured," by Peter Hood, Oxford, 1955. Volusia County Library `529 Hoo`.

   DEFINE:

   - Gregorian shift
   - Equation of time
   - International date line

   ANSWER:

   - Why did Phileas Fogg, the protagonist in Jules Verne's novel, "Around the World in 80 Days," arrive back in England one day early?
   - Do you think the "World Calendar" will ever be implemented?

2. READ:

   - "The Roman calendar and its reformation by Julius Caesar," Roscoe Lamont, *Popular Astronomy*, **27** 583-595 (1919).

   DEFINE:

   - intercalary

   ANSWER:

   - When was the system of one leap day every four years first used? By whom?
   - What date is the actual extra day in a leap year, as envisioned by the Romans? HINT: It's not February 29.
   - What is your birthday, expressed the Roman way?
   - List the days of the week (in English and one other language) along with the "planet" that each corresponds to.

3. READ:

   - "Calendars and Time Reckoning," Chapter 4 in *The history and practice of ancient astronomy*, James Evans, Oxford Univ Press, 1998.
     Read only §4.1-4.2, pages 163-171. Reading §4.3-4.9 is optional.

DEFINE:

- vernal equinox
- synodic
- sidereal

ANSWER:

- What are the dates of the Islamic holy month of Ramadan for the years 2009-2013? List the predicted dates of all the new moons for the same years.
- Look up the Council of Nicaea in 325 C.E. What else, besides Easter, was discussed?
- What was the date of the Bolshevik Revolution in 1917?
- Answer Exercise 4 on page 171. That is, calculate the length of the average Gregorian year in decimal days.
- What famous event occurred on the Ides of March?

EXTRA CREDIT:

- Answer Exercise 3 on page 175.

4. READ:

- "On the Gregorian Revision of the Julian Calendar," Jacques Dutka, *Mathematical Intelligencer*, **10** 56-64 (1988).
- "Answer to Question #4. Is there a physics application that is best analyzed in terms of continued fractions?" Thomas J Pickett, *Am. J. Phys.*, **65** 461-462 (1997).

DEFINE:

- incommensurable
- continued fraction, convergent

ANSWER:

- Express the average Julian year, the average Gregorian year, and the current best measurement of the tropical year (365.2422 days) in the days-hours-minutes-seconds format.
- Why is the Earth's rotational rate slowing down?
- Evaluate the first four convergents of the continued fraction on page 461 of Pickett, and compare to the convergents listed at the top of page 59 of Dutka.
- Does the proposal of Pickett satisfy the two rules of Christoph Clavius, as listed in the first full paragraph of page 61 of Dutka?

5. READ:

- "The evolution of time measurement," Chapter 4 in *The measurement of time: Time, frequency and the atomic clock*, Claude Audoin and Bernard Guinot, 2001. Read only §4.1-4.3, pages 38-51. Reading §4.4, 4.5 is optional.

COLLATERAL READING:

- "On ships, trains, and the equation of time," Anna Sajina, *Physics Today*, pp. 76-77, November 2008.
- "... of Time and the Sun," Richard M. Sutton, *Physics Today*, pp. 15-19, June 1956.

ANSWER:

- What is the eccentricity e of the Earth's orbit? What is the obliquity (i.e., axial tilt) of the Earth's rotation?
- What is the true shape of the Earth? How big is its "flattening factor," and what does it represent?
- Why is GMT technically incorrect?
- How many "minutes" wide is Florida?
- Who is responsible for the first transatlantic radio signal? What award did he win for this achievement?
- From the definition on page 50 of Audoin and Guinot, how many (decimal) days were in the tropical year 1900?
- Write a short paragraph explaining the research of Steven Chu, the current Secretary of Energy, that led to his Nobel Prize in 1997.