Astronomy 410 — Radio Astronomy, Fall 2007
Meeting place and time: CSS 2428, TTh 3:30 pm — 4:45 pm

Instructor: A. Harris, CSS 1229
Phone: 301-405-7531; e-mail: harris(at)astro.umd.edu
Office hours: You are encouraged to make an appointment or just drop by!

Astronomical observations at radio wavelengths are a vital part of the study of nearly any object in the universe. Radio astronomy plays a key role in discovering and understanding objects as diverse as the Cosmic Background Radiation, the huge jets of relativistic matter from the nuclei of luminous galaxies, ionized gas around young stars, pulsars, diffuse clouds of hydrogen atoms orbiting in galactic gravitational potentials, dense molecular clouds with embedded star formation, evolved stellar atmospheres, the Sun, and the planets. This course is an introduction to the basic physics, instrumentation, and observational targets of radio astronomy. This is an upper-division course that assumes some background in basic physics (waves and E&M in particular) and mathematics (calculus, vector analysis, simple differential equations).

Course work includes twice-weekly lectures, approximately weekly take-home problem sets, a midterm, a cumulative final exam, and a term paper or project with topic to be decided by mutual agreement with class members and the instructor.

Course grading and the grade distribution are set by:

<table>
<thead>
<tr>
<th>Item</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>30%</td>
</tr>
<tr>
<td>Midterm</td>
<td>20%</td>
</tr>
<tr>
<td>Final</td>
<td>30%</td>
</tr>
<tr>
<td>Term paper or project</td>
<td>20%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade</th>
<th>% Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>90-100%</td>
</tr>
<tr>
<td>B</td>
<td>80-90%</td>
</tr>
<tr>
<td>C</td>
<td>70-80%</td>
</tr>
<tr>
<td>D</td>
<td>60-70%</td>
</tr>
<tr>
<td>F</td>
<td>&lt;60%</td>
</tr>
</tbody>
</table>

The exams will be rescaled (only upward if necessary) for an 85% class median. Experience shows that this is an A/B class for most students. Grading will use the plus/minus scheme linearly interpolated within each grade.

Problem sets are due at the beginning of lecture on the due date. Late problem sets will be accepted for 80% credit up to one lecture past due, but no credit will be awarded after that. Working the problems is useful in any event, since some of the exam questions will be very familiar to those who have done the problems.
The course textbook is *A student’s guide to Fourier transforms, Second Edition* by J.F. James for some of the mathematical background, a paperback from Cambridge University Press, ISBN 0-521-00428-4. Higher level recommended books are *Tools of Radio Astronomy* by Rholfs and Wilson and the classic *Radio Astronomy* by Kraus. Since there is no text at the right level, we won’t be following a text exactly, so lecture attendance and note-taking are important.

The University regulations apply strictly regarding academic honesty and excused absences. Students with a documented disability who wish to discuss academic accommodations should contact me as soon as possible.
Astronomy 410, Fall 2007
Approximate schedule

**Th, Aug. 30**  Introduction; sources of radio waves
**Tu, Sep. 4**  Overview of detection schemes: direct and heterodyne
**Th, Sep. 6**  Heterodyne radiometers I: amplification and noise
**Tu, Sep. 11**  Mathematical tools: Fourier series and transforms
**Th, Sep. 13**  Heterodyne radiometers II: frequency conversion (Football mess?)
**Tu, Sep. 18**  Spectrometers
**Th, Sep. 20**  The overall receiving system; the radiometer equation
**Tu, Sep. 25**  Antennas: diffraction in single dishes and interferometers
**Th, Sep. 27**  Antennas: wire antennas, single dishes, optics, and feeds
**Tu, Oct. 2**  Antennas: interferometry and aperture synthesis
**Th, Oct. 4**  Antennas: interferometry and aperture synthesis
**Tu, Oct. 9**  Practical observing and coordinate systems
**Th, Oct. 11**  Radiation: energy, power, flux density, Janskys, and all that
**Tu, Oct. 15**  Radiation: spectra revisited; radiative transfer, optical depth

**Th, Oct. 18**  **Midterm**
**Tu, Oct. 23**  Galactic continuum radiation: The Galaxy and other galaxies
**Th, Oct. 25**  Galactic continuum radiation: Synchrotron emission, cosmic rays
**Tu, Oct. 30**  Galactic continuum radiation: Free-free emission and young stars
**Th, Nov. 1**  The Interstellar Medium: Temperatures and line formation
**Tu, Nov. 6**  The Interstellar Medium: Neutral and ionized hydrogen
**Th, Nov. 8**  The Interstellar Medium: Molecular clouds
**Tu, Nov. 13**  Galactic dynamics
**Th, Nov. 15**  Stars and the Sun
**Tu, Nov. 20**  Pulsars
**Th, Nov. 22**  **Thanksgiving break**
**Tu, Nov. 27**  Radio galaxies, quasars, and active galactic nuclei
**Th, Nov. 29**  Cosmology: discrete sources
**Th, Dec. 4**  Cosmology: dust continuum and protogalaxies
**Tu, Dec. 6**  Cosmology: cosmic microwave background
**Th, Dec. 11**  Special topics

**W, Dec. 19**  **Final Exam, 10:30-12:30** (as scheduled by University)