Astronomy 585/485 – Radio Astronomy
Spring 2020

INSTRUCTORS:	Professors Chris Walker	Dan Marrone
OFFICE:	SO Room 211	SO Room N314
TELEPHONE:	621-8783	621-5175
EMAIL:	cwalker@as.arizona.edu	dmarrone@email.arizona.edu

LECTURES: MWF 1:00 p.m. – 1:50 p.m, SO Room 208

COURSE DESCRIPTION: The purpose of this course is to introduce you to the theory, instrumentation, and techniques used in observational radio astronomy. We will achieve this goal by combining lectures and discussions with hands-on laboratory experiences.

GRADING:

Homework	30%
Labs	30%
Midterm	20%
Final	20%

Students registered for the graduate-level course, ASTR585, will be subject to additional homework/lab questions and will be expected to show a higher level of mastery on the exams.

TEXTBOOKS: Much of the course material will be covered by the textbook, "TeraHertz Astronomy" written by Professor Walker. The book can be purchased via the web (Amazon, CRC Press, etc.) and is available in the UA main library, as well as the Steward library. Pdfs of the pertinent sections of the draft version of the book will be made available to students in the class. For the interferometry portion of the class, Thompson, Moran & Swenson, "Interferometry and Synthesis in Radio Astronomy" is required. It can be purchased ($60) or downloaded as a free PDF directly from Springer: http://www.springer.com/us/book/9783319444291

MIDTERM EXAM: An in-class, closed-book midterm is tentatively scheduled during the normal lecture time on February 28th.

FINAL EXAM: An in-class exam will be held on the final class day.

LABS: Lab work is an essential part of this course. Four labs are scheduled for this semester, to be carried out in small groups outside normal class hours.

LEARNING OUTCOMES:

1. Demonstrate the ability to meaningfully analyze, apply and integrate [ASTR585: Exhibit an expert-level facility to engage with] the principle findings, common applications, current problems, fundamental techniques, and underlying theory of the astronomy discipline.
2. Employ discipline skills related to [ASTR585: Demonstrate advanced discipline skills and knowledge necessary to utilize] the observational techniques, instrumentation, computational methods, and software applications used to investigate modern astrophysical phenomena and problems.

***SCHEDULE:**

Jan 15, 17	Introduction to Radio Astronomy: History & Science	CW
Jan 22, 24	Antennas and Diffraction *Source-Beam Coupling, Diffraction, Convolution, Efficiencies* **(Martin Luther King, Jr. Day: Jan 20)**	CW
Jan 27, 29, 31	Gaussian Beam Optics *Theory, Illumination, Design* **Lab #1:** Gaussian beams	CW
Feb 3, 5, 7	Coherent Receivers I *Types, Theory of Operation, Limiting Sensitivity*	CW
Feb 10, 12, 14	Coherent Receivers II: Signal Processing and Calibration *Spectrometer Types, System Temp*	CW
Feb 17, 19	Incoherent Detection *Types, Theory of Operation, Limiting Sensitivity* **Lab #2:** Detector Lab	CW
Feb 24, 26, 28	Practical Radio Astronomy *Atmosphere, Real telescope capabilities, Heterodyne/incoherent comparison, Mapping speed of arrays* **Midterm (Feb 28)**	CW
Mar 2, 4, 6	Emission Processes I: Radiative Transfer and Continuum **(UA Spring Break: Mar 9-13)**	CW
Mar 16, 18, 20	Emission Processes II: Radio Propagation Effects *Interstellar scintillation, dispersion, Faraday rotation*	DM
Mar 23, 25, 27	Single Dish Observing	CW
Mar 30, Apr 1, 3	Fourier Transforms *1D and 2D FT, digital sampling* **Lab #3**: Digital Lab	DM
Apr 6, 8, 10	Interferometry I: Theory *Van Cittert-Zernike theorem, Two-element response*	DM
Apr 13, 15, 17	Interferometry II: Practice *Building an interferometer, u-v sampling*	DM
Apr 20, 22, 24	Interferometry III: Images *Synthesis imaging and deconvolution* **Lab #4:** Rooftop interferometer	DM
Apr 27, 29, May 1	Interferometry IV: Sensitivity and Limitations *Sensitivity, Atmosphere, VLBI.*	DM
May 4	Current and Future Capabilities *Galactic/extragalactic radio astronomy, cosmology* *Capabilities, design considerations and key science goals*	DM
May 6	**FINAL EXAM**	DM

CW = Prof Walker DM = Prof Marrone

*Lecture content on a particular day is subject to change