# SYLLABUS

## ASTR 8000 – STELLAR ATMOSPHERES AND SPECTROSCOPY
**Spring 2019 – 4 Credit Hours – Computer #23054**

Tuesday and Thursday, 10:00 – 11:50 am, 25 Park Place, Room 628

- Instructor:
  Douglas R. Gies, 606 25PP, 404-413-6021, gies@chara.gsu.edu

- Class Web Site:
  http://www.astro.gsu.edu/~gies/ASTR8000/

- Course Description:
  This is a graduate level course that introduces the concepts surrounding our understanding of how light emerges from the outer layers of stars. Because most of our knowledge about stars comes from their emitted flux, the basic properties of stars are derived from an interpretation of starlight. This survey course will cover the interaction of light and matter, how radiative intensity changes through the outer gas layers of stars, mathematical and computational methods to predict the emitted spectrum, and basic applications of these methods to interpret the flux distributions and spectral line properties of observed stellar spectra.

- Learning Outcomes:
  Students enrolled in this course will learn the basic concepts of radiative transfer, the properties of stellar spectra, and observational and computational tools to interpret spectra. Students will also gain a foundation in scientific programming through code development in IDL or Python to solve questions on the problem sets. Each student will gain expertise in one spectral classification category and will develop experience in oral delivery through a class presentation on the subject. The course work will prepare students to begin research in this and related areas.

- Textbooks:
  *Theory of Stellar Atmospheres*, by I. Hubeny & D. Mihalas, 2015
  (Princeton: Princeton University Press). A large book that provides the foundations; very useful if you can purchase or borrow a copy.
  *Stellar Spectral Classification*, by R. O. Gray & C. J. Corbally, 2009
  (Princeton: Princeton University Press). A book that we will use for a series of class presentations.
  *Radiative Transfer in Stellar Atmospheres*, by R. J. Rutten, 2003
  An excellent Web-based resource that emphasizes the solar atmosphere; see
  `http://www.staff.science.uu.nl/~rutte101/Radiative_Transfer.html`
  *The Observation and Analysis of Stellar Photospheres, 3rd Edition*, by D. F. Gray, 2005 (Cambridge: Cambridge University Press). A venerable book with emphasis on observational methods.

- Grades:
  Presentation on spectral types ..... 20%
  Four problem sets ..... 40%
  Mid-term Exam ..... 20%
  Final Exam ..... 20%
  Each student will be assigned a chapter from Gray & Corbally to summarize and present to the class. The presentations should include a short (few page) hand-out to be distributed at the beginning of the class.
  I plan to use a plus/minus grading scheme (i.e., 80 to 83 is B−, 84 to 86 is B, and 87 to 89 is B+, etc.).
  Students are expected to do their own work and to abide by the Policy on Academic Honesty discussed in the GSU *Code of Conduct*:
  https://codeofconduct.gsu.edu/files/2018/10/2018_10_2_codeOfConduct.pdf

- Meeting Schedule:
  The projected schedule is given on the next page. Unexpected circumstances may require changes in the syllabus as the quarter progresses.

- Presentation Schedule:
  Please select a date and topic from Gray & Corbally.

| **Date** | **Gray & Corbally Topic** | **Presenter Name** |
|---|---|---|
| Jan 24 | GC3. O Stars | |
| Jan 31 | GC4. B Stars | |
| Feb 07 | GC5. A Stars | |
| Feb 14 | GC6. F Stars | |
| Feb 21 | GC7. G and K Stars | |
| Mar 07 | GC8. M giants | |
| Mar 14 | GC9. M and L Dwarfs | |
| Mar 28 | GC10. T and Y Dwarfs | |
| Apr 04 | GC11. W-R and LBV Stars | |
| Apr 11 | GC12. Stellar endpoints | |

| Date | Lecture Topic |
|---|---|
| Jan 15 | Introduction |
| Jan 17 | Stellar Properties |
| Jan 22 | Radiation Field |
| Jan 24 | Transfer Equation; hand out PS#1 |
| Jan 29 | Matter and Radiation in LTE |
| Jan 31 | Absorption Cross Sections; **(PS#1 due)** |
| Feb 05 | Continuum Absorption |
| Feb 07 | Analytical Relations for Transfer Eqn. |
| Feb 12 | Grey Atmosphere |
| Feb 14 | Convective Transport; hand out PS#2 |
| Feb 19 | Line-blanketed, LTE Models |
| Feb 21 | Kurucz ATLAS; **(PS#2 due)** |
| Feb 26 | Non-LTE Atmospheres; hand out Mid-term Exam |
| Feb 28 | Measurement of Stellar Continua; **Mid-term Exam due** |
| Mar 05 | Extended Atmospheres of Cool Stars |
| Mar 07 | Resources for Atmospheres |
| Mar 12 | Hot Stars |
| Mar 14 | Stellar Winds and Mass Loss; hand out PS#3 |
| Mar 19 | Spring break - no class |
| Mar 21 | Spring break - no class |
| Mar 26 | Grating Spectrographs |
| Mar 28 | Spectral Data Analysis; **(PS#3 due)** |
| Apr 02 | Spectral Line Physics |
| Apr 04 | Line Broadening |
| Apr 09 | Line Broadening |
| Apr 11 | Spectral Line Transfer; hand out PS#4 |
| Apr 16 | Curve of Growth |
| Apr 18 | Chemical Abundances; **(PS#4 due)** |
| Apr 23 | Rotational and Turbulent Line Broadening |
| Apr 25 | Spectroscopic Binaries and Pulsating Stars |
| May 02 | 8:00 – 10:30 am **Final Exam** |