STARS AND NEBULAE, Winter 2011-2012

Lectures:	Tuesday & Thursday, 10:00 am to 11:30 am
Location:	Farquharson 312
Website:	http://www.yorku.ca/phall/SAN/
Professor:	Patrick Hall
Office:	Room 337, Petrie Science Building
Office Hours:	Mon-Tue-Thu, 11:30 am to 12:30 pm + most afternoons
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WELCOME TO "STARS AND NEBULAE". In this course I will help guide your learning about the physical principles at the heart of a wide range of astronomical phenomena. You will learn via discussion and lecture in class and by doing assignments outside of class. This course is intended for both beginning graduate students and advanced undergraduates in physics and astronomy. For such undergraduates, the course can act act as a springboard to graduate school. In fact, those undergraduates who complete the course successfully and then choose to go on to graduate studies in Physics & Astronomy at York have already satisfied one of the graduate course requirements.

The topics covered in the course will enable you to interpret the light from stars and nebulae anywhere in the universe. They are also applicable to the interactions of light and matter in the atmosphere and laboratories of Earth. We will cover:

* observations, theory and modelling of the atmospheres, interiors and evolution of stars. Equations of stellar structure. Homology relations. Convection.

* radiative transfer: interactions of matter and radiation. Specific intensity. Equation of transfer. Optical depth. Heating & cooling. Emission and absorption line formation.

* observations and interpretation of astrophysical radiation, from asteroids to stars, interstellar/intergalactic gas & dust, active galactic nuclei, etc. Einstein coefficients. Atomic structure and permitted, semi-forbidden, and forbidden transitions. Temperature, density, and abundance diagnostics in ionized gas. Equivalent widths and the curve of growth. Molecular structure and rotational, vibrational, and electronic transitions.

The formal prerequisites for this course are PHYS 1070 (Astronomy) and PHYS 3030 (Statistical & Thermal Physics) or their equivalents. PHYS 3040 (Modern Physics) or its equivalent is a prequisite or corequisite. Weaknesses in the above areas can be dealt with through independent reading in consultation with the professor.

Workload

To help you master the concepts presented, you will be asked to do frequent homework assignments. Assignments will have core questions all students must answer and (usually) an additional question for graduate students only. You can and should work together on the assigned problems, but the writeup you hand in must be your own, not copied.

In addition, there will be a mid-term exam, a final exam, and a computer project.

Finally, graduate students will be asked to give one seminar (no more than 25 minutes in duration) on a current topic in the astronomical literature of particular relevance to the course. Naturally, all students in the class must attend all such seminars.

Recommended Textbooks

No text is **required** for this course. The **recommended** texts are:

Undergraduates: *Introduction to Stellar Astrophysics, Volume 2 (Stellar Atmospheres) & Volume 3 (Stellar Structure and Evolution),* by E. Bohm-Vitense (1989, 1992), which are excellent introductions to stellar astrophysics and relevant radiative transfer topics.

Grad students: *Atomic Astrophysics and Spectroscopy* by A. Pradhan & S. Nahar (2011), an excellent reference with both basic & advanced coverage of many topics.

Copies of the above are on reserve in Steacie, along with some other references given below.

Supplementary notes will also be handed out occasionally.

Additional References

You are encouraged to refer to the following when we cover their subjects. Some of them (and the recommended texts) are on 1-day or 3-day reserve in the Steacie Science Library.

Carroll & Ostlie, 2006	*An Introduction to Modern Astrophysics (2nd Edition)*
D. Gray, 1992	*The Observation and Analysis of Stellar Photospheres* Comprehensive discussion including observing techniques.
G. Herzberg, 1944	*Atomic spectra and atomic structure*
J. Irwin, 2007	*Astrophysics: decoding the cosmos* Basic introduction to many relevant astrophysical concepts.
R. Kippenhahn and A. Weigert, 1990	*Stellar Structure and Evolution* Comprehensive discussion of stellar interiors.
C. R. Kitchin, 1995	*Optical Astronomical Spectroscopy* Good introduction; also covers spectrograph design.
S. Kwok, 2006	*Physics and Chemistry of the Interstellar Medium*
D. Osterbrock and G. Ferland, 2006	*Astrophysics of Gaseous Nebulae and Active Galactic Nuclei (Second Edition)* Excellent but specialized graduate textbook.
G. Rybicki and A. Lightman, 1979	*Radiative Processes in Astrophysics* Comprehensive look at radiative processes over all wavelengths.
T. Swihart, 1981	*Radiation Transfer and Stellar Atmospheres* Outstandingly clear introduction to radiative transfer.
J. Tennyson, 2011	*Astronomical Spectroscopy, 2nd Edition* Introductory undergraduate text on nebular spectroscopy.

Grading

The grading will be as follows:

	Undergrads	Grads
Assignments	45%	45%
Mid-term exam	15%	12.5%
Project	10%	10%
Final exam	30%	25%
Seminar	0%	7.5%
Total	100%	100%

Note: it is your responsibility to be available to take the final at its scheduled time.