AST 320: Introduction to Astrophysics (2009)

Lectures	M2 and F12 in AB 114
Lecturer	Marten van Kerkwijk, MP 1203B, 416-946-7288, mhvk@astro (utoronto.ca) Office hours after each class (M3 and F1), or by appointment
TA	Duy Nguyen, MP 1212, 416-978-6259, nguyen@astro (utoronto.ca) Office hours W 1:30–2:30
Web page	http://www.astro.utoronto.ca/∼mhvk/AST320/

Note on e-mail: both TA and Prof. will try to answer e-mail within one working day. For questions about the problem sets, please come to the TA office hour; please do not expect that e-mails sent in the weekend will be answered before class on Monday.

Outline

This course aims to teach the physics underlying the formation, the equilibrium, and the evolution of structure on all astronomical scales. Two main topics will be discussed:

Stars

– Hydrostatic equilibrium, virial theorem;
– Collapse of molecular clouds, star formation;
– Equation of state in stellar interiors;
– Simple stellar models: polytropes;
– Radiative energy transport, opacity sources;
– Convective energy transport;
– Hayashi track; pre–main sequence evolution;
– Energy balance: contraction, nuclear fusion;
– Stellar model building;
– The main sequence, brown dwarfs;
– Low-mass stars: giant phases, shell burning;
– High-mass stars: fusion up to iron;
– Supernovae.

The Universe

– Cosmological principle, basic parameters;
– Simple relativistic cosmology;
– Big Bang nucleosynthesis;
– Times, distances, horizons, diameters;
– Cosmic microwave background, inflation;
– Fluctuations and structure formation.

Course text book

The text book is *An Introduction to Modern Astrophysics*, 2nd edition, by Carroll & Ostlie (Addison Wesley, 2006). The focus will be on chapters 9, 10, 12, 13, 15, and 16 (Stars), and 29 and 30 (Universe). A more detailed list will be given in class. Furthermore, handouts will be made available that summarise the material and give additional detail where the text does not go into sufficient depth.

Advanced texts

Stellar Structure and Evolution, by Kippenhahn & Weigert (Springer-Verlag, 1990); a very good book (recommended by many of the former students of AST 320) for those who want to delve deeper into the subject.

Prerequisites

The course prerequisites are AST 221H & 222H, and PHY 252H (the latter can be taken concurrently). These are equivalent to parts of the text book, which will be mentioned explicitly in class.

Evaluation

- (32%) Mini problem sets, with one due (almost) every class.
- (8%) Presentation on one of the mini-problems.
- (20%) Term test, in class on **March 2nd**.
- (40%) Final examination.

Mini problem sets

At the start of almost every lecture, there will be a mini problem set due, which uses material already discussed to prepare for the lecture. These mini problem sets will be available at least one week beforehand (except the first one).

As indicated by the name, the mini problem sets are meant to be short, requiring no more than two hours of work, and the answer should easily fit on the page with the question. If you seem to need more time or space, you are problably making things too complicated, and should come to an office hour!

Since mini-problem sets are discussed at the start of the same lecture at which they are due, no credits will be given for anything handed in too late. However, the final grade will be based ignoring the two worst marks; hence, you can afford to miss two (but I recommend you keep these in reserve, e.g., in case you get ill).

Presentations

Each student will have to discuss one mini problem set at the start of a lecture, with dates allocated by drawing lots (you are free, however, to exchange dates with other students, as long as you let me know the result). The discussion should focus on the physical interpretation and astronomical context, not on derivations, and should last no more than 10 minutes (including discussion, so prepare for about 7 minutes). I recommend you use the blackboard for equations and sketches, but if needed, you can also show figures printed on overheads (which I can provide).