ASTR 1120 Section 1 (3 credit hours): Spring 2006

GENERAL ASTRONOMY: STARS & GALAXIES

WELCOME! to General Astronomy: Stars and Galaxies for Spring 2006. This class will introduce you to some of the wonders of the Universe, mostly those beyond our own Solar System. We will discuss the Sun and the stars (what makes them shine?), black holes (how they form and the evidence that they really exist), and the early history and future fate of the Universe as a whole (the topic of *cosmology*, which includes the evidence that the Universe began with a `Big Bang').

This syllabus answers some of the most common questions you may have about the course. Please read it through, and make an immediate note of the dates of exams and observing sessions. You may also want to bookmark the class website:

http://jilawww.colorado.edu/~pja/astr1120/index.html

LECTURER: Prof Phil Armitage. Office JILA 909 (on the 9th floor of the JILA tower, south-east corner), phone 303-492-7836, email **pja@jilau1.colorado.edu** (this is the most direct address). I normally answer email queries promptly. Office hours: Tuesdays and Thursdays 3:15 – 4:30pm. Please feel free to stop by my office at other times as well – if I'm in I'll be happy to discuss problems.

TA: Bruce Ferguson, email **bruce.ferguson@colorado.edu**, office hours and location TBD (will be announced in class, and on website).

REQUIREMENTS AND PRE-REQUISITES: ASTR 1120 satisfies Part B (nonsequence course) of the Natural Science requirement of the Arts and Sciences core curriculum. It does not satisfy Part A (two-semester sequence of courses) – if you've already taken ASTR 1010 or ASTR 1110 then you need to take ASTR 1020 to satisfy the sequence requirement. There are no pre-requisites.

EXPECTATIONS: This course will involve thinking about situations that are *far* outside everyday experience (`what was the Universe like when it was only the size of a grapefruit?'). Common sense is utterly unable to help us grasp such conditions, and as a consequence you may find parts of this class counter intuitive and pretty hard. To succeed, you will need to put in significant time outside lectures reading the textbook, doing homework, and reviewing notes – the textbook suggests 6 to 9 hours per week.

This course is not intended as a test of your mathematical skills. However, we will make extensive use of scientific notation in order to express the enormous range of sizes and masses found in the Universe, and you will need to be completely familiar with this. You will also need to understand and make use of simple algebraic formulae (example $E = mc^2$), and questions to practice these skills will be part of the homeworks.

LECTURES: we will meet 2:00 – 3:15pm on Tuesdays and Thursdays in Duane G1B30. Please sit downstairs to facilitate in-class discussions. If reading from the textbook has been assigned, the class will commence with brief clicker questions on that. During the lecture proper, we will stop

for occasional `discussion clicker questions' that will normally be more challenging. Questions are welcome *at any time*. I strongly recommend that you take your own notes, which I will supplement by posting online a very brief weekly summary of what I consider the most important points. Please ensure your cell phones are switched off, and do not disrupt the class for your fellow students by leaving early – I will always finish on time.

SCHEDULE: The course is divided into three sections, with an exam after each:

1) The Sun and the stars: how we can use the light emitted by a star (its spectrum) to deduce properties such as the star's temperature. Observational properties of the Sun, such as the sunspot cycle, and their influence on the Earth. Einstein's relation between mass and energy ($E = mc^2$) and the distinction between nuclear fission and nuclear fusion. The energy source of the Sun and how that can be tested by observing particles called solar neutrinos.

2) Stellar death and black holes: what happens at the end of a star's life? Properties of supernovae and gamma-ray bursts. Discussion of different stellar remnants, white dwarfs, neutron stars and black holes. What is a black hole? What is the evidence that black holes really exist? Distinction between stellar mass and supermassive black holes.

3) Cosmology: Basic properties of the Universe on the largest scales – galaxies and clusters of galaxies. What is meant by redshift? The evidence that the Universe is expanding and Hubble's Law for the expansion. The concept of the Big Bang and the observational evidence for a Big Bang. Recent discoveries and unsolved questions…

TEXTBOOK: The required textbook is The Cosmic Perspective by Bennett, Donahue, Schneider & Voit. Regular readings will be assigned from the text. If you buy a new textbook, you should get the latest (4^{th}) edition, which is significantly updated and includes recent discoveries that are part of the class. However, the 3^{rd} edition would also be OK. If you buy a new book, you will gain free access to web resources (interactive tutorials, quizzes etc) – these are not required but you may well find these useful as a complement to lectures or when preparing for exams.

I will not be covering the material in the same order as the textbook.

CLICKERS: You will need a personal IR clicker to register answers to in-class quizzes on the reading and discussion questions. You will need to register your clicker online at:

http://capa.colorado.edu/cgi-bin/RegisterAFS

You can start using your clicker prior to registering – your scores will be saved and show up for credit once you have registered. Clicker questions will be scored 2 for a correct answer, 1 for any answer, 0 for no answer. The goal of using clickers is to allow quick checks that you've understood the readings from the textbook, and to facilitate discussion questions on the lecture material. The goal is *not* to have tests every lecture, and accordingly the grading scheme for the clickers is generous – if you do the reading and show up for class regularly your clicker score will probably be the best part of your grade.

HOMEWORK: There will be 6 homeworks, normally with a one week turnaround time. The *best 5* will count toward your final grade (i.e. your lowest score will be dropped). The homeworks are intended, in part, as practice for the exams, so it is to your advantage to plan to complete all 6 homeworks.

EXAMS: There will be 2 midterms plus the final:

- Midterm #1: **Thursday February 16th** in class time. Covers lectures 1 – 9
- Midterm #2: **Tuesday March 21st** in class time. Covers lectures 10 – 17
- Final **Saturday May 6th** 4:30-7:00pm in the usual classroom. Cumulative, but concentrating (2/3 of the questions) on the final third of the class.

Please *note these dates and make sure to keep them free* (also inform your parents if they might otherwise book travel for you that conflicts with these times). I will schedule a make-up exam for the Final, only, in the event of a conflict with an exam in another course (which should not occur with regularly scheduled courses, but does happen).

All exams are closed book and closed notes, and will be based on the content of both the lectures and the assigned textbook readings.

POLICY ON MISSED HOMEWORKS & EXAMS: You may miss one homework, for any reason whatsoever, without any penalty. If you know that you will miss more than one homework, or an exam, for *unavoidable* reasons (for example illness, or a family emergency) please get in touch with me as soon as is practical, and be prepared to provide written confirmation of the circumstances. I will then make allowance in the final grading such that your absence does not impact the final grade.

OBSERVING: 6 evenings have been scheduled for observing with the telescopes at Sommers-Bausch observatory:

- Tuesday January 24th starting at 7:00pm
- Thursday February 9th at 7:00pm
- Monday February 27th at 7:00pm
- Tuesday March 14th at 7:00pm
- Wednesday April 5th at 8:30pm
- Thursday April 20th at 8:30pm

The observing is optional. Extra credit will be available for students who complete one observing session, and turn in a written report of what they have observed on or before April 27th. You may also attend the observing evenings for fun, without doing the extra credit. To limit crowding, a sign-up system will be in place for at least the first couple of sessions. Of course telescopes can't see through clouds, so if you want to do the observing for extra credit plan on attending one of the earlier sessions in case the last couple are clouded out.

Sommers-Bausch observatory is next to Fiske Planetarium, close to the corner of Regent Drive and Kittredge Loop Road.

PLANETARIUM: Three classes (February 14th, March 16th, April 20th) will be held in Fiske Planetarium (the silver domed building on the corner of Regent / Kittredge) rather than in G1B30. On those days please go straight to the Planetarium.

ACADEMIC HONESTY: As students at the University of Colorado, you are responsible for knowing and adhering to the academic integrity policy laid out in the Honor Code. In our class that includes: not using someone else's clicker in lectures (this is straightforward cheating), and

neither giving nor receiving any outside assistance (from notes, friends etc) in exams. When doing homework, you are allowed and encouraged to collaborate with friends, but *work that is handed in must be your own*. Practically, that means that if I were to ask you to verbally justify your answer to a question, you would be able to do so. You must not cut and paste material from the web – when using either books or the web for help with homework please cite your sources (i.e. provide a list of where you got your information from).

GRADING: Your final grade will be based on:

- 20% homework (6 homeworks, lowest score will be dropped)
- 20% midterm #1 (topic: the Sun and stars)
- 20% midterm #2 (topic: stellar death and black holes)
- 30% final (cumulative, but concentrating on the Big Bang and cosmology)
- 10% clickers (I will drop the equivalent of 3 weeks of clicker scores)

The conversion between numeric scores and letter grade will be as follows:

- 87.5% or higher – A- or A
- 75.0% - 87.4% - B-, B or B+
- 60.0% - 74.9% - C-, C or C+
- 45.0% to 59.9% - D or D+

I hope no one will score below 45%, but if they do that will be a Fail. The boundaries between grade subdivisions (e.g. between A- and A) are not fixed in advance and will be determined after the Final.

I do reserve the right to curve scores at the end of the class, but *only upward* (i.e. to improve the average grade). I would do this if, for example, the Final turned out to be much harder than I anticipated, so that very few people would get A's without adjustment. This is unlikely to occur.

Please be aware that *after* grades are determined, it's only possible to change grades in the event of straightforward errors (i.e. I lost your homework, or added up the scores incorrectly). If you're having trouble with the class that may affect your final grade – due to family emergencies, other commitments, etc – please let me know *before* the class is over and I will try to help.

Your scores will be available as the class progresses via WebCT – please check regularly and notify us if you spot any errors.

EXTRA CREDIT: The sole opportunity for extra credit is via the observing evenings. Turning in a written report of your observing will earn 3% extra credit.

STUDENTS WITH DISABILITIES: If you qualify for accommodations because of a disability please submit to me a letter from Disability Services so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities (303-492-8671, Willard 322, www.colorado.edu/disabilityservices).

QUESTIONS & PROBLEMS: Please don't hesitate to get in touch with us if you have questions about any aspect of the class, or if you start running into difficulties following the material or keeping up with assignments – we're here to help.