Astronomy 110G An Introduction to Astronomy Fall 2008

GENERAL INFORMATION for Sections M01, M02 & M03

Instructor: Professor Kurt S. J. Anderson Astronomy Building, Room #105
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Lectures: All sections meet in Biology Annex Room 102 (BX 102) for lecture 10:30 - 11:20 AM on Mondays, Wednesdays, and Fridays

Laboratory Sections and TAs: All sections meet in Biology Annex Room 102 (BX 102)*
M01: Monday 12:30 - 2:30 PM (Section TA is Robert Edmunds)
M02: Monday 2:30 - 4:30 PM (Section TA is Joseph Wellhouse)
M03: Tuesday 3:30 - 5:30 PM (Section TA is Robert Edmunds)
*Laboratory-related observing sessions will be conducted at the Campus Observatory.

Teaching Assistants:

Section M01	Mr. Robert Edmonds	Astronomy #209	646-7724	redmonds@nmsu.edu
Section M02	Mr. Joseph Wellhouse	Astronomy #220	646-8180	jwell@nmsu.edu
Section M03	Mr. Robert Edmonds	Astronomy #209	646-7724	redmonds@nmsu.edu

Textbook: Kuhn & Koupelis, In Quest of the Universe, Fifth (or Fourth) Edition
Laboratory Notebook: Astr 110G Lab Manual (Paper copies available at Kinko's.)
(Download at http://astronomy.nmsu.edu/astro/a110labs/labmanual/index.html)
Astronomy 110G Web Page: http://astronomy.nmsu.edu/astro/ (Schedules,maps, pictures, *etc.*)
Section M01, M02, and M04 Information: http://astronomy.nmsu.edu/kurt/Astronomy110G/

Objectives

Astronomy has played an important role in mankind's cultural and intellectual history. While it has strongly influenced the development of mathematics and the other physical sciences, it also draws heavily on those fields for its own advancement. We wish to convey a knowledge and appreciation of astronomy and its history. In addition to learning about everyday astronomical phenomena, you should also gain some understanding of the overall structure, size, and history of our universe, the characteristics of the various types of objects it contains, and of the physical processes which govern their formation and evolution.

It is important to acquire an understanding of how science is really done - how observations, together with knowledge from other areas, and the tools of mathematics, are used not only to measure the physical properties of astronomical bodies, but to formulate hypotheses and test ideas. That ideas must be testable is fundamental to this endeavor: Science strives toward simplification, and attempts to explain the complexities we observe in terms of a relatively small number of underlying rules and principles. The acquisition of "facts" is only a small part of that scientific effort; to ascertain the basic laws of nature is the more fundamental goal. Indeed, astronomical observations, together with some understanding of these basic laws of nature, allow us to not only understand the past history of our universe but to make some predictions concerning its future.

Astronomy is a subject of fairly wide popular interest. This may reflect a fascination with the very large, or because almost anyone can go out at night and look up at the stars. There are also many connections between astronomy and those rather basic human questions: "Why are we here?"; "How did we get here?"; "Are we alone?"; "What is next?" Certainly the interactions between astronomy, philosophy, and theology have a long (and sometimes contentious) history. Public interest in astronomy does not just generate Scientific American articles and PBS specials: cosmology, comet impacts, and evidence for life on Mars and elsewhere have been the subjects of recent headlines and "cover stories" in national news media. The last few decades have seen the discovery of the first extra-solar planets, new classes of bodies within our own solar system, entirely new kinds of stars and galaxies, and a growing understanding of the most violent stellar explosions. Major puzzles, such as the nature of dark matter and the existence of "dark energy" are commonly addressed and discussed in news and educational media as well as in the scientific journals. Astrobiology is a new and growing field; the search for extraterrestrial life and an understanding of our own origins remain as frequent subjects of news reports, essays, and television specials. Unfortunately, a lot of "science fiction" is presented as "scientific fact" in some of these same media. Furthermore, many people confuse astronomy (a science) with astrology (an ancient religion). A basic knowledge of astronomy should enable you to understand, appreciate, and intelligently evaluate such materials.

Schedule

The course material will cover six broad topic areas in the following chronological sequence:

1. Classical Astronomy: Ancient and early Mediterranean astronomy. The Ptolemaic universe.
2. Foundations of Modern Astronomy: The Copernican Revolution. Beginnings of modern physics.
3. The Solar System: Planets and other constituents of the Solar System. The Sun.
4. The Stars: The stars in space. Stellar properties. Stellar energy. Stellar evolution; the lives of stars.
5. Galaxies: The Milky Way and galactic structure. The interstellar medium. Other galaxies.
6. Cosmology: The contents, structures and history of the Universe. Cosmological theory.

A tentative schedule of lecture topics, together with suggested text references, is given below. Do the suggested reading *before* the material gets addressed in class - and then reread for review. A laboratory schedule is also provided. Some schedule adjustments will probably occur and the ordering of topics given below should be regarded as approximate; some topics might be dropped and others added in the course of the semester. Note the dates of three principal examinations. Also note the drop date: you are responsible for informing the Registrar's office if you decide to drop the course although I may drop students who miss examinations or are too frequently absent from lectures or laboratory sessions. Further information about University regulations regarding registration, attendance, *etc*., can be found in the Undergraduate Catalog .

Class Format

There are three lecture sessions per week. Some time will be allocated for questions, quizzes, and review of earlier materials but lectures and other presentations will occupy most of the period. While usually related to the assigned readings, lectures are not intended to simply repeat or review text materials. Again, please do the assigned reading before class. Consult the syllabus for reading suggestions. Questions in class are strongly encouraged; if you don't understand what I'm saying there is a good chance others are equally mystified. Just raise your hand. There will be review sessions scheduled before each of the three major examinations.

Laboratory

Laboratory grades will be based upon attendance at the weekly laboratory sessions, performance on laboratory exercises and problems, and the results of occasional laboratory quizzes. Laboratory periods will sometimes be used for pre- or post-examination reviews, or for reviewing homework assignments. Questions are encouraged.

Office Hours

The instructor and teaching assistants will post scheduled office hours. Students are strongly encouraged to make use of them. Other times can usually be arranged by appointment. See above for telephone numbers, *etc*.

Attendance Policies

An attendance sheet will be circulated at lectures, and your presence *will* influence your final grade. Moreover, I will be giving unannounced in-class quizzes fairly frequently and these quiz results will also determine part of your grade for the class; regular and prompt attendance is strongly advised. There will generally be no make ups for missed quizzes and exams, or for late homework. Moreover, the lectures (and the quizzes and examinations) will cover some materials not included in the textbook. If you do miss a class, get lecture notes from a classmate.

Homework

Homework assignments might include essays on assigned topics, written answers to particular questions, or brief reports on current events of astronomical interest. Providing written responses to the textbook's end-of-chapter questions will be a regular part of your homework obligation. Some assignments will involve do-it-yourself observational exercises. *Turned-in homework materials should represent your own work*. Late homework, if turned in within a week of the due date, will usually be accepted if accompanied by a reasonably convincing story.

Examinations and Grades

There will be three scheduled written examinations; each will contribute about 15% to your final grade for a total of 45%. The total for the in-class quizzes, which are unscheduled, will contribute another 15%, turned-in homework 10%, and attendance 10%. Finally, your Laboratory grade will make up the last 20%.

Exam and quiz questions will be of the objective type, requiring answers consisting of some sentences accompanied by sketches, *etc*. Examinations will be comprehensive; you will be responsible for all lecture, text, and handout materials. I might allow you to bring some of *your own* notes to each of the major examinations, so polish your note taking skills. Textbooks and other forms of assistance are not otherwise permitted during exams or quizzes. Makeup examinations are normally offered only for university-excused absences and require adequate prior notification. Again, there will no makeup provisions for missed classes or quizzes.

Grading System

Grading will be on a class-based curve, with final letter grade assignments following the University Grading System. (See the current Undergraduate Catalog) Your final grade will depend upon your performance relative to your classmates; those near the top of the class will get A's and B's, those near the bottom, D's or F's. Class standings will be posted periodically.

Academic Misconduct

Plagiarism is defined as the passing off as one's own the ideas, writings, work, etc., of another. This includes the copying someone else's exam, quiz, or homework materials - or using forbidden aids such as crib sheets or electronic media during quizzes and examinations. Plagiarism is cheating - and shouldn't be tolerated. For NMSU's policies on academic misconduct, see http://www.nmsu.edu/%7Evpsa/SCOC/misconduct.html.

Evaluations

I'll ask you for your formal evaluation of the course near the end of the semester. In the meantime please give me your comments, complaints, and suggestions as they arise. E-mail is an easy way to do this. Comments can also be placed (anonymously or otherwise) in my mailbox in the Astronomy Building.

Disabilities and Discrimination

If you have special needs, require assistance with exams, reading, *etc.*, please see me. Call the Coordinator of Services for Students with Disabilities at (505) 646-6840 if you have questions about the Americans with Disabilities Act and/or and its provisions. For questions about NMSU's Non-Discrimination Policy, concerns about discrimination, sexual harassment, *etc.*, contact the Director of Institutional Equity at (505) 646-3635.

Astronomy 110G and the General Education Core Curriculum (GECC)

Astronomy 110G has been certified as a part of NMSU's General Education Core Curriculum. What does that mean? Consider the following:

"The GECC attempts to foster intelligent inquiry, abstract logical thinking, critical analysis, and the integration and synthesis of knowledge; it strives for literacy in writing, reading, speaking, and listening; it teaches mathematical structures, acquainting students with precise abstract thought about numbers and space; it encourages an understanding of science and scientific inquiry; it provides a historical consciousness, including an understanding of one's own heritage as well as a respect for other peoples and cultures; it includes an examination of values and stresses the importance of a carefully considered values system; it fosters an appreciation of the arts; and general education provides the breadth necessary to have a familiarity with the various branches of human understanding."

These are very ambitious goals - and only a committee could produce a single sentence that long! Nonetheless, the aims are commendable, and an academic course built around the subject of astronomy can succeed in approaching most of them. Astronomy has a long history (it has been called the "third-oldest profession") and, in some form, has played major rôles in the cultural histories of most human societies. Early astronomy was often intimately involved with religious practice (a remnant exists today in the form of astrology and the calendars of the major religions) and with timekeeping and navigation. Astronomical understanding draws heavily on the other physical and biological sciences and tools of mathematics and, historically, has contributed significantly to almost all of these areas.

In keeping with the philosophy of the GECC Astronomy 110G will not emphasize the rote memorization of facts about the universe but, rather, will place greater emphasis upon how this factual information is obtained and how what we observe in nature generally results from the action of relatively simple underlying physical laws acting in consistent and predictable ways. Physical laws, in effect, provide the "connections" between "facts" and provide the basis for human understanding of natural phenomena.

Communicating factual information and understanding is part of the learning process. Communication to the student can be by lecture, text materials, or other means. Homework and laboratory exercises are intended to further the learning process, while examinations and quizzes are intended to monitor the success or failure of these endeavors. Most of these materials, as provided by the student to the instructors, will be in the form of written materials; you will be asked to answer questions with sentences, essays, and sketches. You will not encounter many true/false or multiple-choice questions in this course - nor will you find many in the real world! Communication fails if the material is unreadable or lost in static. For homework, quizzes, and examinations you should take some time to organize your responses and then try to present them in a readable and coherent manner. Handwritten materials are perfectly acceptable, so long as they are readable.

Study and Learning Suggestions

The skills and knowledge necessary to successfully compete and survive in a sometimes harsh world have always been changing, but the pace of that change is rapidly increasing. An explosion of knowledge was the outstanding characteristic of the twentieth century; it has accelerated in the twenty-first. As a consequence, the most useful thing a university can now impart to its students is not simple factual knowledge but, rather, the tools and skills needed to obtain, manage, process, and apply new information - and to acquire new skills. These requirements will dominate human endeavors in the twenty-first century. Don't get left behind.

Reading and Writing:

*Read the assigned or suggested text materials before, not after, the subject materials are presented or discussed in class. Think about the material and come to class with your questions. If you are really shy, see me (or a Teaching Assistant) during office hours, telephone, sent me a note, or use e-mail. Reread.

*Make notes as you read: While it is useful to identify key sentences and ideas, it is usually a waste of time to underline or highlight these items in your textbook. (This just reduces its resale value!) It is more effective to write ideas out on paper and in your own words. Note taking is a skill acquired only with practice; so practice.

*Learn to properly use the text's Table of Contents and its Index. Most things in the Universe are connected, linked, or otherwise 'cross-referenced' at some level; textual materials are also. Organization of facts and the discovery of interrelations and connections is an important part of science. It is also an important learning tool. Of course, it always pays to occasionally stop and actually *think* about the material.

*Use the text's Glossary or, better, compose your own, adding entries as you encounter new or unfamiliar terms.

*Answer, in writing, end of chapter questions. (Who knows? You might see some of them on quizzes or exams!) If you have trouble answering a question, review the text materials, consult your instructor, a teaching assistant, or a classmate. Use your written answers for reviewing the materials.

*I will provide "sample questions" as part of pre-exam reviews. Review these and, again, write out your answers.

*Keep up: Don't use the day before an exam for the first reading of the text, nor for reviewing your notes. The best activity for the eve of an exam is eight hours of sleep, not an all-night "cramming" session. Really.

Resources:

*Ask questions in class. If you don't understand the lecture, chances are that others are similarly lost. (This also keeps the instructor on his toes and provides him with an ego boost if he can answer intelligibly. Most teachers actually like to be asked questions; if nothing else, it shows that somebody is listening. Honest!)

*Get your money's worth: Attend class. Take advantage of the posted office hours of the instructor and/or teaching assistants. This is an alternative to in-class questions, if you are shy, and provides an opportunity for inquiries which might require greater explication. (Four credits of Astr110G costs someone about $850!)

*Study groups are a good idea for any class; consider forming one. Post a recruiting notice on the bulletin board.

*One of the most useful survival skills in the university, as well as out in the "real world", is knowing how to use library facilities, including electronic and web-based resources. The NMSU Library can provide assistance; ask at the Reference Desk. Time spent learning to use all kinds of library resources is time well spent.

*All NMSU students should have a computer account giving access to electronic mail and a host of other useful services; such services are the libraries of the future. A working familiarity with the side roads of the "information highway" (a.k.a., the internet or the "web") has become a necessary academic survival skill. There many on-line sources; for most subjects the on-line encyclopedia Wikipedia is often a good starting point. So go Google. (Caution: Consider your sources; just because it's printed in a book or on the web doesn't mean it isn't garbage!)

*NMSU provides drop-in and learning labs and a variety of other resources. These include tutoring services, assistance for those with disabilities, *etc*. Again, get your money's worth and use them!

KRWG-FM broadcasts a one minute program, StarDate, on current astronomical news and events weekdays at 6:59 AM, 12:59 PM, and 6:59 PM, and on Saturdays and Sundays at 5:59 PM. A Spanish language version, *Universo*, is scheduled for broadcast 8:00 PM weekdays. Highly recommended.

Schedule **ASTRONOMY 110G** **Section M01** **Fall 2008**

The sequence of topics given below should be regarded as approximate. Topics will be added (or deleted) as time and circumstances permit. Text references are to chapters of Kuhn & Koupelis, In Quest of the Universe. Additional topic information can be located in the text by consulting that book's index.

Date	Event
Aug 22	First Class (BX102, 10:30-11:20 AM)
Aug 25 or 26	First Laboratory Session (BX102)
Sept 1 or 2	Labor Day Holiday (No class or lab)
Sept 29	Examination #1
Nov 3	Examination #2
Nov 24-28	Thanksgiving Holiday (No classes or lab)
Dec 8	Examination #3

Topic Areas

Classical Astronomy: Ancient Astronomy. Early Mediterranean Astronomy. The Ptolemaic Universe.

Introduction; naked-eye astronomy, the celestial sphere	Prologue, Ch 1
Phenomena: fixed stars and luminaries; motions	Ch 1
Mediterranean astronomy; geometry & interpretations	Ch 1
Aristotle's physics & astronomy; astronomical measurements	Ch 1
Size & distance; Hipparchus' epicycles. The Ptolemaic System	Ch 1, 2

Foundations of Modern Astronomy: The Copernican Revolution. Beginnings of Modern Physics.

The Copernican Revolution; models & predictions	Ch 1, 2
Tycho and Kepler; Kepler's Laws of Planetary Motion; Digges	Ch 2, 3
The beginnings of modern physics; Galileo & Newton	Ch 3
Newtonian gravitation; orbital motions and gravity	Ch 3
Light; description & properties of electromagnetic radiation	Ch 4
Measurement of light; Inverse-square Law and the Doppler effect	Ch 4, 5
Light and matter; optics and spectra; atomic structure	Ch 4, 5

The Solar System: Planets and other constituents of the Solar System. The Sun.

Planetary characteristics; orbits and physical properties	Ch 6, 7
Jovian and terrestrial planets; Earth and Moon	Ch 6,7
Planetary interiors and atmospheres	Ch 8,9
Other constituents; satellites, asteroids, comets, etc.	Ch 10
Origin of the Solar System; the Sun; theories and tests	Ch 7, 11
Evolution of the planets. Other systems and life therein	Ch 7, 9

The Stars: The Stars in Space. Stellar Properties. Stellar Energy. Stellar Evolution: The Lives of Stars.

Stars in space: distances and motions, star systems	Ch 12
Starlight: luminosities, colors and spectra, spectral types	Ch 12
Stellar masses and sizes: Binary stars	Ch 12
Stellar systematics: The HR diagram,star clusters	Ch 12
Stellar structure: Energy sources and lifetimes	Ch 11, 14
Stellar structure: Basic principles	Ch 14
Star formation and the interstellar medium	Ch 13
Stellar evolution: Stellar processes and aging	Ch 14, 15
Stellar evolution: Main sequence stars and giants	Ch 14, 15
Dead stars: White dwarves, neutron stars, black holes	Ch 14, 15

Galaxies: The Milky Way and Galactic Structure. The Interstellar Medium. Other galaxies.

Galactic structure : The distribution of stars in space	Ch 16
Inventory: The contents of our galaxy; stars, dust, and gas	Ch 16
Mapping the Galaxy; radio and infrared astronomy	Ch 16
Galactic structure: Formation and evolution	Ch 16
Island universes: Other galaxies. Galaxy distances	Ch 17, 18

Cosmology: The Contents, Structures and History of the Universe. Cosmological Theory.

The Hubble expansion.	Ch 17, 18
Cosmology: Distance, time, and red shift; Quasistellar objects	Ch 17, 18
Cosmology: The structure of the Universe. A "big bang"?	Ch 18
The Big Bang cosmology. Observations, tests, predictions	Ch 18
Cosmological theories; current problems and questions	Ch 18
A brief history of the Universe; What we know and what we don't.	Ch 18

Astr 110G Laboratory Schedule (Fall 2008)

This schedule of laboratory exercises is subject to change. The first date, a Monday, is for Sections M01 and M02, the second is for section M03 which meets on Tuesdays.

25 &26 August:	Introduction to the Astronomy 110 Labs
8 & 9September:	The Origin of Seasons
15 & 16 September:	Measuring Distances Using Parallax
22 & 23 September:	Shaping Surfaces in the Solar System: Impacts of Comets and Asteroids
or	Introduction to the Geology of the Terrestrial Planets
29 & 30 September:	Kepler's Laws and Gravitation I
6 & 7 October:	Kepler's Laws and Gravitation II
13 & 14 October:	Optics
20 & 21 October:	The Power of Light: Understanding Spectroscopy
27 & 28 October:	The Hertzsprung-Russell Diagram
3 & 4 November:	Mapping the Galaxy
10 & 11 November:	Galaxy Morphology
17 & 18 November:	Hubble's Law: Finding the Age of the Universe
1 & 2 December:	Wrap up and review. Class evaluations.

Observing exercises are also part of the Laboratory requirements. Since observing can be hampered by weather conditions, it is very unwise to put off these observing assignments and exercises until the last moment, because that last moment might be cloudy!

Grading Laboratory and Observing Projects (40 points)

Best 10 of 12 laboratory exercises scaled to 3 points each	30 points
Observing Exercises (four required)	5 points
Observatory Notebook	5 points
	40 points

Grading Scheme for Astronomy 110G

Exam #1	6 questions at 5 points apiece	30 points	15%
Exam #2	6 questions at 5 points apiece	30 points	15%
Exam #3	6 questions at 5 points apiece	30 points	15%
Quizzes	10 best quizzes at 3 points apiece	30 points	15%
Homework*	10 best exercises at 2 points apiece	20 points	10%
Attendance	1/2 point per class to a maximum of	20 points	10%
Laboratory Units scaled to a maximum possible of		40 points	20%
Best 10 Exercises (of 11) @ 3 points each = 30 points			
Two observing exercises at 5 points each = 10 points			
Total:		200 points	100%

*I'll probably be giving some additional "observing" homework exercises worth 3 points each which will be counted among the "10 best quizzes" for grading purposes.