Texas Tech University Department of Physics

CRN 10054 Astronomy 1401 Stars, Galaxies and Cosmology

Course Information Autumn, 2012

Lectures: 5.00-5.50 pm MWF, Sc 007. You will find it beneficial to attend regularly, since much of the material that I cover in class is not in your text, and because we will occasionally do small group exercises in class which count as your class participation grade.

Text: *The Cosmic Perspective: Stars, Galaxies and Cosmology (6th Ed.)* by Bennett, Donahue, Schneider, and Voit. Published by Addison Wesley. The "Starry Night" software is not required.

Also for the lab: **AS1401 Lab Manual, Autumn 2012 edition** by the Department of Physics, Texas Tech University. **(Make sure you get the correct edition)**

Instructor:

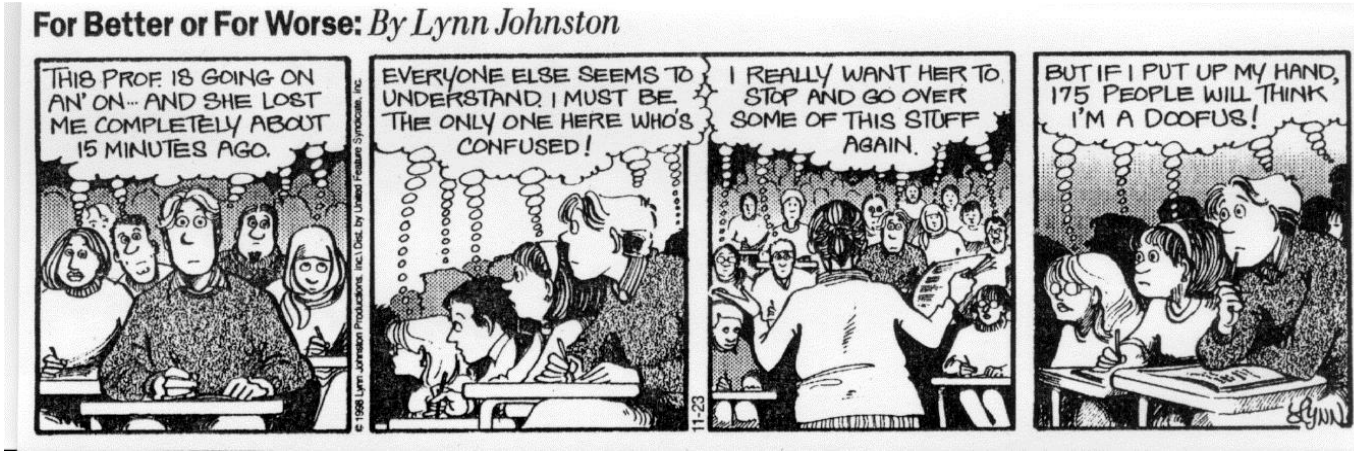
Office

Grading:

Assignments	7 x 2%	14%.	(**A failing grade on the assignment component is a failing grade in the course.**)
Labs	10 x 2.5%	25%	(**A failing grade on the lab component is a failing grade in the course.**)
Observing labs:	2 x 3%	6%	
Course Participation:		8%	
Mid-term Tests:	3 x 8%	24 %	
Comprehensive final		23%	(Just what the name implies)

Grades: The following are the grades to be awarded for this course and the *approximate* scores for which they will be awarded.

A	Has met the course objectives with distinction.	85% +
B	Has met the course objective with credit	73% - 84%
C	Has met the course objectives.	60% - 72%
D	Has met some of the course objectives.	50% - 59%
F	Has failed to meet the course objectives.	49% or less.



What should you get from this course? To a large extent that will depend on you and how much work you are prepared to put in. At the very least there are four major points that I would hope you will gain from the course.

1. To better understand the solar system and the amazing variety of objects that comprise it.
2. To learn to ***think skeptically***, and to realize that science is more about searching for understanding than it is about knowing "The Truth".
3. To gain confidence in your abilities to learn something about which you knew little or nothing before attending this class.
4. To explore the ideas you are learning, both qualitatively (looking at the "Big Picture") and quantitatively (with math and numbers).

Course Purpose:

ASTR 1401 satisfies half of the 6 hour life and physical sciences core curriculum requirement at Texas Tech University. The laboratory section of the course also partially satisfies the university graduation requirement that all students complete 2 hours of science laboratory

The objective of the study of the life and physical sciences component of a core curriculum is to enable the student to understand, construct, and evaluate relationships in the natural sciences, and to enable the student to understand the bases for building and testing theories. The natural sciences investigate the phenomena of the physical world.

Students graduating from Texas Tech University should be able to: explain some of the major concepts in the Natural Sciences and to demonstrate an understanding of scientific approaches to problem solving, including ethics.

ASTR 1401 has no pre-requisites. It serves well the student that is interested in astronomy and the student who is not science oriented but needs to satisfy the science requirement. This course is very important to both groups of students. For those interested (or who inadvertently become interested), it will give you the tools to continue astronomy as a lifelong interest. For those not really interested, astronomy will give you a basic understanding of science which is need for all educated members of society because the population at large determines the role of science in society — not just the scientists!

Expected Learning Outcomes:

Upon completion of this course, students will:

1. Gain a cosmic perspective.
2. Understand astronomy basics (For example: What is a star? A galaxy? Why are nebulae pink? …)
3. Know the history of astronomy.
4. Understand the physics of astronomy at an elementary level and know how astronomers use it to learn about the universe.
5. Understand how telescopes work.
6. Understand how stars are formed, produce their energy and eventually die.
7. Understand the current, most widely accepted theories of the origin and fate of the universe.
8. Understand why some galaxies are extremely active and some are quiet.
9. Understand the various methods astronomers use to derive the distances to celestial objects.
10. Have the tools needed to continuing enjoying astronomy on their own as a hobby if desired, including using a simple telescope to make observations of and identify celestial objects.

Course Format: We will be covering the course material in lecture format on Mondays, Wednesdays and Fridays. However I want to encourage you to ask questions during the lecture. Whether about the

lecture, the textbook, or about any problems you encounter. Remember…. **NO** question is too stupid to ask!!! If you are unsure about something, it is almost certain the several others will be as well. Be sure to let me know if I mention something you are unfamiliar with and help me adjust the pace of the course to better suit your needs. During the course we will be studying worlds far different to our own. From the huge to the tiny, from the densest to the most tenuous, from the hottest to the coldest, even things that cannot be seen. In studying these, we will use tools from many other branches of science, particularly physics and chemistry. Some mathematical skills are necessary as is a vivid imagination! By the end of the course I hope you leave with a deeper appreciation of the awesome universe that we are a part of and can understand why some people devote their lives to spending every possible moment, often in extremely isolated locations, regardless of temperature, to study its wonders.

My expectation is only that you keep up with the material and that you do **not** fall behind. In particular, **I will assume that you have tried to look over the relevant text material *before* the corresponding lecture**, so that the lecture can serve as a concentrated review and clarification. If you are coming to class "cold," without having skimmed the material in the text, you will find yourself at a large disadvantage.

Lecture Powerpoints: My powerpoint presentations from the lectures are available to anyone who comes to my office with a thumbdrive. You should come to my office about once a week to get the latest lectures. **However these are not a substitute for you skipping the lecture or not taking your own notes**! They are to assist you in studying the course.

Attendance: The exams are weighted mostly toward the lecture material, so attendance is important and beneficial. Also, frequent absences will affect your earned points on course participation (8% of grade).

Suggestions for success: *Read ahead, in the textbook, before each lecture, even if it is merely to skim the relevant pages and look at the pictures.* This will prepare you for the lecture and make the lecture much more understandable. It will also ensure that you keep up with the material. *Most importantly, look at or think or talk about the course material as often as possible, even if it means 15 minutes every day--familiarity is remarkably important for understanding a subject conceptually.* Finally, attempt to talk about the material, to yourself or someone else, or an inanimate object if necessary. *My experience is that students who can explain the material in everyday language do well on my exams.* The subset of students who think they have studied hard and understood the material and nevertheless do much more poorly than expected on exams are almost always those who cannot articulate the material themselves. ***The biggest single danger in this course, as in most courses, is to fall far enough behind, either through lack of reading or spotty attendance, that you cannot really understand the material being covered. A related danger is to study the material infrequently and irregularly (e.g. once per week).*** Subsequent chapters will almost certainly seem obscure, and the effect becomes seriously cumulative if you allow this state of affairs early in the semester, when we cover the most "physics-oriented" material that you will need throughout the rest of the book. I realize that all instructors probably say this about not falling behind, but it is one of the most important factors in controlling your success in most classes, and probably the most important factor in this one

Homework Assignments:

(a) There will be 7 homework assignments. These will be handed out in class on a Monday and will be due on the following Monday. These will be graded and each will contribute a possible total of 3 points towards your final grade. The questions will include problem solving and basic maths. **Note that a failing grade on the homework component is a failing grade in the course.**

(b) Make sure to show your work and to explain what you are doing. You will receive very little credit if you do not. **Staple** your assignment together to make sure no parts of it get lost, and leave space in the margins for graders' comments.

(c) **You may work together on assignments and discuss them with others, but this does not mean that you may copy someone else's work**. The paper that you hand in should be the result of **your own** work, with ideas expressed in your own words and with your own calculations shown. **Violations of this policy are taken very seriously.** Here is an example of the difference: - asking "Does Kepler's third law apply in this situation?" is an acceptable question. However asking "Did you get 5.6 metres as the answer for question 6 when you plugged in 5 for x and 0.6 for y in the equation (x + y)?" is **NOT** acceptable. Throughout the semester, I hope you take the opportunity to talk to your fellow ASTRO 1401 students about the material you are learning, and how to apply it during exams and homework assignments—sometimes the best way to learn something is to hear it more than one way, or to try and explain it to someone else! However, please remember that in the end, your answers and all of your work must be your own. Indeed, you'll want to make sure that you understand the material yourself, for when you walk into the lecture hall to take your exam, you will have no one to help you but yourself!

So remember to learn the material yourself, and don't take credit for something someone else told you. **This also includes copying answers from the book!** Your assignment answers **must** show evidence of being **your own work.** Please remember the following, which is part of the Standard Texas Tech Policies that apply to all of your classes:

Students will foster a spirit of academic integrity, and they will not present work as their own that was not honestly preformed by them. For a complete description of this policy see Texas Tech Operating Policy 34.12.

My general policy is that if a student is found to have copied from someone else's assignment, **BOTH** persons get zero for that assignment, on the first occurrence. A second offence will result in a **fail grade** for the course. If two or more students hand in assignments that are basically the same and then claim that they worked together on the assignment, then the marks for the assignment will be split between the students.

(d) You have **ONE** late assignment slip at the end of this information, which entitles you to a 48-hour extension. If you are handing in a late assignment, you should attach this slip to you assignment and hand it to me **at the start of class** on the following Wednesday! As this is the **only** extension you will be granted for the course, **use it wisely**! Assignments are always due in class ***before*** it begins**; if you come to class a little late, hand in the assignment immediately after class. Do not disrupt the class by walking to the front.**

Daytime Labs: There is **a required** laboratory that is part of this course. You will receive one grade for the lecture and laboratory combined—they are not separate courses. For most weeks during the semester you will have a lab during your regularly scheduled lab session. These will be held in Sc 121. If no lab is listed on your schedule, you should see me immediately. You **must attend** the labs in order to get credit (points) for them and all lab work must be turned in to your TA **by you** at the conclusion of each lab. **Work done on your own outside of lab will not be accepted.** You are expected to have read the lab thoroughly before you come to the lab. There will be a quiz at the start of the lab that will be counted are part of your lab grade. Anyone who arrives more than 15 minutes after the scheduled start of the lab will not be permitted to do the lab. **There are no lab make-ups**.
YOU MUST PASS THE LAB SECTION IN ORDER TO PASS THIS COURSE; REGARDLESS OF YOUR GRADE IN THE LECTURE. LESS THAN 50% for the combined lab/observing lab component IS AN AUTOMATIC FAIL IN Astronomy 1401.

Night-time Observing sessions: Observing is an important part of astronomy and as such, is an important part of this course. These are **in addition** to your weekly lab meetings in Sc121 and will be held at the Texas Tech Observatory. Directions to the observatory are posted on the web site http://www.phys.ttu.edu/~gwen/index.htm. Sign-up sheets will be places on the front desk in class a couple of weeks prior to the observing sessions. You MUST sign up for ONE of the nights, and attend on the night you signed up for. Students who come out on a different night to the one they signed up for will not be permitted to do the lab. Likewise anyone who arrives more than 15 minutes after the scheduled start of the observing session will not be permitted to do the lab. Lastly, the last stretch of road to the observatory is unsealed. Driving fast down this road can cause a considerable amount of dust, which can drift over the telescope equipment, damaging it. **So drive slowly down this road, no more than 25 mph!** Anyone driving fast down this road will not be permitted to do the lab.

Tests: They will emphasize concepts and, to a lesser degree, calculations. You should carefully review your class notes, the PowerPoint's, and the assignments, as well as the relevant sections of the textbook, before the exam. You may **not** share calculators. Each test will contribute a possible total of 7 points towards your final grade. **No tests may be dropped**. **There will be no make-up for missed tests after one day from the time the test is given.** If possible please let me know early if you are going to miss a test since there is a possibility that you may take the test in advance.

Final Exam: The final exam will cover the entire course and will be held during the normal exam time. However the final will be **optional** for students who have an "**A**" or "**B**" grade at the end of the course. Students with a "C" grade or below **must** take the final.

One last very important point! The showing of pictures and slides is a considerable component of the course. This requires the room lights to be set down low! This can cause some students to feel drowsy. If this happens you can lose much of what is being presented. While I will by trying to watch out for this, you should also take responsibility for staying awake. Remember, this is **YOUR** course, and what you learn from it will depend largely on you.

LATE ASSIGNMENT SLIP

This slip entitles the bearer to one 48 hour extension to an assignment for Astro 1401.

Attach this slip to the assignment and bring it to Professor Clark.

Natural Science Core Statement
This course satisfies the Life and Physical Science Core Education requirement. To meet this requirement the scientific method will be discussed and the construction of a scientific hypothesis will be explicitly discussed and tested. The scientific method will be the subject of several lecture portions throughout the semester.

Students graduating from Texas Tech University should be able to: explain some of the major concepts in the Natural Sciences and to demonstrate an understanding of scientific approaches to problem solving, including ethics. This section has been moved up to p. 2.

Coordinating Board Objectives	Assessment Measures
Critical Thinking Skills: Students will gain critical thinking skills by evaluating descriptions of physical situations, assessing the relevant parts and representing them graphically, then mathematically, then solving for quantities, and, finally, considering the result to ascertain whether it is a reasonable result. In the lab students learn to relate a physical situation with meaning as they perform measurements and calculations.	In-class exams, class discussion, lab discussion, lab group interactions.
Communication Skills: Students develop oral communication skills through in-class and small group discussions around physical situations and how to interpret them for analysis. The outcomes of these discussions are visual representations of the essentials of the particular physical situation. Written communication skills are developed as the student analyzes problems and writes solutions for discussion in recitation. In the lab students orally communicate as a group coming to a consensus on how to execute the experiment, they collect data as a group, analyzing the results and representing the results graphically and visually and defending individual's interpretations.	Class discussion, lab group interaction.
Empirical and Quantitative Skills: Students learn to categorize physical situations into few types represented by a few free body diagrams. Then, based on the appropriate diagram they construct equations that pertain to the situation and solve them for relevant quantities.	In-class exams, class discussion, lab discussion, lab group interactions.
Teamwork: In lab students will work as groups to design an experiment, execute it, collect the results, assign meaning to the results, and graphically represent the results. In recitation students will work as a group to analyze problems, decide on strategies to address the problem, and attempt to solve.	Class discussion, lab group interaction.
TTU Student Learning Objectives	
Knowledge of the Scientific Method: The student uses the scientific method in analyzing physical problems and then extracting quantities of interest. The student will discuss other methods of deconstructing physical problems and will discuss the ways in which those tactics are insufficient.	Class discussion, lab group interaction.
Knowledge of Tools and Methods of Scientific Inquiry:. Students measure and graphically represent a wide range of data, then interpret their measurements to compare with what more formal measurement has found.	Class discussion, lab group interaction.
Explain some of the Major Theories in Natural Science: Students acquire an understanding of position, velocity, acceleration, force, work, stellar motion, nebular formation, and gravity.	In-class exams, class discussion, lab group interaction.
Describe how research informs social issues, including ethics: The successful student will be able to relate the study of motion to considerations like fission, fusion, gas laws, nebular theories of star formation. Ethical ramifications are drawn out.	Class discussion, lab group interaction.
College Level Competency Objective	
Major Concepts: Students graduating from Texas Tech University should be able to: explain some of the major concepts in the Natural Sciences and to demonstrate an understanding of scientific approaches to problem solving, including ethics. Students completing ASTR 1401 will have a good understanding of the use of the scientific method, motion, force, the origins of stars and galaxies, and how these facts interact with societal beliefs from antiquity to today.	Class discussion, lab group interaction.

CRN 10054 Astronomy 1401 Stars, Galaxies and Cosmology

Course Outline

Here is a **tentative** outline of the lecture topics for the term and the associated readings from the textbook. Some modifications may be made depending on how fast we proceed.

	Date	Topic	Weekly Readings	Weekly Assignment	Labs
Week 1	M Aug 27 W Aug 29 F Aug 31	Introduction. The scale of the Universe. Ancient Astronomy Constellations Sky motions Sky Coordinates.	*The Cosmic Perspective:* Chpt 1 Appendix A. Appendix B. Appendix C. *The Cosmic Perspective:* Chpt 2.1-2.3 Appendix I.		No indoor lab this week
Week 2	M Sept 3 W Sept 5 F Sept 7	**University Holiday** Early Theories. Copernican revolution Kepler's laws.	 *The Cosmic Perspective:* Chpt 2.4 Chpt S1 *The Cosmic Perspective:* Chpt 3.1 – 3.3	Assignment 1 Due Friday Sept 7	Lab 1 Motions in the Sky
Week 3	M Sept 10 W Sept 12 F Sept 14	Newton: Gravity: Orbits. Light, Radiation, Atoms Spectroscopy Doppler effect	*The Cosmic Perspective:* Chpt 4.2 – 4.5*The Cosmic Perspective:* Chpt 5.1 – 5.3 *The Cosmic Perspective:* Chpt 5.4 - 5.5		Lab 2 Extending the Scale
Week 4	M Sept 17 W Sept 19 F Sept 21	Telescopes I Telescopes II The Sun – Structure	*The Cosmic Perspective:* Chpt 6 *The Cosmic Perspective:* Chpt 14.1, 14.3	Assignment 2 Due Friday Sept 21	Lab 3 Spectroscopy
Week 5	M Sept 24 W Sept 26 F Sept 28	The Sun – Energy Production. Measuring the stars I **First mid-term test:**	*The Cosmic Perspective:* Chpt 14.2 *The Cosmic Perspective:* Chpt S4.2		Lab 4 Lifetime of the Sun
Week 6	M Oct 1 W Oct 3 F Oct 5	Measuring the stars II Between the stars I Between the stars II	*The Cosmic Perspective:* Chpt 15.1 - 15.2 *The Cosmic Perspective:* Chpt 16	Assignment 3 Due Friday Oct 5	Lab 5 Parallax
Week 7	M Oct 8 W Oct 10 F Oct 12	Life cycle of a one solar mass star I Life cycle of a one solar mass star II Life cycle of a medium mass star. Star Clusters	*The Cosmic Perspective:* Chpt 17.1, 17.2 Chpt 18.1 *The Cosmic Perspective:* Chpt 17.4 Chpt 15.3		Lab 6 Classification of Stellar Spectra
Week 8	M Oct 15 W Oct 17 F Oct 19	Life cycle of a high mass star. Exotic leftovers I Exotic leftovers II	*The Cosmic Perspective:* Chpt 17.3 *The Cosmic Perspective:* Chpt 18.2 – 18.3	Assignment 4 Due Friday Oct 19	Lab 7 The H-R Diagram
Week 9	M Oct 22 W Oct 24 F Oct 26	The Milky Way Galaxy I The Milky Way Galaxy II **Second mid-term test.**	*The Cosmic Perspective:* Chpt 19 *The Cosmic Perspective:* Chpt 22.1 - 22.2		Lab 8 Photoelectric Photometry of the Pleiades

Week 10	M Oct 29 W Oct 31 F Nov 2	Other galaxies I: Classification. Other galaxies II: Distribution. When Things go Bump in the Night.	*The Cosmic Perspective:* Chpt 20.1, 20.2	Assignment 5 Due Friday Oct 26	Lab 9 Ages of star Clusters
Week 11	M Nov 5 W Nov 7 F Nov 9	Active Galaxies Quasars Cosmic expansion and Hubble's law.	*The Cosmic Perspective:* Chpt 21.3 *The Cosmic Perspective:* Chpt 20.3		Lab 10 Galaxy Classification
Week 12	M Nov 12 W Nov 14 F Nov 16	The Structure of the Universe. The Big Bang and the origin of the universe. The first 60 seconds.	*The Cosmic Perspective:* Chpt 22.3 *The Cosmic Perspective:* Chpt 23	Assignment 6 Due Friday Nov 9	No indoor lab this week
Week 13	M Nov 19 W Nov 21 F Nov 23	The first 60 minutes. **No classes** **Thanksgiving Break**	*The Cosmic Perspective:* Chpt 23		No indoor lab this week
Week 14	M Nov 26 W Nov 28 F Nov 30	Cosmic mysteries. The Fate of the Universe. **Third mid-term test.**	*The Cosmic Perspective:* Chpt 22.4		Lab 11 The Age of the Universe
Week 15	M Dec 3 W Dec 5 F Dec 7	Strings 'n Things. Are we alone? **No Classes**	*The Cosmic Perspective:* Chpt 24	Assignment 7 Due Friday Nov 30	No indoor lab this week
Week 16	M Dec 10	**Final Exam** 4.30 - 7.00pm			

Important Notes:

ADA: Any student who, because of a disabling condition, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office at 335 West Hall or 806-742-2405.

Religious Holidays: A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. A student who is absent from classes for the observance of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence.

Academic Integrity: It is the aim of the faculty of Texas Tech University to foster a spirit of complete honesty and high standard of integrity. The attempt of students to present as their own any work not honestly performed is regarded by the faculty and administration as a most serious offense and renders the offenders liable to serious consequences, possibly suspension. For details, see TTU OP 39.12