Physics 562 – ***Graduate Stellar Astrophysics***
Books: No official book, see suggestions below for material.
Office Hours: Posted on the office door or by appointment – use email
Course Time: 12:30-1:45 TR, Workman 352, Spring 2015
Instructor: M. Creech-Eakman, Workman 357; mce@kestrel.nmt.edu, x5809
Website for course updates, details, HW, etc: http://kestrel.nmt.edu/~mce/phys562.html

Course Learning Outcomes/ Purpose of Course: My goal is to help you establish a broad and somewhat in depth foundation in stellar astrophysics at the graduate level, including topics in basic stellar physics, stellar evolution, equations of state, processes of radiation, conduction and convection, stellar nucleosynthesis, stellar modeling, asteroseismology and solar structure. We learn by doing and so there will be many opportunities to prove that you are learning the material in this course. Homework will generally be assigned a couple of weeks in advance. You are encouraged to work together, to consult me, other professors and many, many books and journal articles to solve your homework problems… however, each person must turn in individual homework sets that are clear evidence of their mastery and understanding of the material. I will provide generalized but not detailed solutions to the problems upon request. If you need to go through a problem in gory detail, please come see me.

As part of the coursework, there will also be opportunities to model stellar problems, because much of what we understand about stars comes from detailed models that are proven out and refined by observations. Because we will not be able to cover every stellar topic in detail, there will be presentations (both written and oral) at the end of the course by each student on a topic of his or her choosing (I will provide a list as a guide). If you publish papers on stellar topics already, or are planning a stellar topic for your dissertation, I strongly encourage you to choose an area with which you are *unfamiliar* for this part of the course in order to augment your education.

Finally, being a professional astronomer requires that you be able to talk lucidly about your subject, therefore a large component of your grade will include class presentations, in-class discussion of homework and papers, and an oral final. As a postscript, I encourage extra credit work in all my classes, in this case by attending colloquia on stellar astrophysics (check with me before you go if you are not sure about a colloquium's topic). Please keep in mind, however, that mastery of the material offered in this course should be your main goal and extra credit is just icing on the cake.

These learning outcomes discussed above are in-line with the department's goals for our graduate students: to become independent learners, researchers and eventually teachers of this material and to go on to successful careers as professionals, likely in STEM fields.

Tips for Success in this class:
1) Please endeavor to always be on time for class. If you expect to be late or absent, drop me an email or stop by my office. You are still responsible for all the material assigned for that class meeting whether or not you attend.
2) Homework is expected to be turned in during class-time or by 4:45 pm on the day it is due. Late homework will only be accepted in pre-approved and extenuating circumstances….don't

come to me after class to discuss why you won't be turning in your work. (Illness and personal emergencies are exceptions to this and will be handled on a case-by-case basis.)
3) I always endeavor to be fair and prompt in returning your work to you, as my feedback to you is part of the learning process. If you feel I have graded you unfairly or misunderstood a solution you've turned in, please speak with me immediately about the problem so that we can resolve the issue while it is still fresh. Waiting until the last week of class to ask for points is generally frowned upon.
4) Cheating is strictly frowned upon. The first instance results in no credit for that assignment, a second, and you will be dropped from my course and reported for disciplinary action to the Chair and Graduate Dean. Cheating includes, but is not limited to, plagiarism, copying another's homework, having another complete homework for you, etc. Please consult the NMT Student Honor code for all the specifics (below). If you are unsure, when writing a paper for instance, whether something should be referenced/cited, the safest assumption is to reference it.
5) I expect you to challenge me and each other about what is discussed as we cover the course material. We will not learn to become skeptical, critical thinkers if we do not question assumptions. Please try to always do this questioning in a respectful manner…the same way you would wish to be treated by your peers/me.
6) I work very hard and expect that you will also. In general, you should spend about 4-5 hours outside of class for every hour you spend in class. If you find you cannot accomplish the work I've assigned in that time frame, please come see me before you fall behind so that we can attempt to remedy the situation.

Schedule and Grading:
The detailed reading, homework and grading information will be posted on the web page for the class. There will be an *ungraded* midterm, at which time I will inform you of your standing in the class and tell you what grade you would have received, had the midterm been graded. It is your responsibility to keep detailed track of your own grades (but come ask about the participation aspect if you don't know how you are doing). In my classes, all points are considered equivalent and everything is calculated based strictly on percentages – 97.5%^ A+, 91.5-97.4% A, 89.5-91.4 % A-, 87.5-89.4% B+, etc. Finally, part of your grade will be determined by your classmates' review of your final talk, as it is ultimately your peers in the field who will evaluate you in your career. This will be done anonymously and respectfully in all circumstances. The class will consist of the following general components:

Component	**Points**
Homework (5)	400
Computer Projects (2)	150
Final Project/Paper	200
Class Participation	75
Midterm (practice)	0
Final	175
TOTAL 1000	

A note for people auditing the course: You are expected to participate in class as a full member of the course for the purposes of the discussions if you want to get a *Satisfactory Audit* mark. In order to do this, you need to maintain an up-to-date status on the reading assignments. You also should try to turn in at least half of every homework assignment and the first computer project. Participating in the midterm, final and final project are optional, but please inform me early if you would like to participate

in these components so that I budget class time for your participation. I will inform you at midterm time if you are falling behind, and will grade your homework in the same manner I grade that of the people participating in the course for credit. You should be spending about 2-3 hours outside of class for every hour in class; however, the material may be challenging enough for you that you are unable to complete it in that time frame. If this begins to happen, please see me immediately.

Counseling and Disability Services

Reasonable Accommodations: New Mexico Tech is committed to protecting the rights of individuals with disabilities. Qualified individuals who require reasonable accommodations are invited to make their needs known to the Office of Counseling and Disability Services (OCDS) as soon as possible. In addition, New Mexico Tech offers mental health and substance abuse counseling through the Office of Counseling and Disability Services. The confidential services are provided free of charge by licensed professionals. To schedule an appointment, please call 835-6619.

Academic Honesty: NMT's Academic Honesty Policy can be found starting on page 59 of the NMT catalog, http://www.nmt.edu/images/stories/registrar/pdfs/2013-2014_UNDERGRADUATE_Catalog_FINAL.pdf
You are responsible for knowing, understanding, and following this policy.

Supplemental Texts to Consult for the Course:

There are a tremendous number of books which could be used for studying various stellar topics. The following books below, most at the graduate level, are ones on my personal shelf or that I have borrowed from the library which I find useful at times. You should also feel free to borrow books from me or make use of interlibrary loans throughout our class. Below I list some books you may choose to add to your personal library someday.

Basic Stellar Evolution:
Schwarzchild, 1958, *Structure and Evolution of the Stars*
Harwit, 1982, *Astrophysical Concepts*
Cox, (2 vols), 1968, *Principles of Stellar Structure*
Chiu et al., 1972, *Stellar Evolution*
Shklovskii, 1978, *Stars, Their Birth, Life and Death*

Nucleosynthesis:
Clayton, 1983, *Principles of Stellar Evolution and Nucleosynthesis*
Iliadis, 2007, *Nuclear Physics of Stars*

Stellar Physics:
Chandrasekhar, 1939, *An Introduction to the Study of Stellar Structure*
Shu, (2 vols), 1991 & 1992, *The Physics of Astrophysics: Vol 1 and 2*
Rybicki & Lightman, 1979, *Radiative Processes in Astrophysics*
Mihalas, 1978, *Stellar Atmospheres* Gray*, Stellar Photospheres*
Menzel, 1963, *Stellar Interiors* Chiu*, Stellar Physics*
Cox and Giuli, 1968*, Principles of Stellar Structure and Evolution: Vol 1 and 2*
Bohm-Vitense, 1989, *Stellar Astrophysics* Collins (online), *Fund. of Stellar Astrophysics*
Novotny, 1973*, Intro. To Stellar Atmospheres and Interiors*

Kippenhahn and Weigert, 1996, *Stellar Structure and Evolution* (or newer version, 2012)
Hansen et al., 1994, *Stellar Interiors (includes a CDROM of programs)*
Rose, 2008*, Advanced Stellar Astrophysics*

Stellar Properties:
Cox, 1999, *Allen's Astrophysical Quantities* Lang, 2006*, Astrophysical Formulae*

Modeling:
Press et al., 1992, *Numerical Recipes: The Art of Scientific Computing*

Pulsation:
Cox, 1980, *The Theory of Stellar Pulsation* Unno et al., 1989, *Nonradial Oscill. of Stars*

Winds & ISM:
Lamers & Cassinelli, 1999, *An Introduction to Stellar Winds*
Spitzer, 1978*, Physical Processes in the Interstellar Medium*

Compact Objects & High-energy Astrophysics:
Shapiro & Teukolsky, 1983, *Black Holes, White Dwarfs, and Neutron Stars*
Longair, (2 vols.), 1992, *High-Energy Astrophysics*

The following is a rough schedule of the work we will cover this semester. The detailed schedule will be posted on the website.

Week Starting	**Topics/Other**
Jan 12	H-R Diagram and Observations
Jan 19	The Sun
Jan 26	Basic Equations for Stars
Feb 2	Heat Transport: Radiation
Feb 9	Heat Transport Convection & Conduction
Feb 16	Thermonuclear Reactions - BBFH
Feb 23	Star Formation and BDs
Mar 2	Stellar Evolution – Low mass; *Midterms outside of class*
Mar 9	Stellar Evolution – Int &High mass
(*Spring Break week Mar 14-22*)	
Mar 23	Binary Evolution and Late Stages; *Modeling #1 due*
Mar 30	Variable Stars & Pulsation Theory
Apr 6	Degenerate Objects
Apr 13	Accretion, Mass-loss and Winds
Apr 20	Magnetism & wrap-ups
Apr 27	In-class talks; *Modeling #2 due*
May 4	Final papers due – *Final exams scheduled*