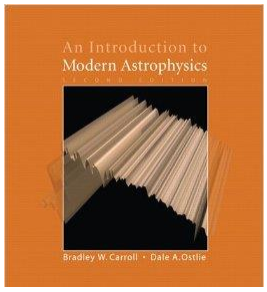
Physics 390: An Introduction to Astrophysics
Spring 2017
TuTh 9:30 a.m. - 10:45 p.m. in Mitchell 107

Course Description/Objective: Astrophysics applies the laws of physics to understand the nature of heavenly bodies. All of the basic physics you have learned is important somewhere in astrophysics. This is an advanced course, and the first and only calculus-based astronomy course offered at West Chester University. The book, while by far the most popular introductory astrophysics text, is 1400 pages (a testament to the size of the field), far too long for a thorough coverage in one semester. As far as the number of topics, I have chosen what I hope is an appropriate balance between breadth and depth, with a slight bias towards topics having decent problem assignments! There will be simple topics, like parallax and luminosity, yet also more advanced topics, such as the Friedmann equations governing of the expansion of space in a homogeneous and isotropic Universe.

Instructor: Prof. Robert Thornton
Office: Merion 129
rthornton@wcupa.edu
Office hours: W 10-11:00 AM OR 5:30-6:30 p.m. (see *courses.wcupa.edu/RThornton* for details); TuTh 1:30-3:30 PM; also by appointment

Required Text:
An Introduction to Modern Astrophysics (2nd Edition) by Carroll & Ostlie. Addison-Wesley 2006.



Grading:
3 Exams x 20% each: 60%
Homework: 20%
Final Exam: 20%

Homework Policy:
There will be about 10 homework sets. I will post the problems before we cover the corresponding topics in class. But because I won't be able to predict how much we'll get covered each class, I will likely have to make adjustments to the due dates. No late problem sets will be accepted. If you fail to turn in a problem set because of absences (excused or unexcused) then you will receive a zero for that problem set grade. If you get stuck while working on a homework problem, PLEASE come see me rather than trying to find and copy solutions - I will help you, I promise! Any evidence of a student copying solutions will be strictly dealt with and result in an "F" for the entire semester grade (not just that homework). I will post the homework solutions after the due date. The problem sets will be graded only roughly, so you should check your returned homework with the posted solutions. No homework assignments will be accepted over email.

Exam Policy:
The intended content of the exams will be similar to the content of your homework. If you are going to miss an exam for a university excused absence (this requires a signed note) you need to notify me one week before the exam is going to be offered, and we'll figure something out. If you miss an exam for without a university excuse, you will receive a zero (unless you are extremely ill - like, dying).

Attendance:
Attendance is an important part of the class, so I will be recording it most every time. After you miss more than three classes with no excuse, the instructor reserves the right to have each additional unexcused absence result in your course average being lowered by half of a letter grade. Excused absences are limited to those due to participation in University - sanctioned events (see policy in the WCU undergraduate catalog) or those accompanied by written confirmation from a doctor, the Dean of Students, etc. If you are sick, you MUST obtain a doctor's note. Finally, whether your absence is excused or unexcused (or if you are late to class), you will be responsible for any material covered and any announcements that were made in class that day.

Disability:
We at West Chester wish to make accommodations for persons with disabilities. Please make your needs known by contacting the Office of Services for Students with Disabilities at extension 3217 as well as myself. Sufficient notice is needed in order to make the accommodations possible. The University and I desire to comply with the ADA of 1990.

Public Safety:
The Emergency Communication Committee has made the recommendation that the emergency phone number for WCU's Department of Public Safety be listed on all course syllabi. That number is 610-436-3311. This specific recommendation is made to help the campus be prepared in case of an emergency situation.

Intellectual Property Statement:
The instructor for this course utilizes copyrighted materials under the "Freedom and Innovation Revitalizing United States Entrepreneurship Act of 2007" (Fair Use Act). Apart from such copyrighted materials, all other intellectual property associated with this course is owned and copyright protected by the instructor, including, but not limited to, lectures, course discussions, course notes and supplementary materials posted or provided to students authored by the instructor, assessment instruments such as quizzes and exams, and Power Point presentations. No recording, copying, storage in a retrieval system, or dissemination in any form, whether electronic or other format, by any means of the intellectual property of the instructor, either in whole or in part, is permitted without the prior written permission of the instructor. When such permission is granted, it must specify the utilization of the intellectual property and all such permissions and waivers shall terminate on the last day of finals in the semester in which this course is held.

Links and references to on-line resources provided by the instructor may lead to other sites. The instructor does not sponsor, endorse or otherwise approve of any information appearing in those sites, nor is responsible for the availability of, or the content located on or through, external sites. Apart from materials used in accordance with the Fair Use Act, the instructor takes no responsibility for material that is otherwise offered at web sites and makes no warranty that such material does not infringe any third party rights. However, should any of this type of material be present and this fact is brought to the attention of the instructor, they will remove references to it from course materials.

Course Schedule on Next Page →

Tentative Schedule of Topics

Basic Distances, Measures, and Radiation (Ch 3*) *~2-3 lectures*
Topics include stellar parallax, magnitude scale, blackbody radiation, flux, luminosity, and (astronomical) color.
HW 1 & 2

Interaction of Light and Matter (Ch 5) *~1 lecture*
Review basics of spectral lines (from Modern Physics and chemistry), and introduce spectrograph basics and Kirchhoff's laws. Homework problems will also be assigned on the Bohr model, even though it will not be discussed in class.
HW 2

Unit 3: Stellar spectra (Ch 8) *~2 lectures*
Topics include Maxwellian velocity, the Boltzmann and Saha equations, classification of stellar spectra, and the H-R diagram.
HW 3

TEST #1

Unit 4: Stellar Atmospheres (Ch 9) *~2-3 lectures*
Topics include specific intensity, stellar opacity, mean free path, optical depth, the radiative transfer equation, and the profile of spectral lines (equivalent width and curve of growth).
HW4

Unit 5: Stellar Interiors (Ch 10) *~2 lectures*
Topics include theories of the Sun's source of energy, equations of stellar structure, fusion/tunneling, nuclear reactions (p-p chain and CNO cycle), energy transport, stellar lifetimes, mass/luminosity/temperature relationships, and radiation pressure/the Eddington luminosity limit.
HW 5

Unit 6: Celestial Mechanics/Binary Stars (Ch 2 & 7) *~2 lectures*
Topics include Kepler's Laws, the Virial theorem, and types of binary systems.
HW 6

Unit 7: Stellar Evolution (Ch 15, 15, & 16) *~1 lecture*
This is an extensive topic that, in the interest of time, I have chosen not to discuss in detail. Therefore, I will only present the big picture at a very basic level, and not assign any written homework on it.

TEST #2

Unit 8: Star Formation & ISM (Ch 12) *~2-3 lectures*
Nebulae, HII regions, extinction, redenning, dust, 21-cm, molecular clouds, Jean's collapse.
HW 7

Unit 9: Astronomical Optics & Instrumentation (Ch 6) *~2 lectures*
Topics will include collecting area, plate scale, resolution, detectors, f ratio, and signal to noise. If time permits, we will get into spectrographs as well.
HW 8

Unit 10: Milky Way & Galaxies (Ch 24 & 25) *~2 lectures*
We will talk briefly about the Milky Way, its major components, and other types of galaxies. Though the details are not yet fleshed out, quantitative topics will likely focus on mass distribution, rotation curves, and dark matter halos. If we have time, we may dedicate a lecture to AGN.
HW 9

Unit 11: Cosmology (Ch 27, 29 & 30) ~3 *lectures*
Topics will include the Hubble constant, scale factor a(t), geometries of the Universe, Robertson-Walker metric for curved spacetime, dark energy, and the Friedmann equation.
HW 9

TEST #3

*Relevant chapters in text, although other sources will also be used.