Physics 299: Introductory Special Topics, Astrophysics Spring 2017

Meeting: Trexler 263 — Time: MWF 2:20 - 3:20PM
Instructor: Matthew C. Fleenor — Office: Trexler 2661D
email: fleenor@roanoke.edu — Office Hours: W 3.30-5:00 PM
R 1.00 — 2.30PM or by appt.

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Required Textbook: *Foundations of Astrophysics*, B. Ryden & B. M. Peterson,
ISBN 13: 978-0-321-59558-4

Required Prerequisites: Math 118 or 121, Physics 201 or Instructor Permission

Other Required Readings: Provided by Instructor

I. Components of Learning

There are several factors that make a course "good" (by good, I mean a healthy combination of the intellectual and the affective). Good courses are also clear about their essential components. Below is an attempt to be clear about how will I operate within PHYS 299, as well as my expectations of a student
who is enrolled in PHYS 299.

Descriptions

Aspiration: Physics is a framework for observing and appreciating the physical universe, in as much as it is a manner of explaining the phenomena within it. Therefore, a few different levels of interpretation exist for the sentence, "I understand physics." My approach in this course is a 'both/and' mentality, where both the conceptual understanding (and dare I say, appreciation) and the analytical problem-solving approach can mutually coexist. Arguably, if you don't have both an interest in the conceptual and the mathematical, then eventually neither will deepen. I will provide the proper atmosphere and avenues so that neither of these necessary levels of understanding need to be sacrificed. My goal for you is that you will walk away with a deeper understanding in each of these contexts.

Introductory special topics (IST) implies that your learning will be focused in a particular area that may be new to you. Learning how basic and fundamental physical principles fit within the context of astrophysics can be enlightening, enriching, and invigorating. There are many concepts introduced within a basic physics course (like 201) that remain segregated or compartmentalized from other topics. Our IST series intends integrate some of these topics so you get a real-world view of how physics "works" to reveal understanding.

Expected Learning Objectives: Successful students will —

1. demonstrate a proficiency with the use of units and estimation;
2. display a working knowledge between the various kinematic quantities and their graphical representation;
3. manipulate Newton's laws of motion in order to show conservation principles (energy and momenturn);
4. analyze different contributions of the total energy of a system and comment on how the energy is conserved;
5. determine the centripetal force for uniform circular and show that Kepler's laws of motion are produced by Newtonian gravitation;
6. calculate the escape velocities for atomic and molecular species for planetary atmospheres;

7. apply concept of total angular momentum as it relates to orbital energy and stability;
8. demonstrate an understanding of the force balance within a star to give an equilibrium state;
9. describe the environment of black holes and their effects on accreting matter.

Attendance: Although roll will not be taken, daily attendance is expected. Your absence will be noted by the lack of contribution to our discussion and problem-solving interactions in class. Due to the mathematically rigorous nature of the course, you may not miss more than four classes without a legal excuse (court, hospital, police, etc.). Late arrivals greater than 10 minutes will constitute an official absence. At the third un/excused absence, I will request a meeting with you and send an email to you, your Advisor, and the Registrar alerting them of the situation. After the fourth absence, you will be dropped (forcibly, with a "DI?" or "DP," or willingly with a "W" before the ninth week) from the class. Late arrivals greater than 10 minutes will constitute an official absence.

As is the case for all Roanoke College classes, the time spent on this course will constitute at least 12 hours a week. This includes class, lab, reading, and any homework or writing assignments.

Office Hours: Please take advantage of the office hours prescribed above, or make an appointment with me. Drop-ins are at the total mercy of my daily schedule.

Inquire (NQR): I use the NQR environment extensively to place notes, announcements, assignments, proofs, solutions, links, and other course documents. Please do NOT forget to check NQR before you come to class or if you have a question about previous assignments.

Academic Integrity: I want to foster a mutual respect for the classroom hours that we have together. In light of this, please remember to silence cell phones, electronic devices, laptops, etc. during class and come prepared. Please ask if you want to use these devices for educational purposes in class. Refer to the "Academic Integrity" page on the RC website

http : //roanoke.edu/A—Z-Index/Registrar/P01icies-and-Information/Academic-Integrity.htm

Included here is an explanation of how violations of the College's academic integrity policy are handled.

Grades: Standard letter grades (A—F) are assigned according to the following scale for this course: "A" (92-100), "B+" (88-91), "B" (83-87), (80-82), "C+" (78-79), "C" (74-78), (70-73), "D" (60 _69), "F" 60).

II. Modes of Learning

Rubric

Your grade is determined according to the following distribution:

Exams (3)	45%	Home/Classwork	30%
Final	15%	Quiz (weekly)	10%
Participation	5%		

Descriptions

Exams: All exams are planned (by me) for completion in 1.0 hour, however, you will have up to 1.25 hours to complete each exam. Since the class begins at 2.20PM, each student has the option to arrive at 2.15PM and/or stay until 3.30PM. NOTE: If you have a class that begins at 3.30PM, it is your responsibility to plan for the late arrival into your next class. All exams will contain comprehensive material from the previous chapters, most probably the one/two most missed problems from the previous exam/quizzes. The final exam will be given in class and will be cumulative. Make-up exams will only be allowed as a result of a discussion with me beforehand or a note related to the emergency (death, hospitalization, misdemeanor, etc.) signed by a governing official (medical doctor, parent, law enforcer, etc.).

Quizzes: Weekly quizzes (FRIs) are completed individually or as a small group (my discretion) in class and graded. The quiz will consist of one partial problem from the class discussion, which contain the more important concepts and/or phenomena. Typically, the problem will not be numerical ill nature.

Problem Sets: Un-/assigned problems (like those in the problem sets) are "when and where" you will learn the course material. For better and for worse, there is no way to learn the depth of the material within the one-hour sessions that we will have together. Due to the nature of problem solving, I expect that you will work together toward a solution. However, I also expect that you will create an original solution to each assigned problem. Substitutions and simplifications should NOT be left to the "reader" (that's me) to figure out. If necessary, words and phrases need to be properly placed so that I can follow your train of thought. Problem sets are your final draft essays and/or compositions that display the fruit of your higher-level critical thinking skills, so you need to view them in that light. These can be completed in electronic format or by-hand (neatly). If you do not follow these guidelines, I will return them to you for completion. I can provide examples of the kind of work that I expect on a final submission for the problem sets.

Participation: What it means to "participate" in Physics 299 should include the following: on-line quiz completion, listening to audio-video lectures, attentive attendance, engagement in question and answer, reflective write-up for two extracurricular lecture or presentations, and responsibility for your own learning (office hours, etc.).

III. Daily Course Outline

In what follows, you will see the plan for working through the course. Each course meeting provides a section of the text, a conceptual topic, and a homework problem to reinforce the topic. Quizzes (Q) and Exams (EXAM) are also marked on the course outline, so please refer to it often. If there are deviations from the following outline, I will certainly draw your attention to them.

PHYS 299 Course Outline, Spring 2017

Week	Date	R & P Text	Supplemental	Topic	Homework
1	16-Jan 18-Jan 20-Jan	 1.1 - 1.2	Morin (1.2) Swokoski (3.3) Morin (3.5), MT A.F	Units, Conversions, Dimensional Analysis Average and Instantaneous Quantities Coordinate Systems (r — 9Ù-9-q) (Q)	1.3, 1.4, 1.9, 1.11 2,4,5,15-17,21 1.1-2,1.4-6,1.8
2	a-Jan 25-0an 27-Jan	 1.3 - 1.5	co (2.1), sw (12.3) Notes/ SJ SO (3.4), (MT) 1.11	Geometry of ellipses and parabolas Vectors, scalars, and kinematics Vector analysis and unit vectors (Q)	2.1-2,12.33-34
3	30-Jan I-Feb 3-Feb	2 1-. 2.2 2.3 — 2.4 2.5	MT (1.14), M (3.5) Sezebehely (1) Carroll & Osti (2.1)	Uniform circular motion and centripetal acc Angular quantities and kinematics Kepler's Laws & Center-of-mass (Q)	 2.6-7
4	6_Feb 8-Feb 10-Feb	2.6 3.0 	Carroll & Osti (2.1) Carroll & Osti (2.2) 	Rotating coordinate systems Force, inertia, mass, N-3 EXAM 1: IN-CLASS	 Review
5	13-Feb 15-Feb	 3.1.1 31.2	Carroll & Osti (2.2) Carroll & Osti (2.3) Carroll & Osti (2.3)	Gravitation and central forces Deriving Kepler's Second, L conserved Deriving Kepler's First (Q)	
6	20-Feb 22-Feb 24-Feb	31.3 12.3, 13.5 3.2 - 3.3	Carrolt & Osti (2.3)	Deriving Kepler•s Third K3 Applied: Planet Detection & Stellar Mass Orbital Energy and Orbit Speed (Q)	
7	27 -Feb I-Mar 3-Mar	3.4 7.3	Carroll & Osti (2.4) Morin (7.1—7.2) Morin (7.3 — 7.4)	Virial Theorem Conservation of energy and L Kepler's Laws and central forces (Q)	
8	6-Mar 8-Mar 10-Mar			Spring Break: No Classes	
9	13-Mar 15-Mar 17-Mar	 4.2 4.3	Morin (7.3 — 7.4) Carroll & Ost (19.2) Carroll & Ost (19.2)	Kepler's Laws and central forces Tidal Forces Astronomical Contexts for Tidal Forces (Q)	
10	20-Mar 22-Mar 24-Mar	 13.1—2 13.3—4	Carroll & Ost (19.2) semny & J (21.5) Carroll & Ost (19.3)	Astronomical Contexts for Tidal Forces Kinetic Theory & Maxwell-Boltzmann Physics of stellar & planetary atmospheres	 Review
11	27-Mar 29-Mar 31-Mar	 14.1 15.1	 Carroll & Ost (10.1)	EXAM 2: IN-CLASS Static & hydrostatic equilibrium Static & hydrostatic equilibrium (Q)	
12	3-Apr 5-Apr 7-Apr	 15.1.2 15.2-3	Carroll & Ost (10.2) Carroll & Ost (10.4) Carroll & Ost (10.3)	Pressure equation of state Energy transport Timescales and energy sources (Q)	
13	10-Apr 12-Apr 14-Apr	15.4 	 	Stellar modeling: how to build a star EXAM 3: IN-CLASS Good Friday: No Class	Review
14	17-Apr 19-Apr 21-Apr	 	Carroll & Ost (17.1) Carroll & Ost (17.2) Carroll & Ost (17.3)	General relativity: when gravity doesn't work Intervals, metrics, and GR mechanics Black holes (Q)	
15	24-Apr		Carroll & Ost (18.1)	Binary star systems & accretion disks	
	2-May			FINAL EXAM: CUMULATIVE (2—5 PM)	