Galaxies and the Universe – Syllabus, Winter 2017
AST 5100

Lecture: Tuesday and Thursday, 1:00pm – 2:15pm
Location: 185 Physics
Professor: Edward Cackett
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Office hours
Tuesday 11:30am – 12:30pm. If you can't make it during regular office hours, please feel free to email me to schedule an appointment at some other day/time. As a general rule, if my office door is open, you're free to come in and ask questions.

Course synopsis
This is a 3-credit course which covers the nature of galaxies and their structure and evolution as well as cosmology (the nature of the Universe and its structure and evolution). This is the capstone course of the BA in Astronomy.

Learning Outcomes
By the end of the course students should be able to do the following:

1. Know the basic structure of the Milky Way galaxy, including approximate size scales
2. Know the basic properties of spiral and elliptical galaxies, including appropriately using the Tully-Fisher, Faber-Jackson and Fundamental Plane relations
3. Know how galaxy rotation curves show strong evidence for dark matter
4. Understand the accepted picture for galactic evolution, including the hierarchical merger model
5. Know Hubble's law and that it implies the universe is expanding
6. Know how galaxy clusters show strong evidence for dark matter
7. Understand how the properties of Active Galactic Nuclei imply accretion of matter onto a supermassive black hole
8. Know the Friedmann equation and be able to solve for k = 0
9. Understand the implications of the cosmic microwave background for the Big Bang model of the Universe
10. Know how the cosmological constant is included in the Friedmann equation
11. Know the current observational evidence for dark energy and what this implies for the evolution of the Universe
12. Know what the horizon problem, flatness problem and the magnetic monopole problems are, and how the theory of inflation solves these problems
13. Understand the need for cold dark matter to allow structure formation in the early universe

Text
An Introduction to Modern Astrophysics (2nd Edition) by Carroll & Ostlie (Addison Wesley, 2007). This is a (very) large textbook covering the entirety of astrophysics. It is an extremely useful reference for all of astrophysics. The relevant section of the book for this course is *Part IV: Galaxies and the Universe*, which are chapters **24 – 30**. Given how expensive the textbook is I am not requiring the textbook for the course, however I **highly recommend** getting it, if possible. There are several copies available from the

university library. For those who are intending to study astronomy at graduate school this will remain an excellent resource covering almost the entirety of astronomy.

Blackboard

Course announcements, grades, etc will be made using the Blackboard system (blackboard.wayne.edu). Please make sure you check it regularly.

Exams

- There will be 2 mid-term exams and 1 final exam. Each will be worth the same percentage of the final grade.
- As per the university's exam schedule, the final exam will be held on **Thursday, April 27 from 12:30pm – 2:30pm** (note the different time).
- Material covered on each exam will be announced in class, and through Blackboard and is given in the syllabus class schedule.
- Given the Astronomy Assessment Test (see below), the final will **NOT** be a cumulative exam.
- There will be **no make-up exams**.
- **If you do not take the final exam, your course final grade will be automatically 'F' – no exception.**
- **If you miss more than one mid-term, your course final grade will automatically be 'F' – no exception.**

Astronomy Assessment Test

As this course is the capstone course for the BA in Astronomy there will be a 1.5 hour multiple-choice assessment test towards the end of the semester. This test is intended to cover all material from all astronomy classes in the degree, and assess your understanding of astronomy. It will naturally be broad and so will aim to cover the understanding of the major concepts studied, as opposed to detailed mathematical questions.

Homework

There will be 8 sets of homework problems (one for each chapter except Cosmology, which will have two). Due dates for homework sets are noted in the class schedule at the end of the syllabus. Note that each homework set will be worth approximately 3.75% of the overall grade. Missing two homework sets is equivalent to dropping your grade by more than one increment (i.e. going from A- to B+). I therefore highly recommend putting in the time and effort required to do well in the homework. Experience also shows that those who put effort into the homework tend to do better overall.

Performance Evaluation

Your final grade in this course will be based on the following items:

Mid-terms	40%	(each mid-term counts for 20%)
Final Exam	20%	
Homework	30%	
Astronomy assessment test	10%	

Final Grades

Final grades will be given using the grading scale in the table below, however, it is almost impossible to set 'perfect' exams, and so grades may be curved, if necessary.

A	85 – 100 %
A-	80 – 84
B+	75 – 79
B	70 – 74
B-	65 – 69
C+	60 – 64
C	55 – 59
C-	50 – 54
D+	45 – 49
D	40 – 44
D-	35 – 39
F	< 35

Advice

1. **Get the text**, read it before class, go to class, take notes and participate in the discussion.
2. **Come to class!** Research has shown that students who come to class do better, on average, than those that don't.
3. **Ask questions in class**. If things aren't clear, or even if you just want me to leave something up for longer to write it down, **don't be afraid to ask**. You will likely not be the only one with the same question/request.
4. You cannot skip the final exam because you feel you are getting a good enough grade without it. If you miss the final exam you will receive a grade of 'F'. No exceptions.

In-class policies

Out of consideration for the other students in the lecture please abide by the following rules of conduct: (1) Turn off all cell phones while in lecture, (2) Please arrive on time for lecture and do not leave early, (3) Please be mindful of your classmates.

Academic dishonesty

All of the graded assignments are designed to measure your individual understanding of the material. No forms of cheating on these graded assignments will be tolerated (working together on the homework assignments is not considered cheating but copying of someone else's homework is). Anyone found cheating on any graded activity will receive a grade of zero for that part of their grade, and may receive a failing grade for the course.

Student e-mails

I am happy to answer questions via e-mail. However, please be sure to look for announcements on Blackboard and check this syllabus before emailing me with questions. Please also follow proper professional etiquette in your emails. For instance it is appropriate to use full sentences with proper grammar and punctuation (i.e. no 'text' slang, please). **Rude or improper emails will not be answered**.

Students with Disabilities

If you have a documented disability that requires accommodations, you will need to register with Student Disability Services for coordination of your academic accommodations. The Student Disability Services (SDS) office is located at 1600 David Adamany Undergraduate Library in the Student Academic Success Services department. SDS telephone number is 313-577-1851 or 313-577-3365 (TTY: telecommunication device for the deaf; phone for hearing impaired students only). Once you have your accommodations in place, I will be glad to meet with you privately during my office hours to discuss your special needs. Student Disability Services' mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University.

Course Schedule

This is the expected schedule for the course, though it is subject to change as needed.

Day	Date	Lecture Topics	Chapter	HW
Tu	1/10	The Milky Way: morphology, ISM distribution	24.1, 24.2	
Th	1/12	The Milky Way: kinematics	24.3	
Tu	1/17	The Milky Way: kinematics, the Galactic Center	24.3, 24.4	
Th	1/19	Galaxies: Hubble sequence, galaxy types	25.1	
Tu	1/24	Galaxies: spiral galaxies, rotation curves	25.2	HW 1 due
Th	1/26	Galaxies: spiral structure	25.3	
Tu	1/31	Galaxies: Elliptical galaxies	25.4	
Th	2/2	Review/examples class	24 & 25	HW 2 due
Tu	2/7	Galactic Evolution: interactions of galaxies	26.1	
Th	2/9	**Exam 1**	24 & 25	
Tu	2/14	Galactic Evolution: formation of galaxies	26.2	
Th	2/16	Structure of the Universe: Extragalactic distance scale, expansion of the Universe	27.1, 27.2	
Tu	2/21	Structure of the Universe: Clusters of galaxies	27.3	HW 3 due
Th	2/23	Active Galaxies: types	28.1	
Tu	2/28	Active Galaxies: unified model	28.2	HW 4 due
Th	3/2	Active Galaxies: jets, quasars as probes of the Universe	28.3-28.4	
Tu	3/7	Review/examples class	26 – 28	HW 5 due
Th	3/9	**Exam 2**	26 – 28	
Tu	3/14	***Spring Break – no class***		
Th	3/16	***Spring Break – no class***		
Tu	3/21	Cosmology: Newtonian	29.1	
Th	3/23	Cosmology: Newtonian	29.1	
Tu	3/28	Cosmology: Cosmic Microwave Background	29.2	HW 6 due
Th	3/30	Cosmology: Cosmic Microwave Background	29.2	
Tu	4/4	Cosmology: Relativistic cosmology	29.3	
Th	4/6	Cosmology: Observational cosmology	29.4	
Tu	4/11	The Early Universe: Inflation	30.1	HW 7 due
Th	4/13	The Early Universe: The Origin of Structure	30.2	
Tu	4/18	**Astronomy Assessment Test**		HW 8 due
Th	4/20	Review/examples class	29 - 30	
Th	4/27	**Final exam, 12:30 – 2:30 pm**	29 - 30	