

University of Alberta, Faculty of Science
Department of Physics
Winter 2016

ASTRO 322: Galactic and Extragalactic Astrophysics

3 Credits

MWF 13:00–13:50

CCIS L1-047 (lower level 1, near eastern elevators)

Instructor: Gregory R. Sivakoff

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E-mail: sivakoff@ualberta.ca

Office Hours: Wednesdays 14:15–16:15 or by appointment

Occasional cancellations, if any, will be announced on eClass

Website: <https://eclass.srv.ualberta.ca/my/>

Look for “ASTRO 322 GALACTIC & EXTRAGALACTIC ASTR” under “My Courses.” The site will contain deadlines, class lectures (after the lecture has been given), course announcements, assignments, discussion forums, representative evaluative material for exams, etc.

Calendar Course Description: ★3 (*fi* 6) (either term, 3-0-0). The interstellar medium and interstellar reddening; galactic structure; kinematics and dynamics of stars in galaxies; quasars; introduction of cosmology.

Real Course Description: This course covers the interacting astrophysical processes that lead to the cycles of formation and evolution of galaxies. Using our own Milky Way as a starting point, the course focuses on stellar populations, the interstellar medium (gas and dust), dark matter, and black holes. The introduction of observations across the electromagnetic spectrum (from radio waves to gamma-rays), as well as astronomical techniques, will reinforce what we know with how we know it. Specific objectives include:

- Understand how the life cycle of stars is intimately related to how galaxies form and evolve, using both our own Milky Way and other galaxies as examples.
- Develop familiarity with the necessary background, including astronomical jargon, to understand the feedback cycle of galaxy formation, and generalized astronomy on galactic scales in scientific and media resources.
- Evaluate the energy output from stellar and other galactic processes, and how this output affects galaxies.
- Synthesize the variety of processes and explore deficiencies in current models.

Course Prerequisites: MATH 115 or 118, and PHYS 126 or 146, and PHYS 208 or 271. SCI 100 may be used in lieu of MATH 115 and PHYS 126 or 146. Previous knowledge of astronomy is advantageous. ASTRO 320 is *strongly* recommended. Prerequisites may be waived with instructor approval. Mathematically, this course involves significant algebra and trigonometry, as well as some multi-dimensional calculus.

Required Course Textbook: “An Introduction to Modern Astrophysics”, by Carroll & Ostlie.

Chapters 1, 3, 12, 24–27, and parts of 5, 8, 14, 15, 17, 18, and 28 are covered in this course, along with other special topics. Chapters 1–3, 8, 13, and 16 are critical (ASTRO 320) background.

Additional Course Fees: None

Topics Covered: The schedule below and associated reading are representative and subject to change.

Lectures	Dates	Topic	Reading
1	Jan 4	Course Overview	
2–4	Jan 6, 8, & 11	Background Astronomy	Ch. 1 & 3; Pg. 398–400
5–7	Jan 13, 15, & 18	The Nearest Stars	Sec. 5.1 & 8.2
8–10	Jan 20, 22, & 25	Milky Way Structure	Sec. 24.1–24.3
11–13	Jan 27 & 29; Feb 1	Interstellar Medium	Ch. 12
14–16	Feb 3, 5, & 8	Feedback Sources	Sec. 15.3, 15.5, & 24.4
17	Feb 10	Astronomy & the Media	
18	Feb 12	Midterm	
19–20	Feb 22 & 24	Distance Indicators	Sec. 14.1 & 18.5
21	Feb 26	Expanding Universe	Sec. 27.1 & 27.2
22	Feb 29	Dark Matter	
23–24	Mar 2 & 4	Galaxies Introduction	Sec. 25.1
24–25	Mar 4, & 7	Local Group	
26–28	Mar 9, 11, & 14	Spiral Galaxies	Sec. 25.2–25.3
29–31	Mar 16, 18, & 21	Elliptical Galaxies	Sec. 25.4
32	Mar 23	Groups of Galaxies	
33–34	Mar 30; Apr 1	Galaxy Interactions	Sec. 26.1–26.2
35–36	Apr 4, 6, & 8	Clusters of Galaxies	Sec. 27.3
37	Apr 8	Active Galactic Nuclei	Sec. 28.1–28.3

Grading:

Class Participation:	5%	Over entire term
Homework:	25%	Approximately every week
Redshift Computer Lab:	5%	March 4
Astronomy & Media Reports:	15%	January 29, March 18, and April 1
Midterm Test:	20%	February 12 (CCIS L1-047)
Final Exam:	30%*	April 15, 14:00** (Location TBD)

* There is no possibility of a reexamination in this course as the Final Exam weight is < 40%.

** Students must verify this date/time on BearTracks when the Final Exam Schedule is posted.

Grade Assignment: Grades are assigned by taking the score for each course component and calculating a total course percentage score using the component weights given in the course syllabus. This overall mark is then used to assign course grades. **Grade boundaries will be decided based on a combination of historical student performances and the instructor's expectations and judgment.** Where possible natural grade boundaries will be used. The absolute percentage scores to secure a particular grade will vary from year to year because it is not possible to write exams with consistently identical difficulty levels. Historically, the median letter grade / mean GPA for this course is a B/3.0. All students are responsible for all class participation and assignments from the first day of the course.

Class Participation: All participation will be graded on effort. Most, but not all, of participation will be assessed via in-class think, pair, share questions. Some participation may be assessed via asking and/or answering other questions in class or participating online. For an excused absence where the cause is religious belief, a student must contact the instructor within two weeks of the start of classes to request accommodation for the term.

Assignment Deadline Policy: Late assignments handed within 24 hours of the assignment deadline will receive only 75% of the earned credit. Late assignments handed within 24–48 hours of the assignment deadline will receive only 50% of the earned credit. All other late assignments will receive no credit. Weekend days, reading week, and days where University Buildings are closed will not be counted towards being late. For an excused absence where the cause is religious belief, a student must contact the instructor within two weeks of the start of classes to request accommodation for the term. Assignments due on the last day of course can not be handed in late.

Format for Answering Homework/Exam Questions: Like scientific papers, answering a homework or exam problem should have an introduction, body, and conclusion. The introduction should include clearly identifying the variables (with symbols, text, and numerical values) and (whenever possible) a labelled diagram. The body should include *algebraic manipulation*, with the necessary steps to illustrate that manipulation, until a *single formula* is derived that one can plug numbers into. The penultimate step is plugging in the numbers, when applicable; however, this is not the conclusion. The conclusion should be a concise (no more than a few sentences) evaluation of whether the answer makes sense, or an acknowledgment that the answer does not make sense. The units of the final answer should always be evaluated in the conclusion. For numerical questions, some effort should be made to check if the order of magnitude for the answer is reasonable; sometimes this can be done via analogy to known answers, while other times this can be done via illustrating a hand-check on the order of magnitude (i.e., a check made without a calculator). This final stage of checking units and the order of magnitude for an answer is crucial because while homework/exam questions may have known answers, real-world problems rarely do. All of the above steps must be completed to earn full marks on homework/exam questions.

Homework: Your homework problem set with the lowest score will be dropped from your final mark.

Astronomy & Media Reports: (3 Parts)

- Identification of astronomy media story (3% of total grade - January 29)
- Summary of original science paper (6% of total grade - March 18)
- Mock press release (6% of total grade - April 1)

Midterm Test / Final Exam Rules:

Calculators and formula sheets are allowed in the Midterm Test and Final Exam. Most types of calculators will be allowed; however, devices with any remote communication or reception capabilities are explicitly forbidden (e.g., but not limited to iPods, PDAs, pagers, cell phones and laptops). If in doubt, ask before using a device in an exam because ignorance of these rules will not be an acceptable excuse. I will distribute formula sheets before the Midterm Test and Final Exam. While you should feel free to lightly annotate these sheets, only these formula sheets will be allowed during the Midterm Test and Final Exam.

Using an illegal formula sheet or device on the Midterm Test or Final Exam will result in your case being forwarded to the associate dean with a minimum recommendation of 25% penalty of your earned grade on the test/exam. In addition, your formula sheet, illegal device, or exam may be seized.

Your student photo I.D. is required to verify your identity. Students will not be allowed to begin an examination after it has been in progress for 15/30 minutes (for the Midterm/Final). Students must remain in the exam room until at least 15/30 minutes (for the Midterm/Final) has elapsed.

Midterm Test Deferral Policy: A student who cannot write the Midterm Test because of an incapacitating illness, severe domestic affliction, or other compelling reasons may apply to defer the Midterm Test weight to their Final Exam. The numerical value of the deferred portion of the grade may be adjusted if the Midterm Test and Final Exam have different grade distributions. Deferral applications must be made to the instructor within 48 hours of the missed test and must be supported by a statutory legal declaration made before a Commissioner of Oaths in the Student Services Office, Faculty of Science, or other appropriate documentation (§23.3(1) of the University Calendar). For an excused absence where the cause is religious belief, a student must contact the instructor within two weeks of the start of classes to request accommodation for the term. Deferral of term work is a privilege and not a right, with no guarantee that a deferral will be granted. Misrepresenting facts to gain a deferral is a serious breach of the Code of Student Behaviour.

Final Examination Deferral Policy: A student who cannot write the final examination because of an incapacitating illness, severe domestic affliction, or other compelling reasons may apply for a deferred final examination. Deferral applications must be made to the student's Faculty office within 48 hours of the missed examination and must be supported by a completed University of Alberta Medical Statement Form or other appropriate documentation (§23.3(2) of the University Calendar). For an excused absence where the cause is religious belief, a student must contact the instructor within two weeks of the start of classes to request accommodation for the term. Deferred examinations are a privilege and not a right; there is no guarantee that a deferred examination will be granted. Misrepresenting facts to gain a deferred examination is a serious breach of the Code of Student Behaviour.

The deferred Final Exam will be held on Monday, May 16th from 09:00 a.m. to 12:00 noon in CCIS L1-029.

Electronic Communication:

This course outline will be archived at <http://www.ualberta.ca/~sivakoff/teaching.html>. Primary online content (e.g., deadlines, class lectures, and important class notifications) will be organized through an eClass Moodle course (available at <https://eclass.srv.ualberta.ca/my/>). The eClass will have a few discussion forums that students may participate in; respectful communications at all times is required. Please note that "individual blogs (under the My Profile section) are viewable by the entire UAlberta Moodle community."

As University classes occur in a professional setting, all e-mails for this class should include a formal salutation and signature and should not include internet slang. E-mail not following this convention will be ignored. The instructor will try to respond to all e-mails within 1 "business" day. Please include "ASTRO 322" as part of the subject line to help the instructor quickly identify the message (e.g., "ASTRO 322: Appointment Request").

Disclaimer: Any typographical errors in this Course Outline are subject to change and will be announced in class. The date of the final examination is set by the Registrar and takes precedence over the final examination date reported in this syllabus.

Recording and/or Distribution of Course Materials: Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan. Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study, and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

Student Responsibilities:

Academic Integrity:

“The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour (online at <http://www.governance.ualberta.ca>) and avoid any behaviour which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.”

All forms of dishonesty are unacceptable at the University. Any offence will be reported to the Associate Dean of Science who will determine the disciplinary action to be taken. Cheating, plagiarism and misrepresentation of facts are serious offences. Anyone who engages in these practices will receive *at minimum* a grade of zero for the assignment, paper or exam in question and no opportunity will be given to replace the grade or redistribute the weights. As well, in the Faculty of Science the sanction for **cheating** on any examination will include a **disciplinary failing grade** (NO EXCEPTIONS) and senior students should expect a period of suspension or expulsion from the University of Alberta.

Students are encouraged to discuss assignments with their classmates, friends, family, etc. If students choose to work together on reading and standard assignments, they must submit their own work for grading whether it be submitted online or offline. Direct copying of another's work is plagiarism.

Cell Phones:

Cell phones are to be turned off during lectures, labs, and seminars. Cell phones are not to be brought to the Midterm Test or Final Exam.

Specialized Support & Students with Disabilities:

Students who require accommodations in this course due to a disability affecting mobility, vision, hearing, learning, mental or physical health are advised to discuss their needs with Student Accessibility Services (SAS), 1-80 Students' Union Building, 492-3381 (phone) or 492-7269 (TTY) to determine their rights and responsibilities.

Please note: Students registered with SAS who will be using accommodations in the classroom or the lab, or who will be writing exams through SAS, are required to provide a “Letter of Accommodation” to the instructor as soon as possible. Those students who need accommodated exams must provide the instructor with an Exam Instructions & Authorization form at least one week before each exam. Students are encouraged to make an appointment with the instructor to discuss any required accommodations.

Academic Support:

As adults, students are expected to take more responsibility for their own education. If a student needs additional assistance in developing strategies for better time management, study skills or examination skills, keeping up with the material, or adjusting to university learning, then they need to seek help themselves. Sources of help include: the instructor, Isaac Isaac (the Physics Undergraduate Advisor, CCIS 4-185), and the Student Success Centre (2-300 Students' Union Building).

Policy about course outlines can be found in §23.4(2) of the University Calendar.