Astronomy 3303A: Galaxies
2018-2019: Fall term

General Information

- **Lectures:**
  Tuesdays 9:30am–10:30am and Thursdays 9:30am–11.30am; Rm 117 PAB

- **Instructor:**
  Prof. Els Peeters
  Rm 206 PAB; phone: 661-2111 ext. 80973; epeeters [at] uwo.ca

- **Office hours:**
  Office hours: Drop by **after 1pm** or by appointment
  I can also be reached immediately after class and during the week through e-mail for simple inquiries or to make an appointment.

- **Teaching assistant:**
  Robin Arnason: rarnaso [at] uwo.ca

- **Course website:**
  Sakai OWL: http://owl.uwo.ca

- **Required textbook:**
  Sparke & Gallagher, *Galaxies in the Universe, An Introduction, 2nd Edition*, Cambridge University Press (on course reserve at Taylor Library: QB857.S63x 2007)

Course Description

- **Calendar description:**
  Course description: Introduction to galaxies, including the Milky Way. Galaxy components and their variation with location, shape, and age; the distribution of galaxies in space and time; interpretation of observational data to derive physical properties of galaxies.
  Pre-requisites: Physics 2101A/B, 2102A/B
  Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

- **Course Goals:**
  By the end of this course, students should have a basic understanding of the theory and observations that underpin current research in galaxies and galaxy evolution. More specifically, students should be able to:

- Explain quantitatively how the three-dimensional structure of the Milky Way, the Local Group, and the large-scale distribution of galaxies is measured, and the results of those measurements.
- Quantitively describe the components that make up galaxies, explain how these components are studied and their relation to galaxy morphological type.
- Compute properties of galaxies by combining observational data with physical laws.
- Describe the statistical distributions of integrated galaxy properties in the universe and explain how these properties have changed over cosmic time.

- **Outline of topics to be covered:**

1. Galaxies in the Local Universe
   - The Milky Way and its satellites
   - The Hubble Diagram
2. Galaxy Structure
   - morphology: (thin and thick) disk, bulge, halo
   - globular cluster systems
   - interstellar medium and star formation
   - light distribution
   - dynamics of stars, gas, dark matter (rotation and random motions)
   - nuclei
   - stellar populations
   - scaling relations (Tully-Fisher, fundamental plane)
   - distance scale
3. Galaxy Populations
   - dwarf ellipticals, dwarf spheroidals, dwarf irregulars
   - properties and environmental dependencies
4. Galaxy Environments
   - field
   - groups
   - clusters
   - large scale structure
5. Galaxy Evolution
   - changes with cosmic time
   - the active galactic nuclei phase
   - mergers

Course content may vary.

- **Mark distribution:**

  Assignments: 30% (each 10%)
  Midterm: 30% (2hrs)
  Final exam: 40% (3hrs)

  In order to pass the course, you must attain a grade of at least 50% on the weighted average of the midterm and the final exam. Unless you achieve this criterium, your maximum grade in this course will be 40%. The Department of Physics and Astronomy may, in rare cases, adjust the final course marks in order to conform to Departmental policy.

  Any errors, or appeals to your scores, must be reported to your instructor within two weeks of their initial posting.

- **Assignments:** There will be three assignments. The first assignment is a group project for which presence in class on Thursday October 4, 2018 is mandatory. The second and third assignment will be problem sets which will include conceptual, analytic, and computational questions. These two problem sets will need to be submitted **electronically**. Both of the two problem sets will have a submission deadline as well as a late submission deadline. You are allowed to submit one of the two problem sets by its late submission deadline without requiring a penalty. A penalty of 50% (of the maximum score) will be applied to the second problem set if you submit both problem sets by their late submission deadline. Assignments submitted after their late submission deadline will not be accepted.

Course Calendar/Schedule

- Assignments are due by 9.30am on Oct. 4, Oct. 30 and, Nov. 27
- Midterm is on Nov. 15 (2hrs) in class.
- Final exam: during the December exam period. Details to be announced.
- Last day to drop this course: Nov. 12

Course policies & friendly reminders from UWO:

- Students are expected to come to class prepared, to bring a calculator and to work through exercises (alone or in groups).
- `Course website:` The course website will be the only medium where course materials are distributed, announcements are made and where you can access your marks for various components of this course. It is your responsibility to check this website frequently.
- `e-mail:` In accordance with policy, http://www.uwo.ca/its/identity/activatenonstudent.html, the centrally administered e-mail account provided to students will be considered the individuals official university e-mail address. It is the responsibility of the account

holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner.

- `Assignments:` Remember that clarity is essential for getting partial or full credit for problems. Please show all steps leading to your final answer. Finally, remember to include the appropriate units for any numerical answer and take care of the significant digits.

- `Working together:` Students are encouraged to work on problem sets together. However, the work that is handed in must be an honest representation of your own effort and understanding.

- `Calculator:` A basic scientific calculator (e.g. the Sharp EL-510RB calculator used for first year physics courses) is allowed during the midterm and the final exam.

- `Missed midterm or final exam:` Documentation must be provided to the Dean's Office in order for you to receive permission to write a make-up (see item on "medical or other serious circumstances" below). Note that if you fail to write a scheduled Special Examination, permission to write another Special Examination will be granted only with the permission of the Dean in exceptional circumstances and with appropriate supporting documents. In such a case, the date of this Special Examination of a final exam normally will be the scheduled date for the final exam the next time the course is offered.

  Students needing to make travel arrangements are advised to book a travel date after the end of the examination period. No make up exams will be given to accommodate travel!

- `Accessibility:`

  Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Student Accessibility Services (SAS) at 661-2147 if you have any questions regarding accommodations.

  The policy on Accommodation for Students with Disabilities can be found here:
  http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_disabilities.pdf

- `Medical or other serious circumstances:` If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or supporting documentation to the Academic Counselling Office of your home faculty as soon as possible and contact your instructor immediately. If you are a Science student, the Academic Counselling Office of the Faculty of Science is located in NCB 280, and can be contacted at scibmsac uwo.ca. For further information, please consult the universitys medical illness policy at
  http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf.

  It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. If

you miss the Final Exam, please contact your faculty's Academic Counselling Office as soon as you are able to do so. They will assess your eligibility to write the Special Exam (the name given by the university to a makeup Final Exam). You may also be eligible to write the Special Exam if you are in a Multiple Exam Situation (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

- `Academic misconduct:`

  Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:
  http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

  Computer-marked multiple-choice tests and exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

  If you are caught cheating, there will be no second warning. Cheating includes having available any electronic devices other than an approved calculator during tests and exams. You may not have a cell phone, PDA etc. accessible during tests or exams, not even to use it as a calculator.

- `Religious holidays:` The policy on Accommodation for Religious Holidays can be found here:
  http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

- `Useful links:`

  Registrarial Services: http://www.registrar.uwo.ca

  Learning-skills counsellors at the Student Development Centre (http://www.sdc.uwo.ca) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered in the drop-in Learning Help Centre, and through individual counselling.

  Students who are in emotional/mental distress should refer to Mental Health@Western (http://www.health.uwo.ca/mental_health) for a complete list of options about how to obtain help.

  Additional student-run support services are offered by the USC, http://westernusc.ca/services.

Advice for successful performance:

This is a challenging class that will require you to apply many different types of physics in novel ways. You are advised to do the reading, participate in class, and work through the assignments to succeed in this course. If you encounter difficulties in doing the homework assignments, ask your fellow students, the TA or me for help.

Estimation of student workload: Expect to spend 10-15 hours (including class time) per week on this course alone.