

**PHYC 2452 Syllabus: *Stellar and Galactic Astrophysics* – Winter 2026**  
**Department of Physics & Atmospheric Science**

*Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people. Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.*

**Instructor:** **Philip Bennett** [Philip.Bennett@dal.ca](mailto:Philip.Bennett@dal.ca) **Office: DUNN 226**

**Lectures:** T, Th 5:35 pm – 6:55 pm in Dunn 101. **Course Delivery: In-person**

**Laboratories:** **Planetarium sessions** will be scheduled during tutorials. Two identical shows will be scheduled for consecutive Tuesday tutorials to accommodate the entire class. You only need to attend one of these shows.

**Tutorials:** T 7:05 pm – 7:55 pm in Dunn 101.

**Teaching Assistants:** **Abby Yashayaeva** [Abby.Yashayaeva@dal.ca](mailto:Abby.Yashayaeva@dal.ca)

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### Course Description

This companion course to **PHYC 2451** provides a general introduction to the astrophysics of stars and galaxies for science students. The basic properties of stars, star formation, stellar evolution, stellar populations, star clusters, and the late stages of stellar evolution will be discussed. The course will examine the interstellar medium, galactic structure and evolution, & compact objects (neutron stars, black holes, quasars) at an introductory level. The role of dark matter & dark energy in the formation of the universe, and in establishing the present-day large-scale structure of the universe will be reviewed.

### Course Prerequisites/Restrictions

A first-year science course.

### Course Objectives/Learning Outcomes

- The night sky and the apparent motions of the stars
- Stellar catalogues – an historical perspective
- Stellar spectroscopy and the Hertzsprung-Russell diagram
- Star Formation
- The Main Sequence Life of Stars
- The Sun in detail
- Late Stages of Stellar Evolution & Stellar Death
- Our Galaxy – the Milky Way
- Normal & Active Galaxies
- The Local Group of Galaxies
- The Large-Scale Structure of the Universe
- The Big Bang and Cosmological Models
- Dark Matter & Dark Energy

Course Textbooks: *Learning Astronomy by Doing Astronomy*, 2<sup>nd</sup> ed, (Smartwork 5 version) is **\*\*required\*\***, as this text will be used for lab exercises. The other (optional) two textbooks are no longer available from the publisher. Bookstore link here: [https://bookstore.dal.ca/CourseSearch/?course\[\]=SUB,202620,PHYC,PHYC2452](https://bookstore.dal.ca/CourseSearch/?course[]=SUB,202620,PHYC,PHYC2452)

**1. Required- Learning Astronomy by Doing Astronomy, 2<sup>nd</sup> ed. (Smartwork 5 version)**

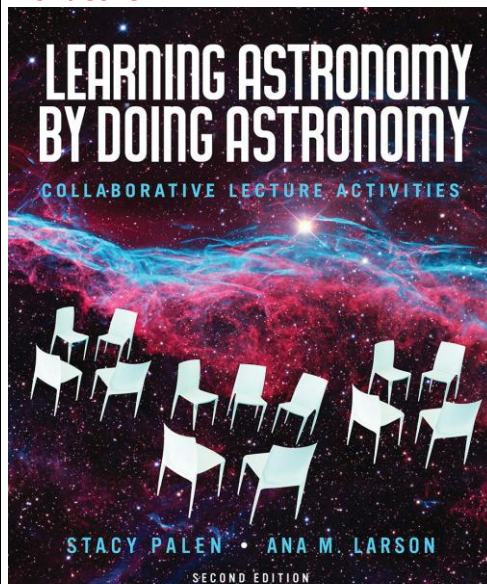
**Authors:** Stacy Palen & Ana M. Larson

**Publisher:** W.W. Norton & Company

**ISBN:** 978-0-393-41984-9 (pbk)

978-0-393-89293-2 (e-book)

**Front Cover:**



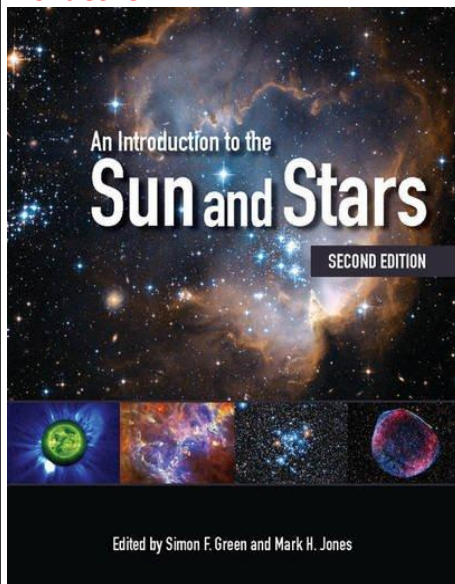
**2. An Introduction to the Sun & Stars, 2<sup>nd</sup> ed. (optional – not available)**

**Editors:** Simon F. Green, Mark H. Jones

**Publisher:** Cambridge University Press

**ISBN:** 978-1-107-49263-9 (pbk)

**Front Cover:**



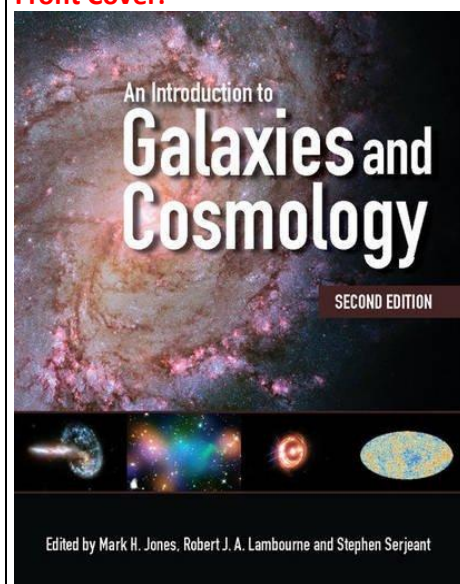
**3. An Introduction to Galaxies and Cosmology, 2<sup>nd</sup> ed. (optional-unavailable)**

**Editors:** Mark H. Jones, Robert J.A. Lambourne, & Stephen Serjeant

**Publisher:** Cambridge University Press

**ISBN:** 978-1-107-49261-5 (pbk)

**Front Cover:**



**Materials:** Lectures will be available as PDF slides on **Brightspace**.

**Course Assessment**

Component	Weight (% of final grade)	Date
<i>Midterm Exam 1</i>	<i>16%</i>	<i>Tues, 10 Feb 2026, 5:30—8:00 pm, Dunn 101</i>
<i>Midterm Exam 2</i>	<i>16%</i>	<i>Tues, 10 Mar 2026, 5:30—8:00 pm, Dunn 101</i>
<i>Final exam</i>	<i>16%</i>	<i>Tues, 7 Apr 2026, 5:30—8:00 pm, Dunn 101</i>
<i>Multiple-Choice Assignments</i>	<i>16%</i>	<i>3-4 Brightspace quizzes</i>
<i>Smartwork activities</i>	<i>12%</i>	<i>6 pre- and post-activities (12 activities in total)</i>
<i>In-Class Quizzes</i>	<i>5%</i>	<i>5 multiple-choice quizzes during selected lectures</i>
<i>Lab Assignments</i>	<i>16%</i>	<i>1 laboratory assignment</i>
<i>Participation</i>	<i>3%</i>	<i>attending 1 planetarium session</i>

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (<50)
A- (80-84)	B- (70-72)	C- (55-59)	

## Course Policies

- Be sure to plan your term to include the dates and times of the tests and the examination. You are expected to write exams on the date scheduled. If you must miss an exam due to COVID or other illness or other some justified reason, **advance notice MUST be given, in writing (e-mail is OK)**. If an exam is missed without prior notice, **there is no guarantee that you will be able to write a rescheduled exam**. If sick, please complete and submit the [Student Declaration of Absence](#) form.
- Assignments will be posted to Brightspace, and will generally be due 2 weeks later.
- **Multiple choice assignments should be answered online via Brightspace**. Other assignments, requiring a written response, **should be scanned and uploaded to Brightspace**.
- Late assignments will generally receive a “per-lecture” late penalty, unless justified to the instructor prior to the deadline.
- **Assignments will NOT be accepted** (without prior permission of the instructor) more than 1-2 weeks after the deadline, because we will discuss the assignments after that time, and answers will be given.
- All examinations will be **open book**, and various resources may be brought into the exam room including course textbooks, course notes, other written materials, and calculators. **The average of the top 2 grades for the 3 exams (2 midterms & 1 final) will be used to calculate the overall exam grade**.
- Calculators will generally be **required** and should be brought to exams.
- Laptop computers, tablets, cell phones or other devices will be allowed in exams for the sole purpose of viewing of local files such as electronic copies of the course textbook or course notes, or Brightspace course pages. **No internet access outside of Dalhousie is allowed during exams**.
- Students are **strongly encouraged to work together on assignments** since the purpose of assignments is not to evaluate students’ knowledge (exams serve that purpose), but to help students learn the course material and analysis methods. However, the work that you submit **must be your own**. All the drawings, observations, and calculations that you submit **must be your own**, and any written work submitted **must be written in your own words**.
- It is an **academic offence** to copy another student’s solution, or to copy solutions obtained from solutions manuals, or by any other means other than your own work. Please note that instructors are obligated to report any academic offences to the Senate Disciplinary Committee. See the Academic Calendar for more details about intellectual honesty.
- Students are **strongly encouraged to attend tutorials** and participate in group problem-solving activities. You may ask anything you wish at the tutorials: help with the problem sets, solutions to the previous problem sets, but also about being a science major, and expectations in your current and upper year classes. We may use some tutorials to observe the night sky with departmental telescopes, weather permitting, and hold planetarium sessions on some cloudy nights.
- **All students are required to comply with health and safety requirements on campus**. Non-compliance may be reported under the Code of Student Conduct.
- I have not set office hours, but will generally be available in my office (Dunn 226) on Tuesday & Thursday afternoons (until 5:30 pm), or by e-mail appointment request to [Philip.Bennett@dal.ca](mailto:Philip.Bennett@dal.ca). I try and respond promptly to all e-mails (e-mail is the best way to contact me).

## University Policies and Statements

### **Recognition of Mi'kmaq Territory**

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or [elders@dal.ca](mailto:elders@dal.ca). Additional information regarding the Indigenous Student Centre can be found at: [https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

### **Internationalization**

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: <https://www.dal.ca/about-dal/internationalization.html>

### **Academic Integrity**

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: [https://www.dal.ca/dept/university\\_secretariat/academic-integrity.html](https://www.dal.ca/dept/university_secretariat/academic-integrity.html)

### **Accessibility**

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre ([https://www.dal.ca/campus\\_life/academic-support/accessibility.html](https://www.dal.ca/campus_life/academic-support/accessibility.html)) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (<https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html>)

### **Conduct in the Classroom – Culture of Respect**

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

### **Diversity and Inclusion – Culture of Respect**

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: <http://www.dal.ca/cultureofrespect.html>

### **Student Code of Conduct**

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at: [https://www.dal.ca/dept/university\\_secretariat/policies/student-life/code-of-student-conduct.html](https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html)

### **Fair Dealing Policy**

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: [https://www.dal.ca/dept/university\\_secretariat/policies/academic/fair-dealing-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html)

### **Originality Checking Software**

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at: [https://www.dal.ca/dept/university\\_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html)

### **Student Use of Course Materials**

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.



## Student Resources and Support

### University Policies and Programs

**Important Dates in the Academic Year** (including add/drop dates):

[http://www.dal.ca/academics/important\\_dates.html](http://www.dal.ca/academics/important_dates.html)

**Classroom Recording Protocol:** <https://www.dal.ca/content/dam/www/about/leadership-and-governance/university-policies/class-recording-protocol.pdf>

**Dalhousie Grading Practices Policies:** <https://www.dal.ca/content/dam/www/about/leadership-and-governance/university-policies/grading-practices-policy.pdf>

**Grade Appeal Process:** [https://www.dal.ca/campus\\_life/academic-support/grades-and-student-records/appealing-a-grade.html](https://www.dal.ca/campus_life/academic-support/grades-and-student-records/appealing-a-grade.html)

**Sexualized Violence Policy:** <https://www.dal.ca/content/dam/www/about/leadership-and-governance/university-policies/sexualized-violence-policy.pdf>

**Scent-Free Program:** <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>

### Advising

**General Advising (Halifax):** [https://www.dal.ca/campus\\_life/academic-support/advising.html](https://www.dal.ca/campus_life/academic-support/advising.html)

**General Advising (Truro):** [https://www.dal.ca/campus\\_life/ssc.html](https://www.dal.ca/campus_life/ssc.html)

**Faculty of Science Advising Support:** <https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html>

**Indigenous Student Centre:** [https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

**Mi'kmaq and Indigenous Relations:** <https://www.dal.ca/about/mission-vision-values/mikmaq-indigenous-relations.html>

**Elders-in-Residence** (The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit the office in the Indigenous Student Centre or contact the program at [elders@dal.ca](mailto:elders@dal.ca) or 902-494-6803: <https://www.dal.ca/about/mission-vision-values/mikmaq-indigenous-relations/elders-in-residence-and-traditional-knowledge-keepers.html>

**Black Students Advising Centre:** [https://www.dal.ca/campus\\_life/communities/black-student-advising.html](https://www.dal.ca/campus_life/communities/black-student-advising.html)

**International Centre:** [https://www.dal.ca/campus\\_life/international-centre/current-students.html](https://www.dal.ca/campus_life/international-centre/current-students.html)

**LGBTQ2SIA+ Collaborative:** <https://www.dal.ca/about/mission-vision-values/equity-diversity-inclusion-and-accessibility/about-office-equity-inclusion/community-specific-groups/lgbtq2sia-collaborative.html>

## **Other Academic supports**

**Dalhousie Libraries:** <https://libraries.dal.ca/>

**Writing Centre:** [https://www.dal.ca/campus\\_life/academic-support/writing-and-study-skills.html](https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html)

**Studying Skills/Tutoring:** [https://www.dal.ca/campus\\_life/academic-support/study-skills-and-tutoring.html](https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html)

**Copyright Office:** <https://libraries.dal.ca/services/copyright-office.html>

**Fair Dealing Guidelines** <https://libraries.dal.ca/services/copyright-office/fair-dealing.html>

**Dalhousie Student Advocacy Services:** <https://www.dsu.ca/dsas?rq=student%20advocacy>

**Dalhousie Ombudsperson:** [https://www.dal.ca/campus\\_life/safety-respect/ombudsperson.html](https://www.dal.ca/campus_life/safety-respect/ombudsperson.html)

**Human Rights and Equity Services:** <https://www.dal.ca/about/mission-vision-values/equity-diversity-inclusion-and-accessibility/about-office-equity-inclusion/human-rights-and-equity-services.html>

**On Track** (helps you transition into university, and supports you through your first year at Dalhousie and beyond): [https://www.dal.ca/campus\\_life/academic-support/On-track.html](https://www.dal.ca/campus_life/academic-support/On-track.html)

**Student Health & Wellness Centre:** [https://www.dal.ca/campus\\_life/health-and-wellness.html](https://www.dal.ca/campus_life/health-and-wellness.html)

## **Safety**

**Biosafety:** <https://www.dal.ca/dept/safety/programs-services/biosafety.html>

**Chemical Safety:** <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

**Radiation Safety:** <https://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

**Laser Safety:** <https://www.dal.ca/dept/safety/programs-services/radiation-safety/laser-safety.html>