Physics and Astronomy
School of Physical and Chemical Sciences

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

ASTR323/423 Stellar Structure and Evolution, Semester 2, 2023

Introduction

This is a 15-point course designed to give students an in-depth understanding of modern stellar astrophysics. A background in physics and mathematics including at least 30 points at 200 level is required. ASTR112 is recommended.

Students enrolled under the ASTR423 course code should expect more difficult assessments than will be required for 323 students.

Prerequisites

(1) 30 points from PHYS203-206, ASTR211-212; and (2) MATH103 or MATH109 or EMTH119 or MATH201.

Lecturers

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<td>Term 3
Associate Professor Michael Albrow
West 616
Michael.Albrow@canterbury.ac.nz</td>
<td>Term 4
Associate Professor Karen Pollard
Julius Von Haast 620
Karen.Pollard@canterbury.ac.nz</td>
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Topics to be covered in lectures include

Physical parameters of stars and their observational constraints, equations of stellar structure, nuclear fusion processes, timescales, energy transport, stellar models, stellar atmospheres and spectroscopy, star formation and evolution. Stellar variability, stability, excitation mechanisms and pulsation. Practical observational analysis and applications of stellar variability and pulsation.

Textbook

Stellar Structure and Evolution, O.R. Pols
Stars and Stellar Evolution, K.S. de Boer, W. Seggewiss

PDF copies of both of these are provided on LEARN.

Other Recommended reading

Stellar Structure and Evolution, R. Kippenhahn, A. Weigert, A. Weiss
An introduction to Modern Stellar Astrophysics, B.W. Carroll, D.A. Ostlie
Asteroseismology, D.W Kurtz, J. Christensen-Dalsgaard, C. Aerts

Timetable

Two lectures and one tutorial per week, as scheduled in the UC Timetable.

Assessment

Term 3 Assignments 20%	These will be given out in alternate weeks and will usually be due two weeks later.
Mid-course test 15%	One hour test, usually in a lecture slot.
Term 4 Assignments 20%	These will include problems sets, a practical analysis, a short oral presentation and a written report.
Final examination 45%	**Date and time to be determined by the Central Administration of the University at the end of the first week of the semester.** Location will be advised by Registry just prior to the exam period. Duration 3 hours. The examination will cover all material from the course.

General Physics and Astronomy Information

Please consult the document General Information for Physics and Astronomy Students on the Physics and Astronomy Web Page:
https://apps.canterbury.ac.nz/1/science/phys-chem/PHYS%20-%20Course%20Outlines/General.PDF

Marks and Grades

The following numbers should be considered as a guide to the expected grades under normal circumstances. The School reserves the right to adjust mark/grade conversions, if necessary.

Please note that for all invigilated assessments (tests and exams) worth 33% and above, failure to obtain a mark of at least 40% will result in a final grade no higher than an R at 100 and 200 level, and a C- at 300 level.

Grade:	**A+**	**A**	**A−**	**B+**	**B**	**B−**	**C+**	**C**	**C-**	**D**	**E**
Minimum mark %:	**90**	**85**	**80**	**75**	**70**	**65**	**60**	**55**	**50**	**40**	**0**

ASTR323/423 Anticipated Schedule 2023

Week 1	1. Key physical parameters of stars and their observational constraints. 2. Eulerian and Lagrangian coordinates, mass conservation, hydrostatic equilibrium, dynamical timescale.
Week 2	3. Virial theorem, dynamic, thermal and nuclear timescales. 4. Equations of state, Lane-Enden equation, polytropic and Eddington models, Chandrasekhar limit.
Week 3	5. Energy transport in stars. 6. Nuclear fusion processes. Simple stellar models.
Week 4	7. The Sun, radiative transfer, stellar atmospheres. 8. Spectroscopy, Voigt profile, Equivalent width, curve of growth, stellar spectral and luminosity classes.
Week 5	9. Stellar evolution: pre-main-sequence, main-sequence, giant branch. 10. Stellar evolution: horizontal branch, asymptotic giant branch.
Week 6	11. Evolution of massive stars. 12. Mid-course test.
Week 7	TERM 4 lecture/tutorial sessions to be confirmed 1 & 2. Observed properties of stars and introduction to variable stars
Week 8	3 & 4. Introduction to pulsating stars
Week 9	5 & 6. Stellar structure equations
Week 10	Oral sessions.
Week 11	7 & 8. Stellar structure equations and pulsations.
Week 12	9 & 10. Radial and non-radial pulsations