ASTR325/425
The Structure and Evolution of Galaxies – 2022

Introduction

ASTR325/425 The Structure and Evolution of Galaxies is a 15-point course designed to give students an in-depth understanding of modern galactic astrophysics. A background in physics and mathematics including at least 30 points at 200 level is required. ASTR112 is recommended.

Students enrolled under the ASTR425 course code should expect more difficult assessments than will be required for 325 students.

Lecturer

Associate Professor Michael Albrow
Office: West 616,
Phone: 3695189
Michael.Albrow@canterbury.ac.nz

Textbook

Sparke, L.S., & Gallagher J.S., *Galaxies in the Universe*, 2nd Edition

This should be available from the University Bookshop. There is one copy on "high demand" in the Library. Much of the course is based on this book and you are encouraged to acquire your own copy.

Recommended reading

Binney, J., Merrifield, M., *Galactic Astronomy*
Longair, M., *Galaxy Formation*, 2nd Edition

These have been placed on "high demand" in the Library.

Timetable

Currently we have scheduled lectures on Wednesdays at 9 am and Thursdays at 11 am in Psychology-Sociology 252. Our weekly tutorial, which may often involve computer activities, is in Jack Erskine 248 on Mondays at 9 am. These times and venues are all subject to change, so please monitor your official UC timetable.

Assessment

Assignments 20%.	These will be given out in alternate weeks and will usually be due two weeks later.
Mid-course test 10%	Currently scheduled for 11 am Thursday 18 August in the usual lecture slot.
Talks 10%	During the final week of term, each student will have to prepare and present a 10-minute talk. Details will be advised.
Final examination 60%.	**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.

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

General Physics and Astronomy Information

Please consult the document General Information for Physics and Astronomy Students:

https://apps.canterbury.ac.nz/1/science/phys-chem/PHYS%20-%20Course%20Outlines/General.PDF

Topics to be covered in lectures include

Astrophysical Concepts, Structure Formation, Components of the Milky Way, Galactic Rotation, Stellar Populations of the Milky Way, Stellar Orbits, Bars and Arms, Disk Stability, Elliptical Galaxies, Rotational Support of Ellipticals, Galaxy Spectra, Galactic Chemical Evolution, Gravitational Lensing, Clusters and Groups, Active Galactic Nuclei, High-Z Quasars

ASTR325/425 Anticipated Schedule 2022

Week 1	Introduction 1. Astrophysical concepts review 2. Cosmology clumping of matter after the big bang.
Week 2	Spiral galaxies 3. Observations of galaxies classification Milky Way overview 4. Stars in the Milky Way stellar density functions distances to stars luminosity functions MW components
Week 3	5. The interstellar medium and the Galactic Centre HI emission galactic rotation molecular clouds Galactic Centre 6. Spiral rotation curves Density profiles Dark matter Tully-Fisher relation
Week 4	7. Spiral structure pitch angle differential rotation epicycles rosette orbits

	8. Density waves and resonances epicycles pattern speed resonances
Week 5	9. Arms, bars, rings and orbits stability spiral arm properties bars and box orbits motion out of theplane tube orbits 10. Phase space orbits in 3D Schwarzschild's method collisionless Boltzmann equation
Week 6	Mid-course test
Week 7	**Elliptical galaxies** 11. Elliptical galaxy introduction classification surface brightness profiles 12. Intrinsic light profiles Abel integral deviations from ellipticity
Week 8	13. Rotational support kinetic energy tensor virial theorem Tully-Fisher relation Faber-Jackson relation fundamental plane

	Stellar populations of galaxies 14. Observations spectra post starburst chemical abundances cool and hot gas globular clusters
Week 9	15. The closed box model of galactic chemical evolution chemical yields changes of gas metallicity the G-dwarf problem 16. The leaky-box and accreting box models application to the Galactic halo resolution of the G-dwarf problem
Week 10	**Galaxies in the Universe** 17. Gravitational lensing strong, weak and micro-lensing microlensing optical depth for an isothermal sphere 18. Galaxy groups dynamical mass estimates X-ray gas galaxy mergers starbursts
Week 11	19. Galaxy clusters galaxy luminosity function accretion of galaxies mass estimates 20. Active galactic nuclei types of AGN power source unified model quasars superluminal motion

Week 12	Student talks