MONASH University
Science

School of Mathematical Sciences

ASP3012

Stars and Galaxies

Unit Guide – on campus Clayton

Semester 2, 2011

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Office hours:	Scheduled consultation hours will be published on the unit website.
Tutors	Contact details of all tutors appear on the unit website.
Teaching school/department	School of Mathematical Sciences
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Office hours	Monday to Friday 9-12 and 2-4

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Unit Outline

This is a 6 point unit that forms part of the core of the Astronomy and Astrophysics major. It is designed to give students an appreciation of the basic building blocks of the Universe – Stars and Galaxies. Both have links back to some of the oldest areas of astronomical study, from the thermodynamics of the interior of stars to the gravitational dynamics of stars in a galaxy. They are among the most advanced and quantitative areas of modern astrophysical research. As well as the basic theory of stars and galaxies, students will be exposed to modern computational techniques used to research these objects. There will be a field trip to the Astronomical Society of Victoria's "Dark Sky" site in Heathcote for a night of observing astronomical objects.

Unit synopsis

Stellar thermodynamics; equation of state; reduced equations of stellar structure; polytropic stellar models; full equations of stellar structure; the main sequence; post-main-sequence evolution; nuclear reactions in stars; stellar nucleosynthesis; current problems in understanding the chemical evolution of the Galaxy; Galactic morphology and stellar content; elliptical and spiral galaxies; large-scale structure of the Milky Way; dark matter; potential theory; galactic dynamics-orbits in spherical and axisymmetric potentials, high energy astrophysics. Field trip.

Objectives

On completion of this unit, students will: understand the nature of stars - their life histories, how they produce energy, how they synthesise the chemical elements, their ultimate fates; be able to build simple polytropic numerical stellar models; be able to distinguish and discuss the different galactic types; understand the relationships between stellar evolution, galactic evolution, and the creation of the elements; understand the implications of the observed nature of galaxies for theories of the universe; be familiar with the morphology and kinematics of the Milky Way; understand the significance of Dark matter to galactic structure; understand Active galaxies and provide a prime example of high-energy processes operating in the Universe; Types of active galaxies, be able to use a large research-level telescope, including for data collection and analysis.

Workload

Contact hours: Three 1-hour lecture, one 1-hour support classes per week and one 2-hour computer laboratory in most weeks

Private study, assignment work and preparation for the exam: 6 hours per week, (on average).

Unit relationships

Prerequisites: MTH2010 and MTH2032 or equivalent

Prohibitions: ASP3011, ASP3032, MAT3111 or MAT3132

Feedback from you

This unit has been through successive improvements over the past years. Some of these improvements were suggested by students who provided constructive feedback to the teaching team. As part of Monash's commitment to monitor the quality of the programs it offers, towards the end of the semester you will be given the opportunity to evaluate this unit. If you would also like to provide feedback during the semester, please send an email to the unit coordinator.

If you wish to view how previous students rated this unit, please go to
http://www.monash.edu.au/unit-evaluation-reports/

Teaching and Learning Methods

There will be 6 contact hours per week as follows:

- Three one-hour lectures
- One one-hour tutorial (also known as support class)
- One two-hour computer lab

Lectures

The lectures will be in S11 on Mon and Tue, and S10 on Wed for weeks 1 to 6; after that they are in S14 near the Building 28. Lecture notes and/or slides will be available on MUSO.

Support Class

In the tutorials you will work on problem sets under the guidance of a tutor. The tutor for the first part of the unit, on Galaxies, will be Mr Chris Hanson and Ms Shelley Hansen. The tutor for the second half of the unit, on Stars, will be Mr Stuart Heap. Problem sets will be available via Blackboard. They are not assessed during the semester but they are typical exam questions. These start in the *second* week of semester.

Computer Class

There are weekly computer lab classes or tutorials, starting in the second week also. In these you will learn computer methods used for solving real astrophysical problems. In some cases you will use existing computer codes to illustrate principles introduced in lectures. These laboratory exercises are assessed and you should hand your work to your tutor who will mark it and return it to you the following week (usually; see schedule below). Late handings is are not allowed.

Field Trip

There will be a field trip as part of the unit, in collaboration with the Astronomical Society of Victoria. You will be taken (by bus) to their "dark sky" site in Heathcote. Here you will observe various objects and you will be expected to prepare a literature review and observation report for one of the objects viewed, highlighting its relationship to the topics discussed in the unit. This written report will be part of the assessment for this unit. The field trip is not optional, but if you cannot go for some reason we will provide an alternative form of assessment.

You will receive more information closer to the date of the trip (early August).

Feedback to you

By now you should realize that University students are adults and hence are expected to take responsibility for their own learning. Nevertheless, you will still receive plenty of feedback on your progress. In ASP3012, the following opportunities should help you get a sense on how you are doing:

Assignments: Always look through the marked assignments, and read the comments written on the assignment itself or in class to the whole group. Always ask if there is something that it is not clear to you.

Tutorials: Tutorials are the best place to get feedback from both the tutor and your peers. Take the problem sets seriously, and clarify anything that you are unsure about. Questions on the final exam are often very similar to those included on the exercise sheets.

Consultation outside scheduled classes: You can always receive one-on-one help and feedback from the tutor or your lecturers, although please realise that all are very busy and have their own work to do. Nevertheless, they will do their best to be available to help you.

Previous exams: Towards the end of the semester we will put on MUSO some previous exams and possibly solutions. Work through the exams, and check through the solutions only once you finished your attempt.

Remember that we are here to help you … but the first move is up to you!

Lectures: week-by-week schedule for Part I: Galaxies Chapter 24,25,26

Week	Lecture	Lecture topic	Section(s) in textbook (2e)
1 Jul 25	1	**Part 1:** Galaxies	CO 3
	2	Spiral Galaxies I	CO 25
	3	Spiral Galaxies II	CO 25
2 Aug 1	4	Spiral Galaxies III	CO 25
	5	Elliptical Galaxies I	CO 25
	6	Galaxies	
3 Aug 8	7	Elliptical Galaxies III	CO 25
	8	Elliptical Galaxies III	CO 25
	9	Magnetic fields in Galaxies	CO 24+notes
4 Aug 15	10	Galaxy Dynamics	Ch 2, Binney and Tremaine's book
	11	Dynamics	Ch 2, Tremaine's book
	12	Dynamics/Galaxy interaction	Ch 2, Tremaine's book
5 Aug 22	13	Galaxy interaction	CO 26+notes
	14	AGN/quasars	CO 28
	15	AGN/black holes	CO 28
6 Aug 29	16	AGN/high energy astrophysics	CO 28
	17	AGN/jets	CO 28
	18	AGN	CO 28

A list of exam galaxies topics will be provided in the revision week. Students will follow this list when learning for the exam.

Lectures: week-by-week schedule for Part 2: Stars

Week	Lecture	Lecture topic	Section(s) in textbook (1e)
7 Sep 5	1	• **Part 2: Stars** • Intro and timescales	
	2	• Stellar thermodynamics	10.2, 10.4 Clayton 2-1
	3	• Polytropic stellar models I	Clayton 2-4
8 Sep 12	4	• Polytropic stellar models II	Clayton 2-4
	5	• The Equations of Stellar Structure	10.1, 10.5 Clayton 6 to 6-2
	6	• Convection in Stars	10.4 Clayton 3-5
9 Sep 19	7	• Nuclear Reaction in Stars: the PP Chains	10.3 Clayton 4-1, 4-2, 5-1 to 5-3
	8	• Nuclear Reaction in Stars: the CNO Cycles	10.3 Clayton 5-4
	9	• Stellar Evolution from the Main Sequence to the Red Giant Branch	10.6, 13.1 Clayton 6-5 6-6
Sep 26		• **Semester Break**	
10 Oct 3	10	• Red Giants	13.2 Clayton 6-7
	11	• Nucleosynthesis	p525-527 Clayton 7
	12	• Nucleosynthesis with neutrons	p525-527 Clayton 7-3
11 Oct 10	13	• Asymptotic Giant Branch Stars	13.2
	14	• Abundances in Stars; Pre-solar grains	
	15	• Galactic Chemical Evolution • Extremely Metal Poor Stars in the Halo	
12 Oct 17	16	• Abundance Anomalies in Globular Clusters	
	17	• Stellar Advances with Supercomputers: *Djehuty*	
	18	• Revision of Stars section	
13 Oct 24	1	• **Revision**	

Computer Labs and Support Classes: week-by-week schedule

Week	Lab	Lab topic	Support Classes topic
1 Jul 25		• **None**	• **None**
2 Aug 1	1	• Rotation speeds of galaxies and Dark Matter	• Magnitude scales
3 Aug 8	2	• Distance to M100 as determined by photometry of Cepheid variable stars	• Globular clusters/scientific paper
4 Aug 15	3	• CLUSTER for galaxies	• The Nature of Galaxies and Galactic Evolution
5 Aug 22	4	• Galactic Dynamics, spherical potentials	• Cosmic magnetic fields
6 Aug 29	5	• Black Holes, Accretion Disks •	• Distant quasars
7 Sep 5	6	• Superluminal Motion in the M87 Jet	• High energy astrophysics. Discussions.
8 Sep 12	1	• **Part 2: Stars** • Solving DEs on a computer	• Timescales, plotting on computers
9 Sep 19	2	• Polytropic Stellar Models	• Thermodynamics
Sep 26		• **Semester Break**	
10 Oct 3	3	• H Burning	• Polytropes
11 Oct 10	3 4	• H Burning (cont) • Stellar Evolution	• PP Chains and CNO Cycles
12 Oct 17	4	• Stellar Evolution (cont)	• Main sequence stellar structure • Nucleosynthesis
13 Oct 24		• **None**	

Unit Resources

Unit website
Unit information, lecture notes, assignments, exercise sheets, all handouts and notices will be available on the web through Monash University Studies Online (MUSO). Go to **my.monash.edu.au**, click on **ASP3012**, and then on **Blackboard**. Further, there are websites run by the lecturers on a more personal basis. The Stars site can be found at:

http://web.maths.monash.edu.au/~johnl/astro/ASP3012/stars.html

and you will be advised about the Galaxies page later.

Lecture notes
These will be provided on MUSO.

Textbook and References
The prescribed text for this unit is *An Introduction to Modern Astrophysics* by B.W. Carroll and D. A. Ostlie. The lecture schedule and references are to this book. However, your lecturers will supplement this material with other sources as needed. C&O is a good overall book but when discussing specialized topics it is inadequate. Some good references you might like to seek in the library are:

D Clayton "Principles of Stellar Evolution and Nucleosynthesis"
R. Kippenhahn and A. Weigert "Stellar Structure and Evolution"
H. Habing and H. Oloffson "Asymptotic Giants Branch Stars"
J. Binney and S. Tremaine "Galactic Dynamics"

Assessment

The assessment scheme for this unit consists of

Assessment task	Percentage of final mark	Due date	Return Date
Assignment 1	10%	Week 4	Week 6
Assignment 2	10%	Week 10	Week 12
Computer Labs	10%	Weekly (from second week)	The following week
Field Trip Report	10%	TBA	Week 12
Final examination	60%	During examination period	

You will be allowed to take to the final examination a scientific calculator provided it has been approved by the Science Faculty before hand. Please see your lecturers for approval of your calculator.

Assignments
Assignments will consist of specific tasks, analytical or numerical, which illustrate that you have learned material covered in the lectures, tutorials and computer laboratories.

Late assignments
Late assignments have to be submitted to the Unit Coordinator in room 319, building 28 (slip under the door if there is nobody in the office). A 20% penalty per day will apply. Special consideration may be given upon presentation of original medical certificate(s).

There is a two day deadline for applying for special consideration. Past that deadline the student has no rights to apply (unless of course, it can be proven that he was incapacitated to apply within that time frame)

Special consideration
Information about special consideration that may be granted for science units is available at http://www.sci.monash.edu.au/undergrad/specialcon.html.

Policy on assessment

Assessment for the unit as a whole is in accordance with the provisions of the University assessment legislation, policy and procedures located at http://www.policy.monash.edu/policy-bank/academic/education/assessment/index.html, and the faculty policies located at http://www.sci.monash.edu.au/policies/student.html#assessment.

Plagiarism, cheating and collusion

The University is actively committed to preventing plagiarism, cheating and collusion for the protection of the university's reputation and standards for current and future students. Severe penalties may be imposed on students who engage in, or who support other students to engage in, activities which seek to undermine the integrity of the unit assessment process.

University statements on plagiarism, cheating and collusion are contained in the University Discipline Statute 4.1:
http://www.monash.edu.au/pubs/calendar/statutes/statutes04.html#Heading102 ,

The University's Plagiarism Policy is located at: http://www.policy.monash.edu/policy-bank/academic/education/conduct/plagiarism-policy.html; and

The University's Plagiarism Procedures are located at: http://www.policy.monash.edu/policy-bank/academic/education/conduct/plagiarism-procedures.html

Special accommodations for students with disabilities

Students with disabilities who require special arrangements for assessment should contact the Disability Liaison Office. Website: http://adm.monash.edu/sss/equity-diversity/disability-liaison/index.html;

Other important links

You are encouraged to refer to the web-based Student Information Index http://www.monash.edu.au/pubs/sii/ for further information about their study needs at Monash University.