SCIPHYS102 Introduction to Astronomy
[Spring 2021]

COVID-19
Wednesday, January 20, 2021
At the time of writing, it is planned that this course is taught online using Zoom all semester. The intention is to hold the written Midterm and written Final on campus. Should circumstances change (for example, no exit from lockdown), written exams may be substituted by open-book, take-home tests which will incorporate a number of unseen questions.

[SCIPHYS102; Introduction to Astronomy]

[Spring 2021]

Classroom no:
Class times: **TUE 08:45-10:45 FRI 13:45-15:45**

Instructor: **Dr. Andrew Brooks**
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Office hours: **appointments - see Moodle scheduler activity**

I. Track information

a) SCIPHYS102 is part of the Physics track.

II. Course description

This course will present an introduction to astronomy and cover the following topics: science and the universe, observing the sky, orbits and gravity, radiation and spectra, astronomical instruments, the Solar System, comets and asteroids, the Sun a nuclear powerhouse, stars and analyzing starlight, black holes and curved spacetime, the Milky Way Galaxy, the evolution and distribution of galaxies, the Big Bang, and life in the Universe. Some course materials will be derived from the free OpenStax book on Astronomy. Emphasis will be more on conceptual, as contrasted with mathematical, comprehension.

There will be weekly laboratory exercises which will involve desk checking formulaic calculations and interpreting computer simulations. Some of these laboratory exercises will involve rudimentary programming in Python. Homework exercises reinforce conceptual understanding. Project work allows students to undertake investigations of the cosmos.

There is a written midterm exam and a written final exam. By the end of the course a student will have obtained a reasonable familiarity with the nature of the physical universe.

III. Study Load

This course earns students four credits (equivalent to 7.5 ECTS). The class meets twice a week for two hours. Preparation time is approximately 10 hours per week.

IV. Course materials

The required textbook for this course is the free OpenStax textbook on astronomy.
See https://openstax.org/details/books/astronomy
Other materials will be made available (see Appendix A for an example).

V. Course organization and requirements

The first session of each week will cover content. This session will involve a mix of lecturing, discussion, and various in-class activities (e.g. short presentations by students, online quizzes, one-to-one or group face-offs). Discussion-based learning will involve rotations of discussion group membership.

The second session of each week will be a laboratory in which exercises are undertaken. The instructor will provide assistance where needed and sign out completed exercises when they have been successfully demonstrated.

Homework and laboratories will be issued approximately on a weekly basis. If the number of issued homework or laboratories exceeds 10, the additional work will count as extra-credit. Other extra-credit opportunities may be available at the instructor's discretion.

At least two class moments (of 1 or 2 hours duration) will be provided to allow students the opportunity to work in-class on projects or on revision for written exams and to ask questions of the instructor.

A minimum of two office hours will be offered weekly with the opportunity for students to schedule a 15 minute appointment.

Students are expected to:

(i) make use of their own (modern) laptop at every class
(note: a Chromebook is not a suitable device for this course)
(ii) read materials placed or linked to in Moodle
(iii) participate actively in class sessions when asked to do so
(iv) monitor Moodle, the official mode of communication, on a daily basis
(v) attend class and inform the instructor beforehand if they cannot attend because of illness or some other urgent reason
(vi) work consistently on the laboratory exercises, outside of class meetings if necessary
(vii) tackle all assessment individually unless the task is explicitly described as group-based or the instructor gives explicit guidance on acceptable collaborations
(viii) be able to explain any programming code they have written or made use of
(ix) not use mobile devices in class other than their own laptops for class exercises
(x) not redistribute materials made available in Moodle to third parties
(xi) attend office hours for help and guidance on any aspect of the course when required

Homework deadlines are firm. Homework should be returned one week from the date of issue. Laboratories have full value for one week from the date of issue. After one week, their value is halved. After two weeks, they no longer have value.

This course is subject to UCR academic rules and procedures. Both students and instructors are required to know and follow these rules and procedures. Students should not commit acts of plagiarism or collusion. Students are advised that if they miss more than 6 class sessions they will receive an automatic F **(i.e. 6 absences only are permissible**). Two hours of lateness in attending class meetings will count as one absence.

VI. Assessment

assessed component	value	
written midterm	20%	sample questions will be provided
written final	20%	sample questions will be provided
project 1	10%	citizen science
project 2	10%	celestial object (galactic) investigation
project 3	10%	celestial object (extragalactic) investigation
project 4	10%	research using astronomical data
homework (each 1% or 2%)	10%	individual
laboratories (10 each at 1%)	10%	individual

Homework, laboratories, written midterm and written final will be assessed on correctness of answers. Partial credit will be awarded for partial correctness. Comprehension questions will be asked of laboratory work. Partial credit will be awarded when comprehension questions are not fully answered. Some components of laboratory work may be peer assessed.

The written midterm and written final may incorporate wild card questions based on homework (up to 2% of the 20%).

Projects are assessed on a sliding scale of accomplishment. For example,

A	in addition to the expectations under B, summarizes what is known about the celestial object from professional publications, explaining relevant physics conceptually
B	in addition to the expectations under C, summarizes what is known about the celestial object from astronomical databases
C	in addition to the expectations under D, summarizes what is known about the celestial object from professional organizations
D	presentation which summarizes what is known about the celestial object from everyday sources
F	lightweight presentation

Full project specifications are available in Moodle.

VII. Course schedule

The course schedule may be subject to change. For example, if things are progressing very well, it might be possible to occasionally tackle more material in a week. National holidays or special college events may result in some content being covered in less depth. A tour of the local astronomy museum (Volksterrenwacht Philippus Lansbergen) may take place. Key dates within any week will be posted in Moodle.

Time	**Topics to be discussed**	**Course material used**	**Assignments and assessment**
Week 1 [1 Feb]	universe tour; night sky	Chapters 1 & 2	homework & laboratory
Week 2 [8 Feb]	orbits; earth and moon	Chapters 3 & 4	homework & laboratory
Week 3 [15 Feb]	spectra; instruments	Chapters 5 & 6	homework & laboratory
Week 4 [22 Feb]	solar system; cratering; inner planets	Chapters 7-10	homework & laboratory **~ project 1 deadline (10%)**
Week 5 [1 Mar]	outer planets	Chapters 11 & 12	homework & laboratory
Week 6 [8 Mar]	comets, asteroids, meteors, meteorites	Chapters 13 & 14	homework & laboratory
Week 7 [15 Mar]	astrobiology	Chapter 30	homework & laboratory
Week 8 [22 Mar]	the Sun	Chapters 15 & 16	**midterm exam (20%)** **project 2 deadline (10%)**
SPRING BREAK [29 Mar]			
Week 9 [5 Apr]	starlight; H-R diagram; cosmic distances	Chapters 17-19	homework & laboratory
Week 10 [12 Apr]	interstellar medium; star formation; exoplanets	Chapters 20 & 21	homework & laboratory
Week 11 [19 Apr]	stellar evolution	Chapters 22 & 23	homework & laboratory **~ project 3 deadline (10%)**
Week 12 [26 Apr]	Milky Way galaxy, galaxies, active galaxies, black holes	Chapters 25-27	homework & laboratory
Week 13 [3 May]	distribution and evolution of galaxies; the Big Bang	Chapters 28 & 29	homework & laboratory
Week 14 [10 May]	relativity	Chapter 24	homework & laboratory
Week 15 [17 May]			**final exam (20%)** **project 4 deadline (10%)**

VIII. Student learning outcomes

Upon successfully completing this course, a student should be able to:

SLO 1 demonstrate a conceptual understanding of the night sky and the motions and properties of celestial objects in the solar system and the solar neighbourhood

SLO 2 demonstrate a conceptual understanding of the birth, life, and death of stars, galaxies, and the universe

SLO 3 demonstrate a knowledge and understanding of the role of citizen science in astronomy

SLO 4 investigate and report what is currently known about a celestial object in our own galaxy

SLO 5 investigate and report what is currently known about a celestial object which is extragalactic

SLO 6 investigate a research question about astronomy (by selecting, retrieving and analyzing astronomical data held in one or more repositories) and to communicate the results

SLO 7 demonstrate a conceptual understanding of the different techniques used to observe different parts of the electromagnetic spectrum

SLO 8 demonstrate a conceptual understanding of one or more specialist topics (such as relativity and astrobiology)

Period	**Teaching activities**	**Student is able to do**
Weeks 1-8	lectures & homework & laboratories & written midterm examination	SLO 1 SLO 7 (mainly Week 3) SLO 8 (astrobiology in Week 7)
Weeks 1-4	Project 1 citizen science	SLO 3
Weeks 5-8	Project 2 celestial object (galactic) investigation	SLO 4
Weeks 9-15	lectures & homework & laboratories & written final examination	SLO 2 SLO 8 (relativity in Week 14)
Weeks 9-11	Project 3 celestial object (extragalactic) investigation	SLO 5
Weeks 12-15	Project 4 research using astronomical data	SLO 6

Appendices
Appendix A Course Materials

free OpenStax textbook on astronomy
See https://openstax.org/details/books/astronomy (many linked resources per chapter)

Many additional materials are also provided in Moodle.

For example, below is a copy of just some of the materials in the sub-section on astronomical data and databases.

Messier Catalogue objects
https://en.wikipedia.org/wiki/Messier_object
https://en.wikipedia.org/wiki/List_of_Messier_objects
http://www.messier.seds.org/
https://www.wwu.edu/planetarium/a101/a101_messier.shtml
The Messier Objects
https://link-springer-com.proxy.library.uu.nl/chapter/10.1007/978-3-319-03170-5_2/fulltext.html
(Solis-ID required)

New General Catalogue (NGC) objects
https://en.wikipedia.org/wiki/New_General_Catalogue
https://en.wikipedia.org/wiki/List_of_NGC_objects
http://spider.seds.org/ngc/ngc.html
http://www.glyphweb.com/esky/ngc.html
NGC (New General Catalogue) Objects
https://link-springer-com.proxy.library.uu.nl/chapter/10.1007/978-3-319-03170-5_3/fulltext.html
(Solis-ID required)

Open Clusters
https://en.wikipedia.org/wiki/Open_cluster
https://en.wikipedia.org/wiki/List_of_open_clusters
Astronomy magazine
https://astronomy.com/tags/open-clusters
Global survey of star clusters in the Milky Way II. The catalogue of basic parameters
https://www.aanda.org/articles/aa/full_html/2013/10/aa22302-13/aa22302-13.html#tabs

Globular Clusters
Globular Star Clusters
http://www.messier.seds.org/glob.html
List of globular clusters
https://en.wikipedia.org/wiki/List_of_globular_clusters
Astronomy Magazine
https://astronomy.com/tags/globular-clusters