



**CAMOSUN COLLEGE**  
**School of Arts & Science**  
**Department of Physics & Astronomy**

**ASTR-102-003**  
**Astronomy: Stars and Galaxies**  
**Winter Semester, 2019**

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## **COURSE OUTLINE**

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The course description is online @ <http://camosun.ca/learn/calendar/current/web/astr.html>

$\Omega$  *Please note: This outline will not be kept indefinitely. It is recommended students keep this outline for their records, especially to assist in transfer credit to post-secondary institutions.*

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### **1. Instructor Information**

<b>(a) Instructor</b>	<b>Dr. Greg Ballentine</b>
<b>(b) Office hours</b>	<b>5-6 pm Tuesday and Thursday</b>
<b>(c) Location</b>	TEC 221
<b>(d) Phone</b>	250-370-4470 <b>Alternative:</b>
<b>(e) E-mail</b>	<a href="mailto:BallentineG@camosun.bc.ca">BallentineG@camosun.bc.ca</a>
<b>(f) Website</b>	<a href="http://Online.camosun.ca">Online.camosun.ca</a>

### **2. Intended Learning Outcomes**

*(If any changes are made to this part, then the Approved Course Description must also be changed and sent through the approval process.)*

Upon completion of this course the student will be able to:

1. Describe how the Sun works, its structure (interior, atmosphere, corona), its evolution and its future (as a red giant and then a white dwarf).
2. Outline the concepts of radiation (light) and energy, the different states of matter (solid, liquid, gas), and temperature scales.
3. Compare the properties of stars (single, binary and in clusters), including their distances, motions, temperatures (from spectra), masses, flux densities and luminosities.
4. Describe interstellar matter and the formation of stars from gas and dust.
5. Comment on the interiors and evolution of many different kinds of stars (such as red giants, planetary nebulae, novae, Cepheid and RR Lyrae variable stars, etc.) and why mass is the main factor controlling the evolution of stars.
6. Describe and explain the different kinds of stellar deaths and end-products, including supernovae, black holes, white dwarfs, and neutron stars.
7. Describe the Milky Way Galaxy, its contents, the massive black hole at its centre, and its evolution.
8. Describe the properties of the different kinds of galaxies, from ordinary elliptical and spiral galaxies to dwarf galaxies and quasars.
9. Outline ideas about the origin and evolution of the Universe.
10. Assemble experimental apparatus related to spectroscopy, analyze and interpret data to test astronomical hypotheses and complete written laboratory reports.

### 3. Required Materials

- (a) Textbook: The Cosmic Perspective, Bennett et al. 8<sup>th</sup> edition (any edition is better than none)  
There is an open source (free) online text available at  
<https://openstax.org/details/books/astronomy> should you not want to purchase a text
- (b) Other: Pocket calculator

### 4. Course Content and Schedule

**Course takes place in TEC 222. We also have computer lab in TEC 147/148 booked should we need it.**

Course schedule is on D2L (class website). This schedule is subject to change if necessary. It will be updated on D2L should this be necessary

Jan 8<sup>th</sup> – Introduction, Star Chart, Solar/Sidereal Day, Astrology sections in Cosmic Perspective 2.1 3.4 3.5

Jan 10<sup>th</sup> – Star naming, parallax, telescopes, Hershel's Method 6.1 6.2 6.3 6.4  
Lab: The Flow of Energy Out of the Sun Period 1

Jan 15<sup>th</sup> – Magnitudes, Magnitude/Luminosity, Hydrogen discharge tube 15.1  
Lab: The flow of Energy Out of The Sun Period 2

Jan 17<sup>th</sup> – Simple Atom, Kirchhoff's Laws, OBAFGKM 5.1 5.2 5.3 5.4  
Lab: The flow of Energy Out of the Sun Period 3 \*Final\*

Jan 22<sup>nd</sup> – Hertzsprung-Russell Diagrams, Star Masses, Kepler's Laws 15.2  
Lab: The Classification of Stellar Spectra Period 1

Jan 24<sup>th</sup> – Mass/Luminosity, Measuring properties of stars, Sun, Nuclear Reactions,  $E=mc^2$  14.1 14.2  
Lab: The Clasification of Stellar Spectra Period 2

Jan 29<sup>th</sup> – Regions of the Sun, Heat Transfer, Neutrinos, Sunspots, Aurora 14.3  
Lab: The Classification of Stellar Spectra Period 3 \*Final\*

Jan 31<sup>st</sup> – Midterm #1

Feb 5<sup>th</sup> – Sun on Main Sequence, Lifetime on Main Sequence, Stellar evolution 17.1 17.2 17.3  
Lab: Photoelectric Photometry of the Pleiades Period 1

Feb 7<sup>th</sup> – Supernovas, White dwarfs, escape velocity, black holes 18.1 18.2 18.3  
Lab: Photoelectric Photometry of the Pleiades Period 2

Feb 12<sup>th</sup> – Special relativity, general relativity, wormholes, time travel S2.1 S2.2 S2.3 S2.4 S3.1 S3.2 S3.3 S3.4 S3.5 S3.6

Lab: Photoelectric Photometry of the Pleiades Period 3

Feb 14<sup>th</sup>- Binary stars, Doppler effect. Algol paradox

Lab: Photoelectric Photometry of the Pleiades Period 4 \*Final\*

Feb 26<sup>th</sup>- Midterm #2

Feb 28<sup>th</sup>- Milky Way, Standard Candle, Rotation of the galaxy, Dark matter 19.1 19.2 19.3 19.4

Lab: Hertzsprung-Russell Diagrams of Star Clusters Period 1

Mar 5<sup>th</sup>- Size of Galaxies, Hubble's Galaxy classification, All galaxies have dark matter 20,1 20.2 23.1 23.2

Lab: Hertzsprung-Russell Diagrams of Star Clusters Period 2

Mar 7<sup>th</sup>- Radial velocity of galaxy, Hubble Law, Age of universe/length 20.3 21.1 21.2

Lab: Hertzsprung-Russell Diagrams of Star Clusters Period 3 \*Final\*

Mar 12<sup>th</sup> – Is Hubble constant a constant?, Hubble to find galaxy distance, Quasars 21.3

Lab: The Hubble Redshift Distance Relation Period 1

Mar 14<sup>th</sup> – Blackbodies, Radiation falling into black holes, Active galaxies, where are we in the universe?

Lab: The Hubble Redshift Distance Relation Period 2  
 Mar 19<sup>th</sup>- Hubble's Law/Einstein, Shape of universe, Dark Energy 23.3 23.4  
 Lab: The Hubble Redshift Distance Relation Period 3 \*Final\*  
 Mar 21<sup>st</sup> – Midterm #3  
 Mar 26<sup>th</sup>- Big Bang evidence, Early universe, Cosmic microwave background 22.1 22.2 22.3  
 Lab: Large Scale Structure of the Universe Period 1  
 Mar 28<sup>th</sup>- density of universe, What does CMB tell us? 22.4  
 Lab: Large Scale Structure of the Universe Period 2  
  
 Apr 2<sup>nd</sup> – dark energy as missing mass, forces in the universe, particle creation S4.1 S4.2 S4.3 S4.4  
 Lab: Large Scale Structure of the Universe Period 3  
 Apr 4<sup>th</sup> - string theory, cosmological picture  
 Lab: Large Scale Structure of the Universe Period 4 \*Final\*  
 Apr 9<sup>th</sup>- UFOs, what is life?, Miller/Urey experiment, goldilocks zones 24.1 24.2 24.3  
 "Lab": Course review 1  
 Apr 11<sup>th</sup>- Drake equation, Mars life searches, SETI 24.4 24.5  
 "Lab" Course review 2

Final exam date and time TBA within Camosun College exam period April 15<sup>th</sup>-26<sup>th</sup>

## 5. Basis of Student Assessment (Weighting)

Final exam 40%  
 Laboratory 20%  
 Best 2 of 3 midterms 20% each (the lowest midterm will be dropped)

- Students must obtain an overall grade of 50% or higher in the laboratory component of the course order to obtain credit for the course.
- Attendance is mandatory & you may be required to "sign in" at the beginning of each lab period. A lab may be waived or made up at a later time only in the case of documented illness or other extenuating circumstances. If you will be absent from a lab period due to illness it is your responsibility to notify your instructor.
- Labs are due at the end of the lab period marked \*Final\* in the class schedule above unless the instructor clearly communicates otherwise
- Unless otherwise stated by your instructor late penalties are as follows: For overdue labs (or assignments), a late penalty of 1 mark per day (10%) will be assessed for the first five days following the due date. After this date a complete report is still required and earns a maximum mark of 50%.
- At the discretion of the instructor, a student who is repeating this Astronomy course with a laboratory grade of 70% or higher may apply for lab exemption.

## 6. Grading System

Standard Grading System (GPA)

Competency Based Grading System

## 7. Recommended Materials to Assist Students to Succeed Throughout the Course

The textbook is on reserve in the Library

## 8. College Supports, Services and Policies



### Immediate, Urgent, or Emergency Support

If you or someone you know requires immediate, urgent, or emergency support (e.g. illness, injury, thoughts of suicide, sexual assault, etc.), **SEEK HELP**. Resource contacts @ <http://camosun.ca/about/mental-health/emergency.html> or <http://camosun.ca/services/sexual-violence/get-support.html#urgent>

### College Services

Camosun offers a variety of health and academic support services, including counselling, dental, disability resource centre, help centre, learning skills, sexual violence support & education, library, and writing centre. For more information on each of these services, visit the **STUDENT SERVICES** link on the College website at <http://camosun.ca/>

### College Policies

Camosun strives to provide clear, transparent, and easily accessible policies that exemplify the college's commitment to life-changing learning. It is the student's responsibility to become familiar with the content of College policies. Policies are available on the College website at <http://camosun.ca/about/policies/>. Education and academic policies include, but are not limited to, Academic Progress, Admission, Course Withdrawals, Standards for Awarding Credentials, Involuntary Health and Safety Leave of Absence, Prior Learning Assessment, Medical/Compassionate Withdrawal, Sexual Violence and Misconduct, Student Ancillary Fees, Student Appeals, Student Conduct, and Student Penalties and Fines.

### A. **GRADING SYSTEMS** <http://camosun.ca/about/policies/index.html>

The following two grading systems are used at Camosun College:

#### 1. Standard Grading System (GPA)

Percentage	Grade	Description	Grade Point Equivalency
90-100	A+		9
85-89	A		8
80-84	A-		7
77-79	<u>B+</u>		<u>6</u>
73-76	<u>B</u>		<u>5</u>
70-72	<u>B-</u>		<u>4</u>
65-69	<u>C+</u>		<u>3</u>
60-64	<u>C</u>		<u>2</u>
50-59	<u>D</u>		<u>1</u>
0-49	F	Minimum level has not been achieved.	0

#### 2. Competency Based Grading System (Non GPA)

This grading system is based on satisfactory acquisition of defined skills or successful completion of the course learning outcomes

Grade	Description
COM	The student has met the goals, criteria, or competencies established for this course, practicum or field placement.
DST	The student has met and exceeded, above and beyond expectation, the goals, criteria, or competencies established for this course, practicum or field placement.
NC	The student has not met the goals, criteria or competencies established for this course, practicum or field placement.

## Temporary Grades

Temporary grades are assigned for specific circumstances and will convert to a final grade according to the grading scheme being used in the course. See Grading Policy at <http://camosun.ca/about/policies/index.html> for information on conversion to final grades, and for additional information on student record and transcript notations.

Temporary Grade	Description
I	<i>Incomplete:</i> A temporary grade assigned when the requirements of a course have not yet been completed due to hardship or extenuating circumstances, such as illness or death in the family.
IP	<i>In progress:</i> A temporary grade assigned for courses that are designed to have an anticipated enrollment that extends beyond one term. No more than two IP grades will be assigned for the same course.
CW	<i>Compulsory Withdrawal:</i> A temporary grade assigned by a Dean when an instructor, after documenting the prescriptive strategies applied and consulting with peers, deems that a student is unsafe to self or others and must be removed from the lab, practicum, worksite, or field placement.