

**OAKLAND UNIVERSITY, COLLEGE OF ARTS AND SCIENCES,  
DEPARTMENT OF PHYSICS**

**COURSE INFORMATION**

**PHY 3040-ASTROPHYSICS, SECTION 14093,**

WINTER 2021, ONLINE, 4.0 CREDIT HOURS

**MONDAY, WEDNESDAY, FRIDAY (9:20-10:27 AM),**

JANUARY 6-APRIL 19 (EXAM WEEK APRIL 21-27)

**Course description:** Application of elementary physics to the study of planets and stars

**Prerequisites:** (PHY 1020 or PHY 1520 or PHY 1620) and MTH 1555.

**Additional Information**

**Astrophysics Topics:** Celestial Mechanics, Light and its continuous spectrum, Theory of Special Relativity, Atom and Wave-Particle Duality, Spectral Lines & HR diagram, The Interiors of stars, the Sun, its interior, its atmosphere and the solar cycle. Star formation and the Interstellar medium, Stellar Evolution, Supernovae, Gamma-ray and cosmic-ray sources. Remnants of Stars.

**Course format:** online, lectures are recorded asynchronously, homework assignments submitted on given due dates and time. MWF meetings exist for questions by students on the material. Midterm and final exams done synchronously on specified days given on the schedule.

**INSTRUCTOR INFORMATION**

**Name: Dr. Ilias Cholis**

**Office Location:** 174 Hannah Hall (HH)

**My student hours (office hours)** are on Mondays, Wednesdays and Fridays 9:20-10:27 a.m. through Zoom meetings or by appointment.

**You can reach me** at [cholis@oakland.edu](mailto:cholis@oakland.edu)

**THE GOALS** of the course include becoming aware of basic concepts of astrophysics.

## PROTECTING STUDENTS, FACULTY AND CAMPUS: IMPORTANT INFORMATION

Students must comply with the University mandated health protocols. For face-to-face classes, students must wear face coverings in the class and keep 6 feet apart from each other and from the professor. Students who are unable to wear a face covering should provide documentation of this to the Dean of Students office. If a student refuses to comply with this classroom requirement, the student will be reported to the Dean of Students and not allowed to return to the face-to-face classroom environment until and appropriate face covering is used.

See the [Return to Campus website](https://www.oakland.edu/return-to-campus/) for up-to-date information. (URL: <https://www.oakland.edu/return-to-campus/>)

## LEARNING OUTCOMES

Upon completion of the course the students will be able to:

- Derive Kepler's Laws from Newtonian mechanics.
- Use the Virial Theorem.
- Describe Stellar Parallax.
- Utilize the magnitude scale.
- Describe Blackbody radiation and use the color index.
- Use Lorentz Transformations.
- Implement the Special Theory of Relativity to calculate time dilation and length contraction, evaluate Doppler shifts.
- Be able to calculate relativistic momentum and energy.
- Understand and implement in problems wave-particle duality.
- Describe the Bohr Model for the Atom.
- Use the Boltzmann and the Saha Equations.
- Use the Hertzsprung-Russell Diagram.
- Describe the Hydrostatic Equilibrium in the interior of stars.
- Understand how to implement the Pressure Equation of State inside stars and describe their thermodynamic properties.
- Describe the energy sources of stars including nuclear chain reactions and how energy gets transferred from the core of the stars outwards.
- Describe Past and future evolution of the Sun.
- Describe the interior of the Sun and its atmosphere.
- Describe the Solar Cycle.
- Describe the Interstellar medium's basic properties.
- Understand the formation of protostars and describe pre-main-sequence evolution.
- Describe the evolution of stars on the main sequence and their evolution at their late stages.
- Characterize Stellar Clusters.
- Describe the evolution of very massive stars.

- Classify Supernovae and describe the basic mechanics behind core-collapse.
- Be able to identify galactic versus extragalactic sources of gamma-rays.
- Understand basic energetic arguments about the sources of cosmic-rays.
- Estimate the Chandrasekhar limit.
- Describe the conditions inside white dwarfs and neutron stars.
- Describe the properties of pulsars.

## REQUIRED MATERIALS:

### TEXTBOOK:

“An Introduction to Modern Astrophysics” by Bradley W. Carrol and Dale A. Ostlie,  
2<sup>nd</sup> edition

**ISBN-13:** 9781108422161

**Teaching Method:** Recorded Lectures. Zoom meetings for Student’s Questions.

I will assign Homework through Moodle. Late Homework will not be graded.

### TECHNOLOGY HELP:

- For help using Moodle, use the Get Help link at the top of the Moodle page (moodle.oakland.edu).
- For access to technology and in-person assistance, call or visit the [Student Technology Center](https://www.oakland.edu/stc/) (Link to Student Technology Center: <https://www.oakland.edu/stc/>).
- For general technology assistance, consult the [OU Help Desk](https://www.oakland.edu/helpdesk/) (Link to Help Desk: <https://www.oakland.edu/helpdesk/>).

## RESPECT RULES OF NETIQUETTE

- Identify yourself. Begin messages with a greeting and close with your name.
- Respect your peers and their privacy.
- Use professional, respectful language. Do not swear, use profanity or other inappropriate language.
- Avoid sarcasm, which can be misinterpreted and cause hurt feelings.

### Homework:

***The homework is worth 30% of the final grade. Due days are given in the schedule. Due time is at 11:59pm of the specified day.***

**Exams:** There will be a total of three exams.  
All exams are open books.

**The two midterms and the final exam are worth 70% of the final grade in total.**

**Ex 1: 20.0%, Ex2: 20.0%, Ex3 (Final) : 30%**

**Make-up Policy:** In order to be fair to the majority of students who take the exams on time the general policy is: No make-up exams will be given.  
A score of zero will be entered for missed a test.  
If you cannot take an exam due to documentable serious and unavoidable circumstances, contact me before the exam, if possible, or as quickly as possible after the exam to see if an exception can be made.

**Grading:** Course grades will be posted on Moodle.

<b>Homework</b>	<b>30.0%</b>
<b>Exam 1</b>	<b>20.0%</b>
<b>Exam 2</b>	<b>20.0%</b>
<b>Exam 3 (Final)</b>	<b>30.0%</b>

**Grading Scale:**

<b>A</b>	<b>96-100</b>
<b>A-</b>	<b>90-95</b>
<b>B+</b>	<b>85-89</b>
<b>B</b>	<b>80-84</b>
<b>B-</b>	<b>75-79</b>
<b>C+</b>	<b>70-74</b>
<b>C</b>	<b>65-69</b>
<b>C-</b>	<b>60-64</b>
<b>D+</b>	<b>55-59</b>
<b>D</b>	<b>50-54</b>
<b>F</b>	<b>&lt; 50</b>

# CLASSROOM AND UNIVERSITY POLICIES

## STUDENT CONDUCT

1. **IN-CLASS BEHAVIOR.** Be respectful of other students during class. If you arrive to class tardy, please enter the classroom as quietly as possible. Cell phone usage will not be tolerated during class for any reason. Refrain from talking while someone has the floor but please do not hesitate to participate when questions are asked. **Students are not permitted to take notes or record lectures for the purpose of sale.**  
**PLAGIARISM.** Plagiarism will not be tolerated. Although you will be working in groups for many activities, you are required to do writing assignments independently and to acknowledge assistance where appropriate. Copying each other's written work will be considered plagiarism and will result in being referred to the Academic Conduct Committee.
2. **ACADEMIC CONDUCT POLICY.** All members of the academic community at Oakland University are expected to practice and uphold standards of academic integrity and honesty. Academic integrity means representing oneself and one's work honestly. Misrepresentation is cheating since it means students are claiming credit for ideas or work not actually theirs and are thereby seeking a grade that is not actually earned. Following are some examples of academic dishonesty:
  - a. **Cheating.** This includes using materials such as books and/or notes when not authorized by the instructor, copying from someone else's paper, helping someone else copy work, substituting another's work as one's own, theft of exam copies, falsifying data or submitting data not based on the student's own work on assignments or lab reports, or other forms of misconduct on exams.
  - b. **Falsifying records** or providing misinformation regarding one's credentials.
  - c. **Unauthorized collaboration** on computer assignments and unauthorized access to and use of computer programs, including modifying computer files created by others and representing that work as one's own.

For more information, review OU's [Academic Conduct Regulations](https://www.oakland.edu/deanofstudents/policies/). (Link to Academic Conduct Regulations: <https://www.oakland.edu/deanofstudents/policies/>)

### **Academic Integrity confirmation statement for students taking this course.**

*"I pledge that all work I do in the course and on my assignments and tests are my own work and I received no unauthorized assistance. I also understand that if I am unclear about the appropriate or allowable use of any support materials to complete my required coursework, I will contact the faculty for clarification before using said materials.*

*All alleged violations of Academic Misconduct will be reported to the Academic Conduct Committee. Any students found responsible for violations of Academic Misconduct will be subject to disciplinary measures by the University up to and possibly including expulsion (permanent separation) from the University."*

2. **BEHAVIORAL CODE OF CONDUCT.** Appropriate behavior is required in class and on campus. Disrespectful, disruptive and dangerous behavior are not conducive to a positive learning environment and may result in consequences. Core Standards for Student Conduct at OU includes
- a. **Integrity.** See academic conduct policy points above.
  - b. **Community.** Policies regarding disruptive behavior, damage and destruction, weapons, and animals.
  - c. **Respect.** Policies regarding harassment, hazing, and [sexual misconduct](#) (Link to Sexual Misconduct policy: <https://www.oakland.edu/policies/health-and-safety/625/>)
  - d. **Responsibility.** Policies regarding alcohol, drugs, and other substances  
See the [Student Code of Conduct](#) for details. (Link to Student Code of Conduct: <https://www.oakland.edu/deanofstudents/student-code-of-conduct/>)

## **ACCOMMODATION AND SPECIAL CONSIDERATIONS**

Oakland University is committed to providing everyone the support and services needed to participate in their courses. Students with disabilities who may require special accommodations should make an appointment with campus [Disability Support Services](#) (DSS). If you qualify for accommodations because of a disability, please submit to your professor a letter from Disability Support Services in a timely manner (for exam accommodations provide your letter at least one week prior to the exam) so that your needs can be addressed. DSS determines accommodations based on documented disabilities. Contact DSS at 248-370-3266 or by e-mail at [dss@oakland.edu](mailto:dss@oakland.edu). The office of DSS office is located in room 103A North Foundation Hall.

For information on additional academic support services and equipment, visit the [Study Aids](#) webpage of Disability Support Services website. (Link to Disability Support Services website: <https://www.oakland.edu/dss/>).

## **ATTENDANCE POLICY**

*There are no scheduled makeup labs or exams or homework activities.* In the event that you miss an exam/quiz, I reserve the right to issue an alternative assignment/exam or to drop that score from your average. This will be handled on a case-by-case basis.

## **EXCUSED ABSENCE POLICY**

This policy for university excused absences applies to participation as an athlete, manager or student trainer in NCAA intercollegiate competitions, or participation as a representative of Oakland University at academic events and artistic performances approved by the Provost or designee. A student must notify and make arrangements with the professor in advance. For

responsibilities and procedures see [Academic Policies and Procedures](https://www.oakland.edu/provost/policies-and-procedures/). (Link to Academic Policies and Procedures: <https://www.oakland.edu/provost/policies-and-procedures/>)

## **RELIGIOUS OBSERVANCES**

Student should discuss with professor at the beginning of the semester to make appropriate arrangements. Although Oakland University, as a public institution, does not observe religious holidays, it will continue to make every reasonable effort to help students avoid negative academic consequences when their religious obligations conflict with academic requirements. See The [OU Diversity Calendar](https://www.oakland.edu/diversity/calendar/) for more information. (Link to calendar: <https://www.oakland.edu/diversity/calendar/>)

## **BEREAVEMENT POLICY**

In the event of the death of certain members within families or among loved ones, the University grants necessary bereavement absences upon student request. For the official bereavement policy, see: <https://www.oakland.edu/provost/policies-and-procedures/>

## **PREFERRED NAME POLICY**

The University recognizes that as a community many of its members use names other than their legal names to identify themselves. As long as the use of this different name is not for the purposes of misrepresentation, or a legal name is required by the University business, policy or legal need, the University acknowledges that a “preferred name” will be used whenever possible. The University reserves the right to not accept a preferred name if it is deemed inappropriate, including a preferred name that is vulgar, offensive, fanciful, or creates confusion with another person. [OU’s Preferred Name Policy](#) ensures a student’s university records can use a name that reflects the student’s identity (abbreviated name, name change etc.).

## **SEXUAL MISCONDUCT**

Faculty and staff are responsible for creating a safe learning environment for our students, and that includes a mandatory reporting responsibility if students share information regarding sexual misconduct/harassment, relationship violence, or information about a crime that may have occurred on campus with the University. In such cases, the professor will report information to the campus’ Title IX Coordinator (Chad Martinez, [chadmartinez@oakland.edu](mailto:chadmartinez@oakland.edu) or 248-370-3496). Students who wish to speak to someone confidentially can contact the OU Counseling Center at 248-370-3465. Additionally, students can speak to a confidential source off-campus 24 hours a day by contacting Haven at 248-334-1274.

## **ADD/DROPS**

The university policy will be explicitly followed. It is the student’s responsibility to be aware of [deadline dates for dropping courses](#) and officially drop the course. (Link to deadlines for dropping courses: <https://www.oakland.edu/registrar/registration/dropornot/>)

## **EMERGENCY PREPAREDNESS**

In the event of an emergency arising on campus, the Oakland University Police Department (OUPD) will notify the campus community via the emergency notification system. The professor of your class is not responsible for your personal safety, so therefore it is the responsibility of each student to understand the evacuation and “lockdown” guidelines to follow when an emergency is declared. These simple steps are a good place to start:

- OU uses an emergency notification system through text, email, and landline. These notifications include campus closures, evacuations, lockdowns and other emergencies. Register for these notifications at [oupolice.com](http://oupolice.com).
- Based on the class cellphone policy, ensure that one cellphone is on in order to receive and share emergency notifications with the professor in class.
- If an emergency arises on campus, call the OUPD at (248) 370-3331. Save this number in your phone, and put it in an easy-to-find spot in your contacts.
- Review protocol for evacuation, lockdown, and other emergencies via the classroom’s red books (hanging on the wall) and [oupolice.com/emergencies](http://oupolice.com/emergencies).
- Review with the professor and class what to do in an emergency (evacuation, lockdown, snow emergency).

**Violence/Active Shooter:** If an active shooter is in the vicinity, call the OUPD at (248) 370-3331 or 911 when it is safe to do so and provide information, including the location and number of shooter(s), description of shooter(s), weapons used and number of potential victims. Consider your options: [Run, Hide, or Fight](#).

*About Tentative Schedule. The chapter definition refers to the chapters from the Textbook, “An Introduction to Modern Astrophysics” 2<sup>nd</sup> edition by Carroll and Ostlie.*

## TENTATIVE COURSE SCHEDULE

Monday	Wednesday	Friday
	01/06 Chapter 2 Celestial Mechanics	01/08 Chapter 2 Celestial Mechanics
01/11 Chapter 3 The EM Spectrum of Stars	01/13 Chapter 3 The EM Spectrum of Stars	01/15 Chapter 3 The EM Spectrum of Stars
01/18 No Class	01/20 Chapter 4 Special Relativity	01/22 Chapter 4 Special Relativity <i>1<sup>st</sup> HW due (Ch. 2 &amp; 3)</i>
01/25 Chapter 4 Special Relativity	01/27 Chapter 5 Light & Matter	01/29 Chapter 5 Light & Matter
02/01 Chapter 8 Spectral Lines and HR diagram <i>2<sup>nd</sup> HW due (Ch. 4 &amp; 5)</i>	02/03 Chapter 8 Spectral Lines and HR diagram	02/05 Chapter 8 Spectral Lines and HR diagram
02/08 <b>EXAM 1 (Ch 2,3,4,5)</b>	02/10 Chapter 10 Interiors of Stars	02/12 Chapter 10 Interiors of Stars <i>3<sup>rd</sup> HW due (Ch. 8)</i>
02/15 Chapter 10 Interiors of Stars	02/17 Chapter 10 Interiors of Stars	02/19 Chapter 10 Interiors of Stars
02/22 No Class	02/24 No Class	02/26 No Class

Monday	Wednesday	Friday
03/01 Chapter 11 The Sun <i>4<sup>th</sup> HW due (Ch. 10)</i>	03/03 Chapter 11 The Sun	03/05 Chapter 11 The Sun
03/08 Chapter 12 The ISM & Star Formation <i>5<sup>th</sup> HW due (Ch. 11)</i>	03/10 Chapter 12 The ISM & Star Formation	03/12 Chapter 12 The ISM & Star Formation
03/15 <b>EXAM 2 (Ch 8,10,11)</b>	03/17 Chapter 12 The ISM & Star Formation	03/19 Chapter 12 The ISM & Star Formation
03/22 Chapter 13 Stellar Evolution	03/24 Chapter 13 Stellar Evolution	03/26 Chapter 13 Stellar Evolution
03/29 Chapter 15 Massive Stars and their fate	03/31 Chapter 15 Massive Stars and their fate	04/02 Chapter 15 Massive Stars and their fate <i>6<sup>th</sup> HW due (Ch. 12 &amp; 13)</i>
04/05 Chapter 15 Massive Stars and their fate	04/07 Chapter 15 Massive Stars and their fate & Chapter 16 Remnants of Stars	04/09 Chapter 16 Remnants of Stars
04/12 Chapter 16 Remnants of Stars	04/14 Chapter 16 Remnants of Stars	04/16 Chapter 16 Remnants of Stars <i>7<sup>th</sup> HW due (Ch. 15 &amp; 16)</i>
04/19 Chapter 14 On Observations of Pulsars	04/21 <b>EXAM 3 - FINAL (Ch 12,13,15,16) 8:00-11:00 am, TENTATIVE/Not finalized</b>	