Physics 3740 – Introduction to Modern Physics
Fall 2020

“If quantum mechanics hasn't profoundly shocked you, you haven't understood it yet”.
Niels Bohr

“Trying to understand the way nature works involves a most terrible test of human reasoning ability. It involves subtle trickery, beautiful tightropes of logic on which one has to walk in order not to make a mistake in predicting what will happen. The quantum mechanical and the relativity ideas are examples of this”
Richard P. Feynman

ZOOM INSTRUCTIONS:

<table>
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<tr>
<th>Lectures</th>
<th>Dr. Deemyad Office Hour</th>
<th>Discussion Section</th>
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Instructor
Professor Shanti Deemyad
Office: JFB 311, Phone: 801-585-5955
Faster email: shanti.deemyad@gmail.com, deemyad@physics.utah.edu
Office Hours: Wednesday 9:00am-10:00am,

Discussion Sections.
- Discussion TA:
  Brian Hassard: brian.r.hassard@gmail.com

- Learning assistants:
  Brecken Larsen: brecken17@gmail.com

Prerequisites:
PHYS 2220 and MATH 2250

1. Course Organization

Textbook
The book adopted for this course is Modern Physics, Paul A Tipler, Ralph A. Llewelly (5th / 6th edition, either one will be okay)
The 5th edition of this book has an online pdf version that you may use. (http://web.pdx.edu/~pmoeck/books/Tipler_Llewellyn.pdf)

Additional Text: (Optional)
Modern Physics by Harris (Second edition)
ISBN-10: 0805303081

COURSE DETAILS
➢ Course Type: Interactive Video Conferencing (IVC - synchronous online), Location & Meeting Times: Via zoom (Time: Aug 24, 2020 03:00-4:20 PM Mountain Time, Every week on Mon, Wed, until Dec 2, 2020, Meeting ID: 965 3252 8043). Some lectures will be posted only on Canvas and should be reviewed by students outside of the lecture time with prior notice.

➢ Attendance & Punctuality: Attending the lectures via zoom is required part of this class. All lectures will be recorded and the summary of the recorded video’s will be posted on Canvas for reviewing the class materials. Every time students connect via zoom they are required to include their UNID together with their preferred name that appears on zoom. Some lectures will be only recorded and there are also simple online quizzes that are occasionally posted on Canvas. It is student’s responsibility to check the Canvas page routinely and beware of the posted assignments and quizzes.

➢ COVID-19 Considerations: Although this is an IVC class but the students must self-report if they test positive for COVID-19 via coronavirus.utah.edu.

➢ Technical and electronic requirements:
   All students should familiarize themselves with Canvas and zoom. Students are expected to be computer literate and Canvas and zoom navigation skills are expected. Knowledge and navigation of canvas and zoom is critical to access all features and resources of this course. It is strongly recommended that students log into Zoom for class with audio and video enabled, but this is not required. We have an online synchronous component and live Zoom sessions please make sure you have strong internet connection and adequate bandwidth. You also would need
   • A computer/laptop/ platform to install and run zoom and routinely access Canvas
   • A scanner/ camera to make good quality electronic copies of homework’s and exams and upload them online.

Course Objectives
Most of you are in programs in Physics or Engineering. You may question whether modern physics will be an important course for you. The answer is "yes!" The course will help you to understand the foundations of many new
day technologies and explains why and how the boundaries of the classical physics were discovered and how the quantum physics and theory of relativity are related to classical physics. This course is “NOT” a class in quantum mechanics or theory of relativity and you would need to take more specialized classes later on to be able to get an in-depth training on how to use these theories to solve complex problems. The list of topics that we will study during this class are:

- **Introduction to Special Relativity**: Michelson Morley Experiment, Lorentz transforms, Einstein postulate, time dilation, length contraction, Doppler effect, Relativistic momentum and energy, Invariant mass
- **Introduction to General Relativity**
- **Quantization of charge, Light and energy**: Planck black body radiation, the photoelectric effect and x-rays, and Bragg diffraction.
- **Basic quantum ideas**: wave-particle duality, uncertainty relations, and wave packets. Introduction to quantum mechanics: Schrödinger equation in one, two, and three dimensions. Square wells barriers, harmonic oscillator, and hydrogen atom. Quantum properties of spin and angular momentum: Zeeman effect, Stern-Gerlach experiment, atomic and molecular structure, and covalent bonding. Multi-electron atoms and the Periodic Table.

Elements of this subject material are found in all parts of nature.

The three most important objectives of this course are to:

1. **Learn the experimental evidence showing the shortcomings of classical physics**
2. **Learn how the limitations of classical physics in explaining the experiments led to developments of quantum physics and theory of relativity.**
3. **Acquire broad but limited problem-solving skills so you can use the principles of quantum mechanics and relativity to solve basic problems.**

At the end of this course I expect you to have an understanding of where classical physics would fail and have developed a deep understanding of basic principles behind the quantum and relativity theories. You should be able to use these principles to solve introductory problems.

This understanding is achieved by a combination of reading the texts, doing the practice assignments before class, listening to lectures, working through examples, discussing questions with your TA, LA and other students, and doing problems. **The assigned homework problems are ABSOLUTELY NECESSARY to develop this understanding.** They are your practice "sessions."

**Course Staff**

The PHYS/ECE 3740 course staffs are here to help you learn physics. We want you to succeed in this class and to come to appreciate physics for its power and beauty. We expect that the entire PHYS/ECE 3740 community – students, instructor, TA, and LA – will strive to be an inclusive and supportive community, appreciative of the many perspectives that come from us each bringing to the class different backgrounds and beliefs. We expect all members of this community to be respectful of each other, and to strive to create a community that facilitates self-expression, inquiry, and learning.
Teaching Assistant (TA)
TA’s in the physics department are graduate students or advanced undergraduate students who have taken this class before. In our case, Brian is an advanced undergraduate student in physics, who has taken this class previously. He will lead weekly discussion sections; hold Office Hours, present Reviews and grade Exams and Problem Sets. Please note that we only have a half time TA this semester and there are some limitation on how much TA support we have.

Learning Assistants (LAs)
Learning Assistants are undergraduate students who have taken this course previously, or a similar course, and who receive special training on how to help students learn science (see more details on the U of U Learning Assistant program page). LAs will help during class and discussion sections to facilitate student learning and hold Office Hours. LAs are not responsible for grading assignments and can be thought of as peer mentors.

Course Content
This is an introductory course in Modern Physics. It introduces the basic concepts and theory of Relativity and Quantum mechanics. Most students will find the concepts introduced in this class to be a very counterintuitive that requires a significant amount of thinking, outside of the class discussions and study time. This class is one of the most exciting and fun classes in physics. We will study the material in chapters 1 – 8 of Tipler, but may change the order of the topics we are covering. Unless specifically announced, you are responsible for all material in these chapters, whether it is covered in lecture or not, as well as any supplemental material actually covered in the lectures. This is the standard curriculum for an introductory semester-long course in Physics. Please see the Course Schedule for details.

How you can do well in this class
1. Be sure to schedule enough study time and follow the topics presented in the class closely. Typically, one should expect to spend no less than 3 hours on reviewing concepts practice assignments, homework problems and review for every hour of the lecture.
2. Practice, practice, practice! The only way to understand physics concepts well enough to use them is to practice on problems.

Attend and review the lectures and discussion sections, ASK QUESTIONS AND DO NOT JUST ACCEPT WHAT YOU ARE TOLD! Do the homework problems, the review problems (before exams), and other related problems in the textbook. Practice
homework assignments by mimicking the exam situation: start with a blank sheet of paper and work the problem through as far as possible without looking for help from the text, notes, or solutions until necessary. **Doing the homework the RIGHT way is the most important factor for doing well in this course.**

**Lectures**

The class meets **twice a week via zoom** for lectures on Mondays and Wednesdays, from 15:00 – 16:20. 10% of your grade will be for attending the lectures, reviewing the lecture materials and taking the online quizzes. We will discuss some of the **practice** questions during some of the lectures. Reading assignments from the textbook will be posted on canvas before each lecture. All midterm and final exam dates and times are set in advance, before the semester starts but are subject to change.

**Discussion Sessions**

Discussion sessions meet roughly once every other week (or more) on Fridays from 15:00 – 16:20 and are led by your TA and by help from your LA. Attendance and active participation in discussion sections is highly recommended. During the discussion sections you will review the homework problems and have the opportunity to work on problems and exercises that are meant to help you understand and apply the concepts, complete the homework, and prepare you for the exams.

3. **Assignments**

**Homework Assignments**

You will complete all homework assignments and submit them on canvas. Homework are assigned roughly once every other week. At the end of the term, your lowest homework score will be automatically dropped. No re-grades will be allowed, and **No late homework will be accepted**. **Please don't even ask.** Solutions will be posted on canvas. Due dates and times, point values for each problem, will be clearly indicated for each assignment.

**Practice Pre-lecture Assignments**

Before each lecture I will assign reading assignments pertaining to the new material to be discussed in that lecture. The purpose of doing these assignments is to make you acquainted with a lecture topic **ahead of time** so you can come prepared to ask questions about the parts that you found more difficult and confusing. Studies have shown that the more prepared students are for the lecture, the more they get out of it and the better they perform in the course. You are strongly encouraged to complete them.

4. **Midterms and Final Exam**
We will have two midterm exams during the semester. The second midterm exam only covers the materials after the prior exam. The final exam is comprehensive and includes all the material that we covered during the semester. All exam dates and times are set in advance, before the semester starts. We will announce the details of the exams in advance and based on the evolving pandemic situation. The following dates are reserved for your two midterm exams but I reserve the right to change these dates with reasonable notice to you; some topics may, for example, take longer than I anticipated.

Midterm Exam Schedule
Midterm 1: Wednesday, September 23rd
Midterm 2: Monday, November 2nd

There will be no make-up exams. The only exceptions to this rule are (a) absence due to a University sponsored activity or to military duty, and (b) serious medical emergencies. In either case the student must provide complete documentation. All requests for exam accommodations are handled exclusively by Professor Deemyad. In the case of exception (a) the request for a make-up exam must be filed with Professor Deemyad at least one week in advance of the anticipated absence. . In the case of exception (b) an official letter from a physician or hospital is required. Please note that all exam dates and times have already been determined; mark your calendars now! Resolve any conflicts as soon as possible. YOU MUST TAKE THE FINAL EXAM TO PASS THIS COURSE.

Final Exam Schedule

The final exam is a comprehensive exam and is scheduled on Friday, December 11th, 3:30 – 5:30 p.m Online. This is a University scheduled exam time. THERE WILL BE NO EARLY FINAL EXAMS!

5. Grades
Grading Scheme
Your grade for the course will be based on your homework assignments, discussion attendance records and midterm and final exam scores:

- Homework assignments: 30%
- Attendance: 5%
- Quizzes: 5%
- The midterm exams 30%
- Final 30%
The lowest homework score will automatically be dropped.

Grading Scale

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<thead>
<tr>
<th>Grade</th>
<th>Range</th>
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<tbody>
<tr>
<td>A</td>
<td>93-100</td>
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<tr>
<td>A-</td>
<td>90-92.99</td>
</tr>
<tr>
<td>B+</td>
<td>87-89.99</td>
</tr>
<tr>
<td>B</td>
<td>83-86.99</td>
</tr>
<tr>
<td>B-</td>
<td>80-82.99</td>
</tr>
<tr>
<td>C+</td>
<td>77-79.99</td>
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<tr>
<td>C</td>
<td>73-76.99</td>
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<tr>
<td>C-</td>
<td>70-72.99</td>
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<tr>
<td>D+</td>
<td>67-69.99</td>
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<tr>
<td>D</td>
<td>63-66.99</td>
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<td>D-</td>
<td>60-62.99</td>
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<td>E</td>
<td>0-59.99</td>
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</tbody>
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**Honor System and Collaboration Policy**

Collaboration on tests is not permitted. Collaboration on homework assignments is encouraged, provided the collaboration involves roughly the same amount of give and take. However, students may submit only their own work for grading and this work must be written solo, without copying from any other sources. Students are on their honor to adhere to this policy.

**Re-Grades**

Any request for re-grading of a problem on an exam must be made before the following exam. Exams MUST be done and posted in clear and readable form in order to be eligible for a re-grade. *Since the exams are uploaded online, ONLY materials that are submitted by the deadline will be graded and we will NOT grade materials that you mistakenly forgotten to submit by the deadline.* When you submit a request for the re-grading of a problem, the entire problem will be re-graded, not just the parts that you are disputing. It is usually the case that you will not lose points by submitting a re-grade, but this is not guaranteed. You are allowed to ask for re-grades on the final exam. This request will only be considered in the case that you are near a course grade boundary. However, the entire exam will be re-graded (not just the problems you submit for a re-grade).

**Students Must Check Course Grades**

It is the student's responsibility to ensure the accuracy of all recorded homework, attendance records and exam grades. Please check your scores on canvas regularly, keep all your returned tests (handed out during discussion sections), and contact your discussion TA in case of an error.
6. Office Hours
The instructor has posted office hours: 9:00 – 10:00 am on Wednesdays and you may meet with Prof. Deemyad in her posted zoom space. Outside of these you can meet with Prof. Deemyad by appointment. These may be granted very promptly, but Prof. Deemyad cannot guarantee specific times to meet with you outside of the posted hours. She is best reached by e-mail, not by phone. She checks e-mail most days and will respond promptly. For faster response use the shanti.deemyad@gmail.com email.

7. Important Dates
Deadline for submitting re-grades:
Re-grades for Midterms 1 & 2: By next exam.
Deadline for notification of recording errors, clerical errors, or arithmetic errors on any midterms or homework – December 2nd. Unless you point out any scoring or recording error by this date, the scores as recorded will stand.
Drop/Add/Withdrawal
Please make sure to visit University calendar for:
Last day to add without permission code, Last day to drop (delete) classes with no tuition penalty, Last day to add classes, Last day to elect CR/NC options, Last day to withdraw from term length classes
Holidays
Monday, September 7th, Labor Day

8. Policies and Resources
NETIQUETTE - EXPECTATIONS FOR ONLINE LEARNING ENVIRONMENT
● Classroom equivalency: Respectful participation in all aspects of the course will make our time together productive and engaging. Zoom lectures, discussion threads, emails and canvas are all considered equivalent to classrooms and student behavior within those environments shall conform to the student code. Specifically:
  ○ Posting photos or comments that would be off-topic in a classroom are still off-topic in an online posting.
  ○ Disrespectful language and photos are never appropriate.
  ○ Using angry or abusive language is not acceptable, and will be dealt with according to the Student Code. The instructor may remove online postings that are inappropriate.
  ○ Course e-mails, e-journals, and other online course communications are part of the classroom and as such, are University property and subject to the Student Code. Privacy regarding these communications between correspondents must not be assumed and should be mutually agreed upon in advance, in writing.
○ Emails: When emailing your Instructor and Teaching Team keep a professional tone (e.g. Use a descriptive subject line, avoid “Hey” and always use your professors’ proper title: Dr. or Prof., Sign your message with your name and return e-mail address. Please consult this page for tips on how to write appropriate professional emails: https://academicpositions.com/career-advice/how-to-email-a-professor
○ Treat your instructor, teaching team and classmates with respect in email or any other communication.
○ Remember that all college level communication should have correct spelling and grammar (this includes discussion boards).
○ Avoid slang terms such as “wassup?” and texting abbreviations such as “u” instead of “you.”
○ Be cautious when using humor or sarcasm as tone is sometimes lost in an email or discussion post and your message might be taken seriously or be offensive to others.
○ Be careful with personal information (both yours and others).

Electronic or equipment failure:
It is your responsibility to maintain your computer and related equipment in order to participate in the online portion of the course. Equipment failures will not be an acceptable excuse for late or absent assignments.

Online submissions:
You are responsible for submitting the assignment with the required naming convention, correct file extension, and using the software type and version required for the assignment.

Canvas allows students to change the name that is displayed AND allows them to add their pronouns to their Canvas name. Additionally, students can indicate their pronouns in Zoom. Please feel free to use this features so we can call you using your preferred name and pronoun but also please indicate your UNID as well.

Incompletes:
According to university policy, to be considered for an incomplete, a student must have 20% or less of the course work remaining and be passing the course with a C or better. You must request an incomplete grade and I will consider giving that grade only under exceptional circumstances.

Content Accommodations:
Consistent with principles of academic freedom, the faculty, individually and collectively, has the responsibility for determining the content of the curriculum. Students are expected to take courses that will challenge them intellectually and personally. Students must understand and be able to articulate the ideas and theories that are important to the discourse within and among academic disciplines. Personal disagreement with these ideas and theories or their implications is not sufficient grounds for requesting an accommodation (see https://regulations.utah.edu/academics/6-100.php).

**Academic Integrity**
Cheating of any kind on an exam is a very serious violation of University rules and is unethical. Students caught cheating will receive a failing grade for the course and will be sent on to the University Disciplinary Committee for further action. The teaching and learning assistants, are to be considered proxies for Dr. Deemyad when you are dealing with them regarding this course. They are to be listened to and treated with respect at all times.

All students and faculty need to be aware of important changes in the Student Code that went into effect in the last couple of years. Students now have only 20 business days to appeal grades and other "academic actions" (e.g., results of comprehensive exams). The date that grades are posted on the web is considered the date of notification. A "business day" is every day the university is open for business, excluding weekends and University-recognized holidays. If the student cannot get a response from the faculty member after ten days of reasonable efforts to contact him or her, the student may appeal to the Department Chair if done within 40 days of being notified of the academic action. Students should definitely document their efforts to contact a faculty member. Similarly, faculty members who discover or receive a complaint of academic misconduct (e.g., cheating, plagiarism) have 20 business days to "make reasonable efforts" to contact the student and discuss the alleged misconduct. Within 10 more business days the faculty member must give the student written notice of the sanction, if any, and the student's right to appeal to the college Academic Appeals Committee.

All students and faculty members are urged to consult the exact text of the Student Code if a relevant situation arises. The code is on the University web site at http://www.admin.utah.edu/ppmanual/8/8-10.html.

**Accommodations**

**Inclusivity Statement:** It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students’ learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: age, color, disability, gender, gender identity, gender
expression, national origin, political affiliation, race, religion, sexual orientation, and veteran status, and other unique identities. gender, sexuality, disability, age, socioeconomic status, ethnicity, race, culture, and other unique identities. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you.

**Discrimination and Harassment:**
If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or Office of the Dean of Students, 270 Union Building, 801-581-7066. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS). Please see Student Bill of Rights, section E http://regulations.utah.edu/academics/6-400.php. I will listen and believe you if someone is threatening you.

**Names/Pronouns.**
Canvas allows students to change the name that is displayed AND allows them to add their pronouns to their Canvas name. Class rosters are provided to the instructor with the student’s legal name as well as “Preferred first name” (if previously entered by you in the Student Profile section of your CIS account, which managed can be managed at any time). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class or on assignments. Please advise me of any name or pronoun changes so I can help create a learning environment in which you, your name, and your pronoun are respected. If you need any assistance or support, please reach out to the LGBT Resource Center. https://lgbt.utah.edu/campus/faculty_resources.php

**English Language Learners.**
If you are an English language learner, please be aware of several resources on campus that will support you with your language and writing development. These resources include: the Writing Center (http://writingcenter.utah.edu/); the Writing Program (http://writing-program.utah.edu/); the English Language Institute (http://continue.utah.edu/eli/). Please let me know if there is any additional support you would like to discuss for this class.

**Undocumented Student Support.**
Immigration is a complex phenomenon with broad impact—those who are directly affected by it, as well as those who are indirectly affected by their relationships with
family members, friends, and loved ones. If your immigration status presents obstacles to engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center. Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence. The Dream Center offers a wide range of resources to support undocumented students (with and without DACA) as well as students from mixed-status families. To learn more, please contact the Dream Center at 801.213.3697 or visit dream.utah.edu.

Veterans Center.
If you are a student veteran, the U of Utah has a Veterans Support Center located in Room 161 in the Olpin Union Building. Hours: M-F 8-5pm. Please visit their website for more information about what support they offer, a list of ongoing events and links to outside resources: http://veteranscenter.utah.edu/. Please also let me know if you need any additional support in this class for any reason.

Wellness Statement.
Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student’s ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at www.wellness.utah.edu or 801-581-7776.

Student Success Advocates:
The mission of Student Success Advocates is to support students in making the most of their University of Utah experience (ssa.utah.edu). They can assist with mentoring, resources, etc. Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact a Student Success Advocate for support (https://union.utah.edu/resources-spaces/basic-needs-center/).

The Americans with Disabilities Act:
The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building, 801-581-5020. CDA will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability & Access.

Addressing Sexual Misconduct:
Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran’s status or genetic information. If you or someone you know has been harassed or assaulted on the basis of your sex, including sexual orientation or gender identity/expression, you are encouraged to report it to the University’s Title IX Coordinator; Director, Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or to the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to police, contact the Department of Public Safety, 801-585-2677(COPS).

**Campus Safety:**
The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu

University Counseling Center The University Counseling Center (UCC) provides developmental, preventive, and therapeutic services and programs that promote the intellectual, emotional, cultural, and social development of University of Utah students. They advocate a philosophy of acceptance, compassion, and support for those they serve, as well as for each other. They aspire to respect cultural, individual and role differences as they continually work toward creating a safe and affirming climate for individuals of all ages, cultures, ethnicities, genders, gender identities, languages, mental and physical abilities, national origins, races, religions, sexual orientations, sizes and socioeconomic statuses.

**Office of the Dean of Students** The Office of the Dean of Students is dedicated to being a resource to students through support, advocacy, involvement, and accountability. It serves as a support for students facing challenges to their success as students, and assists with the interpretation of University policy and regulations. Please consider reaching out to the Office of Dean of Students for any questions, issues and concerns. 200 South Central Campus Dr., Suite 270. Monday-Friday 8 am-5 pm.