EGG 401: Rocket Science/CubeSAT I (1 credit)

Fall 2021
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Office Hours: Tentatively Friday, 3:00pm – 4:00pm (BPB Room 248-249) or by appointment.
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Lecture: Mon and Wed 2:30-2:55pm Location: SEB 1240


Prerequisites: Physics 180 and either Physics 181 or 182; and Math 182.

Content: We will be studying introductory rocket science covering the fundamentals of propulsion, gravity, escape speeds. The goal is to prepare students for participation in the RebelSAT/CubeSAT effort.

Learning Outcomes: It is expected that you will:
1. Master the concepts of basic classical mechanics such as force, momentum, impulse, conservation laws and rotational analogues inertial coordinate systems, and solve related introductory undergraduate-level problems.
2. You will be expected to understand the fundamentals of vacuum science and technology including the baking and outgassing of materials.
3. You will have a working understanding of thermal expansion and contraction and radiation damage as it pertains to materials and how this affects the material properties over time.
4. You will have a fundamental understanding of the electromagnetic spectrum, blackbody energy/solar technology, electronics and RF communications at the undergraduate engineering level.
5. You will possess a working understanding of the basic problems in vibrational science and damping of oscillations.
6. You will have a fundamental understanding of semiconductors and solar panels (i.e. electricity-producing systems).
7. You will have a fundamental understanding of power sources and power management.

Grading:
25% Homework
25% Quizzes
25% Midterm Exam (Wednesday, October 13th, 2021)
25% All Inclusive Final Exam Monday Dec. 6, 2021

Grading Scale:
90 → 100: A- → A+; 80 → 89: B- → B+; 70 → 79: C- → C+; 60 → 69: D- → D+; Below 60: F

DO NOT AUTOMATICALLY EXPECT A CURVE!

ATTENDANCE FOR THE FINAL EXAM AT THE SCHEDULED TIME IS REQUIRED.

Attendance: You are expected to attend all lecture and laboratory periods. You are responsible for all assignments and announcements given in class. Missed exams will result in a grade of zero. In the event of an extreme emergency (e.g. hospitalization), make-up exams may be given only with the written permission of the Chair of the Physics Department or the Dean of Arts and Sciences. You may be asked to provide written documentation to justify your request to make up material. For example, often an excuse such as “I had a death in the family” is given for an absence. If such is the case, then proof of death and proof of close family relation must be supplied in order for the work to be made up. If you represent UNLV at any official extracurricular activity, you shall have the opportunity to make up assignments, but you must provide official written notification to the instructor no less than one week prior to the missed class. A student missing a class or laboratory assignment because of observance of a religious holiday shall have the opportunity to make up missed work. The student must notify the instructor of anticipated absences by the last day of late registration. Students who represent UNLV at any official extracurricular activity shall have the opportunity to make up lost work but must provide written notification to the instructor no less than one week prior to the missed class(es).
**Homework:** Homework will be assigned weekly and due one week later. Physics cannot be mastered without working out physics problems. Don't be discouraged when the material initially seems unfamiliar or the homework is difficult. You are not expected to understand the material immediately. Your mastery of physics will be a gradual process that will develop through diligent practice (i.e., homework). Hopefully, you will learn that this is not an unpleasant but intellectually engaging experience. Although each homework assignment is numerically worth the least in terms of your overall grade, it is the most important part of your studies. Although we will discuss homework problems occasionally in lecture, questions on homework can always be raised with your instructor during his office hours.

**Exams:** The Final Exam will encompass ALL of the material covered in the class.

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**Final Note:** Though physics has a reputation of being a difficult subject, you will find that the knowledge and problem solving skills that you learn here will be extremely valuable no matter what career path you follow. Therefore, don't be intimidated, try hard, and never be afraid to ask questions. This syllabus may change as the course progresses. The instructor will provide advance notice if and when this happens.
**Tentative Schedule:**

**Week 1** (8/23, 8/25)  **Classical Mechanics** (Acceleration, inertial frames of reference, conservation of momentum)

**Week 2** (8/30, 9/1)  **Classical Mechanics** (Impulse, torque, gravity, escapee velocity)

**Week 3** (9/8)  **Propulsion** (Thrust, oxidation reactions, oxidizers)

**Week 4** (9/13, 9/15)  **Propulsion** (Thermodynamics, liquid and solid rocket fuels, boosters)

**Week 5** (9/20, 9/22)  **The Electromagnetic Spectrum** (Waves, lasers, Michelson interferometry, speed of light, radio)

**Week 6** (9/27, 9/29)  **Radio telemetry** (Radio/microwave communication, AM/FM)

**Week 7** (10/4, 10/6)  **Mechanical Engineering** (Strength of materials, corrosion, CAD design, 3-d printers)

**Week 8** (10/11, 10/13)  **Vibrations** (Damping including eddy current damping)

**Week 9** (10/18, 10/20)  **Vacuum science** (Pressures in outer space/outer atmosphere, outgassing, baking)

**Week 10** (10/25, 10/27) **The outer atmosphere** (Composition, temperature, density, escape velocity)

**Week 11** (11/1, 11/3)  **Radiation and radiation damage** (Source and types of radiation in outer space, flux, dose)

**Week 12** (11/8, 11/10)  **Electricity and Energy** Power sources, power management, solar technology

**Week 13** (11/15, 11/17)  **Temperature** (Thermal contraction and expansion, Black body radiation, heat transfer)

**Week 14** (11/22, 11/24)  **Invited lecture**

**Week 15** (11/29, 12/1)  **CubeSAT** (Requirements, plans)

**FINAL EXAM:** Monday Dec. 6, 3:10 PM - 5:10 PM