Course Description: An introductory course designed to provide students with a fundamental understanding of (1) electron energy, electron/photon interaction, and electron energy transitions; (2) electromagnetic wave theory and quantization of photon energy; (3) laser theory and operation; and (4) advanced applications such as quantum dots, Zener diodes and resonant tunneling diodes. This includes applying boundary conditions to solve the time-independent Schrödinger’s equation, normalization of the wave function, and applying fundamental solutions such as the infinite potential well (particle-in-a-box) and finite potential well to laser, quantum dot and tunneling applications.

Pre-requisites for Course: PHYS 2421, EE 2350, MATH 2326 and MATH 1312, with grade of "C" or better.

Textbook: Class notes, equation sheets, homework problems and corresponding power point presentations for each lecture were specifically designed for this course and are available in Blackboard.

Course Topics:
I. Electrons and Semiconductors
II. Electromagnetic Waves
III. Schrödinger Equations and Quantum Applications
IV. Advanced Applications of Schrödinger Equations: Quantum Dots, Tunneling, Zener Diodes, Resonant Tunneling Diodes

Course Grade: Dates:
<table>
<thead>
<tr>
<th>Quizzes</th>
<th>10%</th>
<th>Unannounced and announced. <strong>NO MAKE-UPS.</strong></th>
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</thead>
<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
<td><strong>No late work accepted.</strong></td>
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<tr>
<td>Midterm Exam</td>
<td>40%</td>
<td><strong>Midterm Exam – Wed., March 10, 2021. No make-ups.</strong></td>
</tr>
<tr>
<td>Final Exam</td>
<td>40%</td>
<td><strong>Final Exam – Wed., May 12, 2021, 10:00 am - 12:45 pm</strong></td>
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Learning Outcomes:
A. Understand basic fundamental concepts associated with quantum mechanics such as:
   a. Wave-particle duality
   b. Quantization of electromagnetic spectrum
   c. Blackbody radiation
   d. Planck’s constant
   e. Photoelectric effect
   f. de Broglie’s Relations
   g. Compton Effect
   h. 2-slit Experiment
   i. Wave Packets
   j. Heisenberg’s Uncertainty Principle
   k. Discrete Energy Values
   l. Eigenfunctions and Eigenvalues
   m. Electron orbitals

B. Understand the wave nature of quantum mechanics as it applies to electromagnetic waves and electrons by being able to:
   a. calculate the energy, momentum, frequency and wavelength of electromagnetic waves.
   b. understand constructive and destructive interference.
   c. recall the wave equation.
   d. derive the 2nd order differential harmonic equation from the wave equation.

Grade Scale:
A = 90 – 100
B = 80 – 89
C = 70 – 79
D = 60 – 69
F = 0 - 59
Instructor: Deidra R. Hodges
drhodges@utep.edu
Lecture: Online via Blackboard
Office: A 304 & Office Hours:
Mon. & Wed. 2:00 - 4:00 pm via Zoom

- Use solutions from the 2-slit experiment to model the interference pattern.

C. Understand the probabilistic nature of electrons and be able to:
   a. analyze the 2-slit experiment.
   b. solve for eigenfunctions from the time-dependent Schrödinger equation

D. Be able to solve quantum mechanical problems associated with photon-electron interactions such as:
   a. Electron Energy Transitions
   b. Compton Effect
   c. X-Ray Production
   d. Uncertainty Principle

E. Be able to use boundary conditions and the time-independent Schrödinger equation to solve quantum mechanical problems such as:
   a. Infinite Potential Well (Particle-in-a-box)
   b. Finite Potential Well
   c. Tunneling Probability
   d. Particle Confinement

F. Be able to design and simulate electronic devices using simulation tools located on the nanoHUB.org website such as:
   a. PN Junctions
   b. Quantum Dots
   c. Resonant Tunneling Diodes

**Lecture:**
This course will be taught using active student learning activities to include student-student discussions, group problem solving, and feedback from the instructor. Students are asked to come to class prepared by completing the designated reading assignment for that day. The reading assignments will be correlated with a short lecture which will be used to introduce problem solving methods and reinforce critical concepts. Short lectures (10-15 min) will be linked to team problem solving sessions, and team assignments will be picked up on a daily basis. The lecture is designed to include at least one team activity per lecture. Occasionally, extra credit sessions or quizzes will be based on the reading assignment, and some but not all are listed in the course schedule. Visual teaching tools will be used to reinforce and clarify critical concepts. Several visual tools will come from the nanoHUB.org website and students are encouraged to register and explore this website during the first week of class. This educational website is supported by the National Science Foundation and is free to all users.

**Homework:**
Two types of homework activities will be assigned. The first type is team in-class assignments and the second type is homework problems assigned at the end of a section and due the following week.

**Type 1: Team class assignments:** All team members work on an assignment which will be picked up from one random individual per group, and all students present will earn the same grade. Students should work together during these sessions to make sure that all students agree on the method and solution for each problem. Points for in class work will vary depending on the complexity of the assignment. The points for each assignment are included in the class schedule, and are subject to change prior to the date of the assignment.

**Type 2: Homework activity:** Homework will be assigned and will be used to design a learning activity during the following lecture. During the first five minutes of the class period, each group will be assigned roles similar to those listed below and will be given 5 minutes to prepare for their activity. Some examples of group homework activities are listed below.
Activity A: Group work (all members turn in work for a grade)
Activity B: One homework problem (all students have a role)
Activity C: Similar homework problem or concept (all students have a role)
Activity D: Students design a problem (all students have a role)

All homework should follow the standard engineering homework format. Homework that does not follow this format will not be accepted. Students should use the front side of the paper only and include no more than 2 problems per page except when indicated otherwise by the instructor.

Homework Format:
1. Include EE3325, Name, Date
2. Statement of the problem with each solution
3. Neat solutions with legible handwriting

All problem-solving activities are considered homework assignments and will be worth 10% of the final grade.

Exams: The midterm exam is worth 40% of the course grade. The final exam is comprehensive and is worth 40% of the final grade. The final exam will count as a make-up exam for a missed midterm exam, for documented and approved absences only. The equation sheet in Blackboard will be provided for each exam.

Attendance: Attendance is mandatory. When absent, the student is responsible for obtaining notes, handouts, and assignments and for meeting the same deadlines as the rest of the class. Excused absences are limited to documented medical emergencies, religious holidays and UTEP sponsored and/or required activities.

Course Drop Deadline: The deadline to drop this course with an automatic W is April 1st.

Cell Phone and Laptop Policy: Cell phones are not permitted during the lecture. Laptops may be used during assignments as specified by instructor. Students are required to turn off cell phones before entering the classroom. Cell phones should be placed out of sight (like in a purse or backpack). Students should NOT receive or make any calls/text messages during class. Students using cell phones during class will be asked to leave and will receive a zero for attendance and on all group assignments completed that day.

Scholastic Integrity: As an entity of The University of Texas at El Paso, the Department of Electrical and Computer Engineering is committed to the development of its students and to the promotion of personal integrity and self-responsibility. The assumption that a student's work is a fair representation of the student's ability to perform forms the basis for departmental and institutional quality. All students within the Department are expected to observe appropriate standards of conduct. Acts of scholastic dishonesty such as cheating, plagiarism, collusion, the submission for credit of any work or material that are attributable in the whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student, or the attempt to commit such acts will not be tolerated. Any case involving academic dishonesty will be referred to the Engineering Dean’s Office and the Office of the Dean of Students. The Dean of Students will assign a Student Judicial Affairs Coordinator who will investigate the charge and alert the student as to its disposition. Consequences of academic dishonesty may be as severe as dismissal from the University. See the Office of the Dean of Students’ home page at www.utep.edu/dos/acadintg.htm for more information.
I acknowledge that I have received the syllabus for EE 3325 for the Spring 2021 semester, and that I understand all attendance and homework requirements.

I also acknowledge that work and absences does not excuse any missed assignments and graded work.

The student is responsible for any missed work.

_________________________________________________________________________

Print Name

_________________________________________________________________________

Student Signature

_________________________________________________________________________

Date
Course models

Most ECE courses will follow either fully-online or hybrid models. Hybrid models will provide a virtual off-campus component and an in-person on-campus component. To follow social distancing guidelines on campus, faculty will arrange staggered attendance schedules. Laboratory classes will be offered online and/or in-person, in small groups and in spaces adequate to health and safety guidelines. For additional details, read the syllabus and consult your professor.

The ECE Department recognizes that students with health conditions or international students facing travel restrictions may encounter difficult situations. Virtual classes may be recorded to offer needed study flexibility and to allow students to review course material if it’s helpful.

Required COVID-19 Training

Before the semester starts, the ECE Department requires all its students to complete a training module, which includes a video developed in large part by students and hosted by the President of the Student Government Association. Follow the link to this module:

https://covidfstraining.questionpro.com/

Before you come to campus

Before coming to campus all ECE students should conduct a daily self-screening to ensure that they are symptom-free before coming to campus. The screening includes taking your temperature and assessing for the following symptoms:

- Fever or chills
- Cough
- Shortness of breath or difficulty breathing
- Fatigue
- Muscle or body aches
- Headache
- New loss of taste or smell
- Sore throat
- Congestion or runny nose
- Nausea or vomiting
Diarrhea


If you have any of these symptoms, you must **stay at home**, seek medical attention, and report to your professor. If you show any of the following signs, **seek emergency medical care immediately**:

- Trouble breathing
- Persistent pain or pressure in the chest
- New confusion
- Inability to wake or stay awake
- Bluish lips or face

In addition, everyone MUST complete a COVID-19 screening before coming to campus. The link for reporting is [https://screening.utep.edu](https://screening.utep.edu)

This screening includes three required questions:

- In the last 5 days have you (or someone you live with) experienced any one of the COVID-19 symptoms above?
- If you have been tested for COVID-19 in the past 2 weeks, was the result positive?
In the last 2 weeks, have you spent 15 minutes or more within 6 feet of anybody that you know has tested positive for COVID-19?

Before coming to campus, wash your hands, and pack a hand sanitizer bottle and a clean face mask.

Source: https://www.cdc.gov/

While on campus

UTEP is now requiring that everyone on the campus wear a CDC-approved face covering over the mouth and nose in all public spaces. This requirement includes classrooms, building entrances and exits, lobbies and lounges, as well as in hallways, stairwells, restrooms and elevators. UTEP will maintain and adjust its face-covering requirement as the pandemic evolves.

While on campus, ECE faculty will wear a face mask when giving in-person instruction. Likewise, students on campus will wear face masks in classrooms and laboratories and maintain social distancing (6 feet). Anyone refusing to face covering or to social distance themselves will be asked to leave the premises. Any escalation situations will be considered a public disruption and may require actions such as calling the UTEP campus police department and reporting the case to the Chair of the ECE Department and the Office of Student Conduct and Conflict Resolution (OSCCR).

One of the most effective ways of avoiding catching the corona virus, flu, or common cold is to wash your hands thoroughly after touching surfaces in common areas of places with high traffic. If this is not possible, use hand sanitizer as often as needed.

COVID-19 Testing on Campus
UTEP will test for COVID-19 in the fall. This will help us to rapidly identify individuals who have COVID-19 and do not have symptoms so they can isolate and avoid spreading it to others. The testing will focus on faculty, staff, and students who are on campus. Help us stop the spread of the corona virus and agree to participate in this voluntary testing program. Get tested when invited for testing at one of several on-campus locations.

**Resources**
- UTEP Return to Campus Presentation [https://www.utep.edu/resuming-campus-operations/_Files/docs/COVID_Return_to_Campus_Safety_Training_8-7-20.pdf](https://www.utep.edu/resuming-campus-operations/_Files/docs/COVID_Return_to_Campus_Safety_Training_8-7-20.pdf)
- UTEP Counseling and Psychological Services: 747-5302 or [CAPS@utep.edu](mailto:CAPS@utep.edu)
- UTEP Student Health and Wellness Center: [https://www.utep.edu/chs/shc/](https://www.utep.edu/chs/shc/)
- UTEP COVID-19 website: [https://www.utep.edu/ehs/COVID-19/](https://www.utep.edu/ehs/COVID-19/)
- US Centers for Disease Control and Prevention website: [https://www.cdc.gov/](https://www.cdc.gov/)