University of Texas at El Paso

ECE 3343 – Applied Quantum Mechanics for EE
Spring 2024

Course Information
Meeting day and time: TR, 12:00 pm – 1:20 pm
Room: Liberal Arts 108
Final Exam: Tuesday, May 7th, 1:00 pm – 3:45 pm
CRN: 26904

What is this course about? ECE 3343 is the introduction to quantum mechanics in the realm of modern physics, and all the amazing technology enabled by these revolutionary discoveries. You will learn in chronological order the major discoveries that led to the development of quantum mechanics, as well as specific applications enabled by these theories.

What can I expect? It is assumed that students in this class have knowledge of physics, circuits, and mathematics. Students are expected to take a very active role in their learning by completing readings and homework before class, coming to class ready to participate with peers and with the professor, and reviewing routinely for assignments and exams. In this course, we have evidence that every student can achieve if they are motivated to be an active learner!

Instructor Information
Jesus J. Gutierrez, Ph.D.
Assistant Professor of Instruction
Office: ENGR A-338
Office Hours: MW 3:00 pm –5:00 pm
TR 2:00 pm – 4:00 pm or by appointment
E-mail: jjgutierrez4@utep.edu

Course Materials

Textbook (Optional):
Essential Quantum Mechanics for Electrical Engineers
Peter Deák
Wiley Publishing, 2017, 224 pages
ISBN: 978-3-527-80583-9

What should you bring to class everyday:
- Pen/pencil and paper/notebook for taking notes.
- TI-85 scientific calculator or equivalent
- Laptop with access to the internet.
- Access to MATLAB
Course content will be delivered through Blackboard. Also, important class announcements will be delivered via Blackboard and/or e-mail. Please make sure your UTEP e-mail is working, and you have stable access to the internet.

If a student has no computer with access to the internet, from UTEP’s Technology Support Center has borrowing services for laptops and tablets:
https://www.utep.edu/technologysupport/TSCenter/TSC_EQ_LaptopsTablets.html

UTEP’s Technology Support center also helps for technological needs beyond your scope of troubleshooting, so make sure you contact them if you encounter technical difficulties.

**Prerequisites**
By Course (with grade of “C” or better):

- ECE 2301 – Circuits I
- PHYS 2321 and 2121
- MATH 1312
- MATH 2326

**Course Outline**
Topics covered in this course include:

1. Blackbody Radiation and Planck’s Law.
2. The Photoelectric Effect, Compton Effect, and Wave-Particle Duality.
4. Quantum Wells and Tunneling Effect.

**Relationship to (ABET) Program Outcomes**

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics:
  
  Students use mathematical and engineering concepts in the analysis of quantum mechanics.

- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies:
  
  Students learn to use software to design and analyze quantum mechanics theories.

**Rules and Policies**

**How is your grade determined?**
Your achievement on the course objectives will be assessed using a combination of in-class work, homework, participation, and exams. All student grades are protected by the Privacy Act of 1974.

Your course grade will be determined by your weighted performance in the following categories:

1. Homework…………………………60%  
   90% − 100% → A
2. In-Class Assignmnents………………10%  
   80% − 89% → B
3. Midterm Exam………………………20%  
   70% − 79% → C
4. Class Participation……………………10%  
   60% − 69% → D
   0% − 59% → F
For some students, there may be a “gray area” between two-letter grades in the final distribution, so two people getting the same weighted average grade could get different letter grades. If you are in one of these gray areas, whether you get a higher or lower grade depends primarily on two factors: (a) class participation and (b) whether your performance has been improving or declining over time.

**What are the Rules for the Homework?**

- Homework will be due on Thursdays at the end of the day. Any submissions later than this time-frame window will be marked as late. See my course goals below and realize that I am trying to help you succeed in your academic and professional career by giving you these assignments.
- To ensure you are doing your homework professionally and get the best grade possible for your homework, **follow the rubric posted on Blackboard.**
- As engineers, we use engineering notation to express our homework solutions. We will make use of **engineering notation** (up to two decimal places) throughout the course. For example, $3\pi, \sqrt{14}$, $\sin (0.2)$ are *not* final answers. These should be given as 9.42, 3.74, and 0.20.
- **Uphold the honor code!** Academic Integrity is at the heart of UTEP, and we are all responsible for upholding the ideals of honor and integrity for engineering. Your homework must be your own work. Students suspected of cheating or copying homework will be submitted to the Office of Student Conduct and Conflict Resolution (OSCCR) and will be part of your record at UTEP.

~ Missed Homework ~

If for some reason you cannot finish the homework on the due date and time, the grade will be reduced proportionately to the days passed after the due date (30% for each day passed).

**What are In-Class Assignments?**

In any class, with some exceptions, there will be an assignment covering the content from previous classes. The weekly assignments will account for 10% of the final grade. The time allotted for the assignment will be no more than 15 minutes. The assignments may be done individually or in groups. The two lowest graded in-class assignments will be dropped.

**What are the Rules for the Exam?**

- You will only have a calculator, pen or pencil, eraser, and one cheat sheet with formulas or problems with your name and UTEP ID on both sides of the paper.
- Full work must be shown for full credit. Work must be neat and well organized. The final answer must be boxed and given proper units.
- **Uphold the honor code!** Academic Integrity is at the heart of UTEP, and we are all responsible for upholding the ideals of honor and integrity for engineering. Your exam must be your own work. Students suspected of cheating or copying in the exam will be submitted to the Office of Student Conduct and Conflict Resolution (OSCCR) and will be part of your record at UTEP.
- The tentative date for the exam is Tuesday, April 2, 2024.
A missed exam can be made up **IF AND ONLY IF:**

1. you have a **non-frivolous reason** that is beyond the student’s control: medical excuse, jury duty, death in the family or automobile accident, job interview, conference, or out-of-town job-related travel, and

2. **prior consent** is obtained from the professor for missing the exam, and

3. **show up** to the rescheduled exam on the date and time provided.

In either case, the student must submit a written and signed statement before the scheduled exam, describing the reasons for missing, appropriate documentation, and petition for a make-up exam. Then the instructor will re-schedule the exam and the student will show up at the date and time provided. A missed exam will carry zero grade if these conditions are not met.

**How do I Participate in the Course?**

As an active learner, you will appreciate the value of discussions and participation in in-class assignments. Participating in class does not necessarily mean talking a lot or asking a lot of questions. Some of the most helpful things you can do to enrich participation is doing class work, helping fellow classmates by explaining during group exercises, and answer questions asked by the professor in a thoughtful manner.

**How can you participate in class if you’re shy?** Although I do my best to ensure a safe space for learning for everyone to participate, there may be some students that are quiet learners. If you are a quiet learner, you can participate with honest and serious participation through student response systems, collaborating your small group during assignments, engage with me (the professor) during office hours or by e-mail, or even helping fellow students by explaining concepts inside and outside of class. There are many other ways you can participate even if you don’t want to participate in front of the whole class.

**What will I achieve after taking this course? Course Goals**

- **This course should prepare you to succeed in future Electrical Engineering courses.** You will learn how to be an active learner in the lecture hall and how to actively study. Research has shown that students who do readings/assignments before class, actively participate in class, and review notes regularly can and will succeed in this and future courses. This course is designed to equalize your readiness for class, and your effort will pay off as you practice connecting the topics together and gaining confidence in your ability!

- **This course will help you in learning how to learn.** How do you know you are learning? When you make mistakes, you identify what you don’t know. Making mistakes is key to learning. Recognizing gaps and asking questions is key to learning. It is best to make mistakes in homework and assignments when the stakes are low, so you are successful on the exam.

- **This course will provide you with the basic concepts and knowledge that comprises quantum mechanics.** At the end of the semester, you will:
  - Understand fundamental quantum mechanical concepts
This course should excite you about quantum mechanics and electrical engineering in general. Throughout the semester I hope you ask yourself and me, why is this relevant to me? Some lessons will be more obvious as they relate to everyday devices and applications. I hope the content we learn in this semester will cause you to ask more questions, and even leave you with more questions than answers! If I get you to read some circuits and electrical engineering material other than the book on your own, share it with me! I will be a happy professor.

How successful students have done well in this course? They always read the textbook and pay attention to what they are reading and reflect on what they are unsure about. They complete their projects on time with plenty of time to make mistakes and ask questions. They value taking notes and doing assignments as valuable tools to learn. They attend each class and come prepared. They are brave and vulnerable, meaning that they are willing to make mistakes, take the chance of drawing a circuit or a solution wrong, and attempt to answer the question by themselves before checking in with a peer. They review on their own every question to see if they could teach it to someone else. Successful students don’t just get the right answer and move on, they are able to explain how they arrive at that answer.

Course Calendar
This is a tentative schedule of the course topics, and assignments, subject to change.

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Topic</th>
<th>Assignment due</th>
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<tbody>
<tr>
<td>1</td>
<td>Jan 16, 18</td>
<td>1. Classical Physics and Information Technology</td>
<td>-</td>
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<tr>
<td>2</td>
<td>Jan 23, 25</td>
<td>2. Blackbody Radiation</td>
<td>-</td>
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<tr>
<td>3</td>
<td>Jan 30, Feb 1</td>
<td>2. Blackbody Radiation</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Feb 6, 8</td>
<td>3. Photons: The Physics of Lasers</td>
<td>Homework #1</td>
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<tr>
<td>5</td>
<td>Feb 13, 15</td>
<td>3. Photons: The Physics of Lasers</td>
<td>-</td>
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<tr>
<td>6</td>
<td>Feb 20, 22</td>
<td>4. The Physics of Electrons</td>
<td>Homework #2</td>
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<tr>
<td>7</td>
<td>Feb 27, 29</td>
<td>4. The Physics of Electrons</td>
<td>-</td>
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<tr>
<td>8</td>
<td>Mar 5, 7</td>
<td>5. Particles and Waves</td>
<td>Homework #3</td>
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<tr>
<td>9</td>
<td>Mar 12, 14</td>
<td>SPRING BREAK (NO CLASSES)</td>
<td>-</td>
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<tr>
<td>10</td>
<td>Mar 19, 21</td>
<td>5. Particles and Waves</td>
<td>-</td>
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<tr>
<td>11</td>
<td>Mar 26, 28</td>
<td>6. Quantum Mechanics Postulates</td>
<td>Homework #4</td>
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<tr>
<td>12</td>
<td>Apr 2, 4</td>
<td>6. Quantum Mechanics Postulates</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td>Apr 9, 11</td>
<td>7. Quantum Wells</td>
<td>Midterm Exam</td>
</tr>
<tr>
<td>14</td>
<td>Apr 16, 18</td>
<td>7. Quantum Wells</td>
<td>-</td>
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**Academic Dishonesty Statement**

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 is the basis for departmental and institutional quality. All students within the Department are expected to observe appropriate standards of conduct.

Any student who commits an act of scholastic dishonesty is subject to discipline. Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in 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.

Any case involving academic dishonesty will be referred to the Office of the Dean of Students. The Dean 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’ homepage (Office of Student Life) at [http://studentaffairs.utep.edu/dos](http://studentaffairs.utep.edu/dos) for more information.

You can also refer to the IEEE website for information on our code of ethics: [http://www.ieee.org/about/corporate/governance/p7-8.html](http://www.ieee.org/about/corporate/governance/p7-8.html)

**American Disabilities Act (ADA) Statement**

The University is committed to providing services, equipment, and accommodations to individuals with documented disabilities to provide them with equal opportunities to participate in programs, services, and activities in compliance with Sections 503 and 504 of the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act (ADA) of 1990, and the Americans with Disabilities Act Amendments Act (ADAAA) of 2008. If you have a disability and need classroom accommodations, please contact The Center for Accommodations and Support Services (CASS) at 747-5148, or by email to cass@utep.edu, or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at [www.sa.utep.edu/cass](http://www.sa.utep.edu/cass).
Discrimination Statement
I do not discriminate, nor will I allow discrimination, on the basis of race, color, national origin, sex, religion, age, disability, genetic information, veteran’s status, sexual orientation, or gender identity. Members of the UTEP community are protected from discrimination and harassment by the State and Federal Laws.

University Resources

Technology Resources

- **UTEP Technology Support**: Students experiencing technological issues or challenges (e-mail, Blackboard, software, etc.) can submit a ticket to the UTEP Helpdesk for assistance. [www.utep.edu/technologysupport](http://www.utep.edu/technologysupport)
- **UTEP Engineering Technology Center (ETC)**: Provides laptop and computer repair services for engineering students, as well as service requests for software. [www.utep.edu/engineering/etc/](http://www.utep.edu/engineering/etc/)

Academic Resources

- **UTEP Library**: Access to a wide range of resources including online, full-text access to thousands of journals and e-Books, plus reference services and librarian assistance for enrolled students. [www.utep.edu/library/](http://www.utep.edu/library/)
- **Math Resource Center for Students (MaRCS)**: Ask a tutor for help (including remotely) and explore available math resources like formula sheets, tables, and videos. [www.utep.edu/science/math/marcs](http://www.utep.edu/science/math/marcs)
- **Advancement Center for Engineering Students (ACES)**: Students serving other students. Hybrid tutors provide tutoring for a wide range of topics including engineering, math and science, and also manages room reservations. [www.utep.edu/engineering/student-resources/student-resources-aces.html](http://www.utep.edu/engineering/student-resources/student-resources-aces.html)

Individual/Well-Being Services

- **YWCA Early Learning Academy**: Conveniently located on campus to serve the UTEP community, YWCA’s Early Learning Academy is the best childcare solution for UTEP students, faculty, and staff. [https://www.utep.edu/student-affairs/early-learning-academy/](https://www.utep.edu/student-affairs/early-learning-academy/)
- **Military Student Success Center**: Assists personnel in any branch of service to reach their educational goals. [www.utep.edu/student-affairs/mssc/](http://www.utep.edu/student-affairs/mssc/)
- **Center for Accommodations and Support Services (CASS)**: Assists students with ADA-related accommodations, for coursework, housing, and internships. [www.utep.edu/student-affairs/cass](http://www.utep.edu/student-affairs/cass)
- **Counseling and Psychological Services (CAPS)**: Provides a variety of counseling services including individual, couples, and group sessions, as well as career and disability assessments. [www.utep.edu/student-affairs/counsel](http://www.utep.edu/student-affairs/counsel)