MME 3309 (CRN 18903) – Circuits, Electronic Materials and Devices
Course Syllabus
Fall 2022

INSTRUCTOR:

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TAs:

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COMMUNICATION:

Dr. Quinones' Office Hours: Tuesdays and Thursdays, 4-5 pm
Ashley's Office Hours: Monday from 11:30 am – 1:00 pm and Thursday from noon – 1:20 pm
Email: Please use the Email option on the course Blackboard shell to contact us. We will make every attempt to respond to your e-mail every Monday, Wednesday and Friday by the end of the day.
Announcements: Check the Blackboard announcements frequently for any updates, deadlines, or other important messages.

COURSE DESCRIPTION:

Circuits, Electronic Materials and Devices (2-3) Circuit theory, applied hands-on circuit construction, introduction to quantum mechanics concepts, applied quantum mechanics to nanosystems, electronic materials, device physics and modeling of electronic devices using quantum mechanical simulations.

PRE-REQUISITES:

PHYS2420, PHYS2421 and MATH2326 (all w/C or better)

COURSE LEARNING OUTCOMES:

- Become familiar with the Analog Discovery device (oscilloscope and waveform functions).
- Use MATLAB to model experimental data.
- Analyze Simple Circuits using Ohm's Law, Voltage Divider, Equivalent Circuits, and Kirchhoff's Current/Voltage Laws.
- Build and analyze circuits using passive and active components.
- Build and analyze signals through circuits with low pass, high pass and band pass filters.
- Use Bode Plots to characterize filters and predict signal response.
- Build circuits using sensor inputs to create a measureable output.
- Understand basic fundamental concepts associated with quantum mechanics
- Understand the wave nature of quantum mechanics as it applies to electromagnetic waves and electrons
- Understand the probabilistic nature of electrons
- Be able to solve quantum mechanical problems associated with photon-electron interactions
- Be able to use boundary conditions and the time-independent Schrödinger equation to solve quantum mechanical problems
- Be able to design and simulate electronic devices using simulation tools

STUDENT OUTCOMES:

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- An ability to communicate effectively with a range of audiences

- An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

COURSE TOPICS:

The course content is divided into 3 parts:

Part I: Circuits – Understand, build, analyze basic circuits, and interpret input/output signals.
Part II: Electronic Devices: Understand how to model semiconductor materials and devices
Part III: Quantum Mechanics – Understand basic quantum theory, how electromagnetic waves interact with semiconductor materials, and how wave theory is used to explain the most common applications of quantum mechanics (quantum wells). Apply quantum mechanics to electronic devices and understand the unique manner that semiconductor devices respond to applied voltages, to the absorption of light, and how they emit light.

- Circuits: Build Circuits and Measure/Analyze Circuit Signals
  - Introduction to Circuits and Ohm's Law
  - Charged Particles (Electrons)
  - MATLAB data modeling
  - Series and Parallel Circuits
  - Voltage Divider
  - Filters
  - Bode Plots
  - Simple Op-Amp Circuits

- Electronic Devices: Understand and Model Semiconductor Devices
  - Semiconductor Bonding, Doping and Energy Band Models
  - Carrier Concentrations

- Quantum Mechanics: Understand the behavior of very small particles (electrons)
  - Electromagnetic Waves and Photons
  - Charged Particles and Electric Fields
  - Potential, Potential Energy and Kinetic Energy
  - Schrodinger's Equations: Theory and Applications

- Application of Quantum Mechanics to Devices
  - Light (Photon) Absorption
  - PN Junctions (LED)
  - Quantum Wells
  - Tunneling Diode

COURSE STRUCTURE (2-1):

This is a hands-on course that includes a 1.5 hour lecture and a 3 hour lab component. Most assignments from the lecture are due at the end of the lecture or at the beginning of the next lecture. The lab assignments are due at the beginning of the next lab. The lecture provides theory and problem solving experiences that are tied to the hands on laboratory component of the course.

Lecture Activities:
- 10-15 minute lectures
- In class group homework assignments; problem solving homework completed on engineering paper and random paper selected from each group
- Take home individual assignments

Lab Instructions:

- Short lecture
- Lab Handout – provides theory and instructions for each lab
- Lab Reports – lab report reports are completed using a template

COURSE RESOURCES: No textbook is required. Course Notes, PowerPoints and Videos are provided on the Blackboard course shell. The Analog Discovery 2 hardware and lab supplies are provided to each student. Waveforms (software platform for the Analog Discovery 2) and the MATLAB software can be accessed from the Engineering Technology Center website and is also free.

CIRCUIT COMPONENTS: Resistors, Capacitors, Breadboard, Thermistors, Wire Stripper, Power Supply PCB, Photodiodes, LEDs, and Op-Amp IC

HARDWARE: Digilent Analog Discovery 2 is a USB oscilloscope, logic analyzer, and multi-function instrument that allows users to measure, visualize, generate, record, and control mixed-signal circuits of all kinds. The Waveforms software is used to interface with the Analog Discovery 2.

COURSE GRADING:

Quizzes	5%	Worksheets/Lab Reports*	30%
Homework	10%	Lab/Lecture Attendance	10%
3 Exams	45%		

Exam Schedule:

Exam I	October 5th
Exam II	November 2nd
Exam III	December 8th

No late work accepted, and all exceptions will require documentation that must be approved by instructor. All grades will be posted on blackboard. Absences from exams will require documentation such as doctors note in case of illness.

COURSE DROP POLICY: Students who have more than 3 absences (lecture and laboratory combined) or fail to turn in 5 assignments on time will be dropped from the course. The student withdrawal deadline with a 'W' is October 28th. After October 28th, students may drop the course, and will receive a grade of W or F. To drop this class, please contact the Registrar's Office to initiate the drop process. If you cannot complete this course for whatever reason, please contact me. If you do not, you are at risk of receiving an "F " for the course.

INCOMPLETE GRADE POLICY: Incomplete grades may be requested only in exceptional circumstances after you have completed at least half of the course requirements. Talk to me immediately if you believe an incomplete is warranted. If granted, we will establish a contract of work to be completed with deadlines.

TECHNOLOGY REQUIREMENTS: You will need to have or have access to a computer/laptop. Course content will require you to use Waveforms (free) to interface with your Analog Discoery 2 and MATLAB (from Engineering Technology Center-free) to create plots of your results/data. Check that your computer hardware and software are up-to-date and able to access all parts of the course.

If you encounter technical difficulties beyond your scope of troubleshooting, please contact the Help Desk as they are trained specifically in assisting with technological needs of students.

TECHNICAL ISSUES: I strongly suggest that you submit your work with plenty of time to spare in the event that you have technical issues.

NETIQUETTE:

- Always consider audience.
- Respect and courtesy must be provided to classmates, faculty and staff at all times in and outside the classroom. Read all emails twice before you send them to your professor, TA, other students or staff to make sure that the message is courteous and includes your desired goal(s).

ACCOMMODATIONS POLICY:

The University is committed to providing reasonable accommodations and auxiliary services to students, staff, faculty, job applicants, applicants for admissions, and other beneficiaries of University programs, services and activities with documented disabilities in order 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. Reasonable accommodations will be made unless it is determined that doing so would cause undue hardship on the University. Students requesting an accommodation based on a disability must register with the UTEP Center for Accommodations and Support Services (CASS). Contact the Center for Accommodations and Support Services at 915-747-5148, or email them at cass@utep.edu, or apply for accommodations online via the CASS portal.

HEALTH STATEMENT:

Please stay home if you are ill. If you are feeling unwell, please let me know as soon as possible, so that we can work on appropriate accommodations. This includes any illness, such as colds, flu, etc. If you tested positive for COVID-19 or are exposed to someone with COVID-19, please report your results to covidaction@utep.edu, to receive instructions about self-isolation.

SCHOLASTIC INTEGRITY:

Academic dishonesty is prohibited and is considered a violation of the UTEP Handbook of Operating Procedures. It includes, but is not limited to, cheating, plagiarism, and collusion. Cheating may involve copying from or providing information to another student, possessing unauthorized materials during a test, or falsifying research data on laboratory reports. Plagiarism occurs when someone intentionally or knowingly represents the words or ideas of another as ones' own. Collusion involves collaborating with another person to commit any academically dishonest act. Any act of academic dishonesty attempted by a UTEP student is unacceptable and will not be tolerated. All suspected violations of academic integrity at The University of Texas at El Paso must be reported to the Office of Student Conduct and Conflict Resolution (OSCCR) for possible disciplinary action. To learn more, please visit HOOP: Student Conduct and Discipline.

Please submit your own work at all times.

COPYRIGHT STATEMENT FOR COURSE MATERIALS:

All materials used in this course are protected by copyright law. The course materials are only for the use of students currently enrolled in this course and only for the purpose of this course. They may not be further disseminated.