ECE 2214: Physical Electronics (Spring 2024)

MWF 10:10 am -11:00 am GOODW 135 (TC Poon)
MWF 10:10 am -11:00 am PAM 2030 (MK Hudait)
MWF 11:15 am – 12:05 pm DDS 155 (W Zhou)

To excel in this class, follow these guidelines: Attend lectures and focus on understanding the content. Complete all homework assignments. Read and comprehend the textbook. Study and understand all provided examples. Additionally, when attending lectures: Fully engage in the learning process. Silence all cell phones before the lecture begins.

Instructors: Dr. TC Poon (tcpoon@vt.edu), Dr. MK Hudait (mantu@vt.edu), & Dr. W Zhou (wzh@vt.edu)

Office Hours & Communication: All inquiries regarding homework and lab projects should be directed to the TAs listed below. They will be equipped with homework solutions and can assist you effectively. For class logistics and lecture-related queries, please approach the course instructors.

- MK Hudait (Meeting ID: 829 2478 3547; Passcode: 290417)
    - **Tuesday: 10:30 am – 12:30 pm, or send email requests for zoom's or in-person, please put mask**
- TC Poon (Zoom ID: 522 243 7657)
    - **Time: Send email requests for zoom's or in-person's . For in-person's, please put on a mask.**
- W Zhou (In-person meeting: Whittemore 471) (Zoom ID: 679 450 2305)
    - **TH: 3:00 pm – 4:00 pm, or send email requests for zoom's or in-person's, please put on a mask.**

TA office hour information (Location: 255 Whittemore Hall)

- Mehrzad Dizgah (amehrzad@vt.edu), x:00 pm – x:00 pm on Mon, Wed, and Fri
- Ze Zong (zez19@vt.edu), x:00 pm – x:00 pm on Tues and Thurs
- Zineng Yang (zinengy@vt.edu), x:00 pm – x:00 pm on Tues and Thurs

ECE2214 TA Discussion/Recitation Sections:

- Time: TBD
- Location: TBD

Course Description:

Fundamentals of electrostatics and magnetostatics, transmission lines, impedance matching networks, electromagnetic (EM) waves, and basic operating principles of diodes and metal-oxide-semiconductor field-effect transistors (MOSFETs). Designing MOSFET biasing and single-ended and differential amplifier circuits. Basic operating principles of complementary metal-oxide semiconductor (CMOS) device and its application as a digital inverter. Electronic circuit design adhering to professional and ethical practices.

Upon successful completion of this course, students will be able to:

1. Calculate the capacitance and inductance of devices using electrostatics and magnetostatics principles.

2. Determine the reflection coefficient and standing wave ratio using transmission line fundamentals.

3. Analyze transformer voltage/current conversion and generator performance with Faraday's Law.

4. Calculate the phase velocity of uniform plane electromagnetic (EM) waves using Maxwell's and EM wave equations.

5. Using semiconductor physics principles, Calculate carrier concentrations, drift currents, and diffusion currents in semiconductor materials.

6. Analyze PN diode circuits with ideal diode equation, and linear circuit equations.

7. Determine voltage gain, input and output resistance of metal-oxide-semiconductor field-effect transistors (MOSFET) MOSFET amplifiers using DC circuit Q-point analysis and small-signal AC circuit analysis.

8. Analyze input-output voltage conversion of MOSFET inverters using MOSFET and circuit analysis principles.

Prerequisite: ECE 2024 (C or above).

Required Text:

1. D. A. Neamen, **Microelectronics Circuit Analysis and Design**, 4th edition
McGraw-Hill. ISBN 0073380644
2. Steven W. Ellingson, **Electromagnetics, volume 1**
Below is the site you can download a free copy. Please download file **Electromagnetics_Vol1_screen-reader-friendly.pdf** for our course.
https://www.faculty.ece.vt.edu/swe/oem/

Required Course Materials:

The Lab-in-A-Box kit (previously used in ECE1004 and ECE2024)

Course Grade:	**Points**
Exams	65 %
Homework	15 %
Lab projects	10 %
Course attendance	10 %
Total	**100%**

Exams:

- There will be **no cumulative final exam**.
- Four exams will be administered throughout the course.
- **No makeup exams** are allowed, including for emergencies. Refer to the relaxed policy for details.
- Exam content will be derived from lectures, homework, and associated textbook materials.
- All grading is definitive. If you identify a grading error, bring it to the grader's attention within a week from the date the exam is returned. For clarity on your course progress and standing, feel free to consult with us during office hours.
- Each exam permits a **1-page (double-sided) handwritten formula sheet** comprising equations, figures, or theoretical data (Honor Code enforced). However, no solution sets are permitted. Calculators are allowed but must not contain any course material, such as homework solutions or lecture notes (Honor Code enforced).
- If you dispute a graded exam, review the solutions thoroughly first and then approach the grader in their office.
- **Relaxed Policy**: The lowest score from the first three exams will be disregarded. However, the score from Exam 4 is non-negotiable. Note: Exam 4 will take place on the designated final exam day.

Homework/Lab Assignments:

- Assignments will be announced during lectures and uploaded to Canvas. All tasks must be submitted by 11:59 pm on the stipulated deadline. No late HW will be accepted.
- **Relaxed Policy:** The lowest homework score will be dropped. Lab grades are fixed.
- Assignments and labs must be submitted electronically as a singular PDF through Canvas. Any submissions in alternative formats, such as Microsoft Word, will be ineligible for grading. Refer to the "PDF Preparation" section for details. Solutions should be clear, legible, and professional, detailing problem statements and solutions.
- Homework and lab reports should be written on standard 8.5 x 11-inch paper with your name clearly printed on the top right corner of the first page.
- **PDF Preparation:** Ensure you're adept at creating PDFs before your assignment is due. If you're submitting handwritten work, it should be scanned into a legible PDF. Graphs should be computer-generated, preferably using MATLAB, and must be clearly labeled, including all axes, with appropriate units. Any related m-files should be submitted alongside the assignment.
- Collaborative discussion on homework/lab problems is encouraged. However, submitted work must be individual and original. Any homework not adhering to these standards will receive zero credits.
- Graders may only assess a random selection of problems from each homework set. You're advised to complete all assigned problems.

Course attendance score:

- The course attendance will be recorded 10 times over the semester without pre-notification. Dean's letter is requested to relax the class absence in advance. No Late notification will be accepted.

Classroom Expectations:

At Virginia Tech, we prioritize the health and safety of our entire community. Students implicitly agree to adhere to the Virginia Tech Wellness principles by enrolling in this class. In order to maintain a safe environment in this class, students must:

- Isolate themselves from campus if they test positive for COVID-19 or exhibit symptoms potentially related to COVID-19. For more on symptoms, visit CDC's guide on COVID symptoms.
- Ensure they respect the well-being of their peers by practicing good personal hygiene and maintaining appropriate physical distance when possible.
- Refrain from attending class in person if showing even minor signs of illness. In such cases, students should reach out to the instructor for guidance on continuing their coursework and consult the health tips provided by Virginia Tech.
- Understand that these requirements are non-negotiable. Students unable to meet these classroom expectations due to medical reasons or those who are uncomfortable with them should consider alternative online course offerings.
- Beyond the classroom, it's imperative to adopt behaviors such as frequent handwashing and social distancing. Virginia Tech's complete wellness guidelines are available here.

Honor Code Commitment:

As members of the Virginia Tech community, we all pledge to uphold the principles of the **Undergraduate Honor Code**: **"As a Hokie, I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do."**

Every student in this course is expected to adhere to the Honor Code. If you're uncertain about how the Honor Code applies to a specific assignment, it's your responsibility to seek clarification from the course instructor prior to submission. Lack of knowledge of the Honor Code's guidelines doesn't exempt anyone from its expectations. For a deeper understanding of the Honor Code, visit the Virginia Tech Honor System.

Should you witness any suspected breaches of the Honor Code, please inform the course instructor. **This course enforces the Honor Code rigorously, as we believe that academic honesty lays the foundation for professional integrity.**