

Course Policies and Information

Objective The primary objective of this course is to introduce students to the basic properties of semiconductor devices, especially diodes and transistors, and to study the applications of these devices in electronic circuits. The components and analysis techniques covered here are fundamental to the design and operation of all digital and analog electronic devices used in the modern world. The course also exposes students to practical issues often encountered by electrical and computer engineers in professional practice, and it provides opportunities for students to practice technical communication skills.

Course Outcomes A student who successfully completes this course should be able to:

1. Predict and/or mitigate the effects of the nonideal properties of operational amplifiers on circuit performance.
2. Predict the common-mode and differential-mode performance of difference and instrumentation amplifiers based on operational amplifiers.
3. Analyze and/or design circuits involving diodes using the piecewise linear diode model.
4. Analyze and/or design power supply circuits using linear voltage regulators.
5. Determine the region of operation of a MOSFET or BJT.
6. Determine and/or set the bias point (quiescent operating point) of a MOSFET or BJT circuit.
7. Find transfer functions of basic MOSFET and/or BJT amplifier circuits, switching circuits, and digital logic circuits.

Adjustments might be made to the list above, although significant changes are not anticipated. The outcomes map to the general student outcomes specified in ABET Criterion 3 for accrediting college/university engineering programs as follows:

(1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics – Course Outcomes 1–7

Instructor Prof. David F. Kelley, Breakiron 368, 577-1313, dkelley@bucknell.edu

Office Hours Times will be announced. Evening office hours will likely take place via Zoom.

Textbook A. S. Sedra, K. C. Smith, T. C. Carusone, and V. Gaudet, *Microelectronic Circuits*, 8th ed., Oxford University Press, Inc., New York, 2019. ISBN-13: 978-0190853464. Supplemental readings will be posted at the course Moodle site.

Web Site <https://www.eg.bucknell.edu/~dkelley/eceg350>

Prerequisite ECEG 210 or its equivalent or permission of the instructor

Health and Safety Protocols Class and lab meetings are expected to be in person. Remote instruction via the Zoom online platform might be used if, for example, I become ill, I must travel away from campus, or a major weather event makes travel dangerous. In such cases, I will provide as much advance notice as possible. It is also possible that the university will impose remote instruction or allow its adoption if an unforeseen crisis warrants it. Lectures, labs, and other meetings conducted via Zoom will be presented synchronously at their normally scheduled times. Unless recording is taking place (see next section), all students must have their cameras on during the session.

The use of masks in class is optional but recommended if there is a local outbreak of a contagious illness such as flu. However, I reserve the right to require students to properly wear N-95 or KN-95 masks at all times in class in the case of a serious outbreak of COVID-19 or other health crisis. I realize that this policy could be more restrictive than the university's policy, but I must protect a family member who is at high risk of developing serious complications from infection.

Confidentiality Statement If any class meetings take place on the Zoom online platform, they *might* be recorded for the purpose of making them available to students who miss the material due to absence; however, recordings are unlikely. Recordings will be stored securely and will be accessible only to students enrolled in the course. Before a Zoom recording begins, you will be asked to provide your consent to participate. Students who do not provide consent may exit the session and notify me of their decision. The latter group of students may access the recorded session later but are responsible for keeping up with the course material on their own. All students are expected to participate in a Zoom session with their camera on if it is not recorded.

Communication Check your e-mail and the course web site at least **once per day**. Most announcements and course materials will be distributed via the web site or Moodle site. E-mail might be used to distribute time-sensitive announcements. You are responsible for knowing all assignment due dates and adhering to any policies or updates posted at the web site. You should contact me as soon as possible if you expect to miss a lecture, lab session, or other activity.

You may expect prompt, but not instant, responses from me to e-mails, phone messages, and other forms of communication, and I will expect the same from you. We all have multiple responsibilities in our lives, and none of us should be expected to respond instantly to requests. I will strive to provide responses within a few hours but no later than 24 hours during the work week. You should not expect responses, nor should I, late at night or on weekends.

Academic Responsibility You must comply fully with the university's academic responsibility policies. All submitted problem solutions must be your own work. Deliverables produced for team exercises must be your group's own work. General discussion of solution techniques is okay, but copying full or partial solutions or text, sharing step-by-step instructions for solving a problem, sharing computer files, and other forms of plagiarism are not acceptable. It is considered plagiarism if you use text written by an automated system and claim it as your own (e.g., the output from an artificial intelligence tool such as ChatGPT or Claude). If these policies are not clear, please contact me or consult Bucknell's "Academic Responsibility" web site:
<https://www.bucknell.edu/academics/current-students/academic-responsibility>

Artificial intelligence (AI) tools are proliferating, and it is tempting to use them to solve homework problems, produce written work, etc. It is impossible for me to monitor such usage; therefore, I cannot enforce a prohibition against it. However, you should be aware that if you use such tools, you will not fully develop your ability to solve problems and express ideas nor will you fully develop your technical skill and knowledge. You will not be able to use such tools during exams and presentations. Furthermore, if an AI tool generates an erroneous solution or text and you pass it along as your own, you must accept the resulting grade penalty. As explained above, claiming text generated by an AI tool as your own is considered plagiarism.

Intellectual Property Exams, homework and lab assignments, exam and homework solutions, supplemental readings, and all other documents shared with the class are my or others' intellectual property and may not be posted online or otherwise shared with people outside the course without permission. Distributing someone else's intellectual property without their permission is a serious matter.

Bucknell University Honor Code As a student and citizen of the Bucknell University community:

1. I will not lie, cheat, or steal in my academic endeavors.
2. I will forthrightly oppose each and every instance of academic dishonesty.
3. I will let my conscience guide my decision to communicate directly with any person or persons I believe to have been dishonest in academic work.
4. I will let my conscience guide my decision on reporting breaches of academic integrity to the appropriate faculty or deans.

Attendance Policy The decision to attend class either in person or remotely is your responsibility. Although you are not specifically required to attend the lectures, I do notice when you are missing. (Lab attendance is mandatory.) If you struggle in the course, I will point to any absences as a contributing cause. I frequently cover supplemental topics or details in class that do not appear in the textbook. There could also be occasional in-class exercises. While they might not directly

affect your course grade, they could nevertheless help you greatly to comprehend the material. I will not go over course material in detail (i.e., I will not essentially repeat a lecture) for students who miss class without a valid reason such as illness, injury, or an authenticated family crisis.

Final Grade Computation

Your final course grade will be determined as shown below, although your weighted exam average must exceed 60 out of 100 points for you to pass the course. Significant extra credit opportunities are not likely to be provided. Exam dates will be posted at the course web site.

Mandatory Office Hours Visit	2%	
Professional Conduct	4%	
Homework	14%	Weighted equally; lowest score dropped
Laboratory	15%	Low scores weighted less than high scores
Exams #1–#3, Final	3×20%, 5%	Lowest of four scores weighted less than the other three

The weightings above might be adjusted and/or alternative assessment methods might be introduced if necessary to account for unusual circumstances, such as a major error on my part in the preparation of an exam or other assignment, a health-related change in instructional mode, or a long-term university closure. Changes will be announced in advance.

Scores on major assignments will not be discussed until a 24-hour “cooling off” period has passed unless points have been added incorrectly to obtain an overall score. An absolute scale with the following distribution will be used to determine your final course grade.

93–100 A	87–89.9 B+	77–79.9 C+	60–69.9 D
90–92.9 A–	83–86.9 B	73–76.9 C	< 60 F
	80–82.9 B–	70–72.9 C–	

Mandatory Office Hours Visit

You must attend scheduled office hours (help sessions) for at least five minutes at least once after the first week of the semester but before the end of the fifth week. The visit may be in person or online. During the visit, you must discuss something with me that is relevant to the course such as an assignment, a challenging concept, or an item in class that you found interesting. Of course, I encourage you to visit more than once! You must also show evidence that you have access to the textbook in either physical or electronic form. Up to two people may satisfy this requirement simultaneously during a single visit. You will earn only 1 point if your visit is during the last scheduled in-person or online session before the deadline. Appointments outside regularly scheduled sessions do not count unless you have a verifiable time conflict.

Professional Conduct

Everyone in this course must act in a professional manner. Distractions that prevent your classmates from concentrating on instructional activities will not be tolerated. For in-person instruction, these include checking social media, reading newspapers or other noisy print media, web browsing, disruptive eating, excessive talking, chronic tardiness, and other inappropriate behavior. Smart/cell phones, laptops, and other electronic devices other than non-wireless calculators may not be used in class without permission except briefly to take pictures of the whiteboard. Tablet PCs and tablet-like devices may be used to take notes if they are kept flat on the table and are used with a stylus or quiet keyboard, but they will not be allowed if they become a distraction. Please notify me if you need to monitor a device for an important reason such as an ongoing family crisis.

Similar distractions to those listed above during remote instruction will not be tolerated. Unless you have made different arrangements with me, during online sessions I expect you to have your camera on most of the time. Please contact me if you have a reason for keeping your camera off.

Since part of the educational mission of Bucknell is to prepare you for professional practice, your conduct in class comprises a portion of your course grade. You should act as you would in an engineering staff meeting. If you have a valid reason for frequent lateness or for leaving the room or online session during class time, please notify me. Use of prohibited substances and/or possession of associated paraphernalia in class will result in a 1-point drop in the Professional Conduct score per incident and referral to the ECE Chair and/or Dean’s office.

Scoring is necessarily subjective, but the following examples will guide the assignment of scores. This is only a representative list:

- 4 Professional conduct at all or almost all times
- 3 Mild smartphone/laptop use, lateness, or other distraction (up to ~10 times)
- 2 Chronic smartphone/laptop use, lateness, or other distraction (more than ~10 times), multiple mild distractions, or several arrivals more than 10 minutes late
- 1 Multiple chronic distractions
- 0 Consistent disruptive and/or unprofessional behavior

Please contact me if you feel that any of these policies should be adjusted. Professional expectations change over time, and some practices that were once considered unacceptable later become part of normal work culture. I am willing to modify expectations for good reasons and/or truly changing norms. However, I will not permit practices that distract others from learning.

Homework Policies The primary purpose of homework is to help you engage with the concepts presented in the course at a high level. I encourage you to work on homework in groups and to help each other understand the material within the scope of the “Academic Responsibility” section above. However, the less that you rely on a study group to complete assignments, the more effectively you are likely to learn the material. Ultimately, you need to make sure that you can solve exam problems, contribute to lab work, and complete other assigned activities on your own.

Homework assignments will be posted at the course web site, and your completed work must be submitted via the course Moodle site by the indicated deadline. Please follow the formatting guidelines listed below. They help ease the strain on your hard-working grader, and they help ensure that you receive proper credit for your work:

- At the top of the first page, add your name, the course number (ECEG 350), and the homework number. You do not have to use a cover page.
- Add a page number at the top of each subsequent page.
- Arrange problem solutions in the order in which they are listed on the assignment.
- If appropriate, clearly indicate your answers by enclosing them in boxes.
- Write on only one side of the page to prevent “bleed-through.”
- You are not required to use “engineering” paper or graph paper.
- Scan (preferred) or photograph your homework pages and convert them to PDF format. For photos, use a low-resolution setting to minimize the file size. Collect photos into a single PDF file or a word processing file that you then convert to PDF.
- If available, use the black & white photo setting on your phone or scanner to minimize the file size and improve contrast. Check photos for glare that makes the text difficult to read.
- Make sure that submitted images have good contrast and are close to 8.5 x 11 inches in size; that is, make sure that your scanning software does not significantly shrink or enlarge the pages. Moodle does not have a page zoom feature.
- If you use the Goodnotes app, select the “no background” option when you convert to PDF; otherwise, your homework might not be visible in Moodle.
- The file size of your scanned document must be less than 10 MB.

Lack of compliance with one or more of these requirements could result in a score reduction. Sloppy or unreadable work is unacceptable and could result in a score of zero.

Some of the problems in a homework assignment might not be graded. If so, they will be clearly indicated. Only a subset of the problems might be graded if the assignment is especially long. Note, however, that you must study the concepts embodied in *all* problems whether graded or ungraded. Solutions to graded and ungraded problems will be posted at the course Moodle site. It is your responsibility to review the solutions and to understand and rectify any conceptual errors that you might have. You may contact me at any time for assistance.

If a homework grader is not assigned to the course, then only one or two graded problems per homework set will be carefully reviewed for content. The other problems will be assigned scores using a coarse rubric based primarily on apparent effort or might not be graded at all. The carefully graded problem(s) will not be identified beforehand.

Laboratory Policies

Policies and requirements for the laboratory portion of the course will be distributed with the first laboratory assignments. The lab policies document is an extension of this one. That is, the policies outlined there are part of the overall course policies.

Exams

The in-semester exams might be scheduled during lab sessions to allow more time to complete them. The exam schedule will be determined during the first week of the semester and confirmed early in the second week. Exams will be designed to take one hour to complete even if they are given during a 2-hour session. If the lab times are used, a traditional classroom will be used instead of the lab space. The lowest exam score (including the final exam) will be weighted only 5% and the others 20% for the purpose of determining the overall course grade. The final exam will be designed to be completed in much less time than the allotted three hours.

Time Commitment

Time allotted to coursework outside of class is guided by the university's expectations for academic engagement: "Courses at Bucknell that receive one unit of academic credit [like ECEG 350] have a **minimum** expectation of 12 hours per week of student academic engagement. Student academic engagement includes both the hours of direct faculty instruction (or its equivalent) and the hours spent outside of class on student work." During some weeks the work load could be greater than average, some weeks less, but it should average **at least** 7 hours per week beyond lecture and lab time. The total includes time spent on reading, homework, help sessions, lab exercises, exams, and any other course activity. If some aspect of the work seems to require an excessive amount of time, please let me know either directly or anonymously.

Accessibility and Accommodations

If you have or develop a medical condition or a documented or suspected learning disability that might affect your work in this course and for which you might require an accommodation, please contact the Office of Accessibility Resources (570-577-1188 or OAR@bucknell.edu) as soon as possible. Note that moving an exam or obtaining approval for extra completion time requires official coordination with OAR.

Bucknell and I support efforts to maintain mental health. If you are struggling and believe that it could affect your performance in this course, please contact Associate Dean Terri Norton (570-577-1800 or trn005@bucknell.edu) or me if you feel comfortable doing so. Working through official channels will enable me to provide resources and support. If you require immediate mental health assistance, call the Student Counseling Center at 570-577-1604; after business hours, call 570-577-1604 and choose option 2.

Scoring Rubric

The following rubric will be used to assign scores to most individual exam problems. The four numerical columns below apply to problems with total point values of 25, 20, 15, and 10, respectively. For problems with other total point values, scores will be scaled proportionately to the nearest whole number. Some problems could be scored using a different rubric or method.

25	20	15	10	Perfect or nearly perfect solution.
23	18	14	9	Minor math error; missing or incorrect unit in numerical answer; too few or too many significant figures in answer; rounding error; miscopied value.
19	15	11	7	Concept essentially understood, but solution contains a procedural or factual error; concept mostly but not completely understood; incorrect form of key equation; unit prefix error (e.g., mV instead of μ V); major math error.
13	10	8	5	Concept mostly understood, but solution contains several procedural or factual errors; concept only partially understood.
7	5	4	3	Solution contains a few steps in the right direction but is essentially incorrect; main underlying premise mostly misunderstood.
3	2	2	1	One or two relevant facts, equations, or diagrams are provided, but there is no attempt at a solution; main underlying premise is missed.

Typically, if more than one type of error that leads to ~75% credit (the “19, 15, 11, 7” category above) is present, then the score will drop to ~50% or ~25% of full credit, as appropriate.

Conflict and Lateness Policies

If you know that you will not be able to complete an assignment by its deadline or to take an exam at its scheduled time, **please notify me at least 48 hours in advance**. If you miss an exam, a major deadline, or other major activity due to illness, injury, or other misfortune, you must contact me as soon as possible. If a health professional or other relevant authority confirms the seriousness of your case, then your absence and/or missed deadline will be excused. In the case of an exam or other major graded activity, a make-up opportunity will be arranged.

Absences or delays due to job interviews, religious observances, participation in university artistic performances, participation in varsity athletic competitions, and extraordinary personal opportunities will normally be accommodated. However, in accordance with university policy, incomplete or late work due to personal travel plans under your control (especially around the times of recesses and final exam week) will not be accommodated. If possible, please provide me with a list of your expected absences early in the semester.

Unexcused absences or missed deadlines (e.g., due to oversleeping) will be handled on a case-by-case basis, probably in consultation with the Dean’s office. If you begin an exam after the start time, you must complete it in the remaining allotted time. However, you may not take the exam if you arrive after the first student has completed it and left the room; this policy includes the final exam. Such a situation is equivalent to missing the exam. If you miss an entire exam period due to an unexcused absence, you must notify me as soon as possible. Depending on the reason for the absence, a make-up opportunity of some kind *might* be offered. **However, regardless of the reason for the absence, the score will be reduced by 5 points (out of 100).** The second unexcused absence will result in a 15-point reduction, and further unexcused absences will likely result in a score of zero or at least a 15-point reduction.

Each student may request *one* 1-day homework deadline extension, but otherwise a 10% per day score reduction will be imposed for homework submitted after the deadline. Homework will not be accepted at all after the solutions have been posted. Adjustments will be made for extenuating circumstances.

Additional policies might be posted at the course web site. If so, they will be announced via the main web page and e-mail. You are responsible for knowing and adhering to any posted policies.

Statement of Support

I support the right of every student to define their own identity. If you prefer a specific set of pronouns and other forms of address or if you use a name that differs from the one that appears in the university’s records, please let me know.

The ECE Department values and respects all of our students, staff, and faculty regardless of race, ethnicity, nationality, gender, gender expression or sexual orientation, religion or belief system, economic status, or physical ability. We strive to offer a nurturing environment for learning, growth, inquiry, and the respectful sharing of ideas. By joining this community, all members commit to welcoming others in the same manner.

We appreciate and encourage your suggestions to help the ECE Department and the College of Engineering meet this commitment. If something occurs in class that makes you feel uncomfortable, please contact me. If you are not comfortable doing that, then please talk with someone else whom you trust. Resources could include your other instructors, the ECE Department chair (Stu Thompson, mst008@bucknell.edu), or Associate Dean of Engineering Terri Norton (trn005@bucknell.edu). Incidents of bias may be reported (anonymously, if you wish) online at <https://www.bucknell.edu/life-bucknell/health-wellness-safety/bias-incident-policy>. The Department and the College commit to supporting students expressing concerns and/or reporting bias and to ensuring that they are protected from repercussions of any kind.

Advice for Success

Many students find electronics to be a challenging subject. You will have to devote considerable time and energy to succeed in this course. You should attend all lectures and keep up with the reading. Homework assignments will be closely aligned with the assigned reading and could cover material discussed in class as little as two days before the due date. Start working on homework assignments early.

You **must** read the textbook and supplemental readings. My lectures are not a replacement for the assigned readings but instead are meant to expand on them and explain the more challenging aspects. After many years of teaching this course, I have observed that students who do not complete assigned readings tend to struggle significantly with the material. The readings fill in the details that I do not have time to cover in class and provide valuable reinforcement of the lecture topics. I acknowledge that no textbook is likely to be as engaging as the latest bestselling romance novel, but Sedra & Smith is a pretty good one and is widely used, and many students can learn a lot from it alone.

Homework and other out-of-class activities are for your benefit. Take advantage of the opportunity to practice solving problems on your own to improve your learning and retention. Choose active studying over passive studying. Instead of simply reading the examples and derivations given in the textbook or in class, work out at least some of them yourself. Your primary concern should be to understand the concepts and solution techniques presented in the course. Developing valid thought processes that lead to good solutions should be your goal. Arriving at the correct numerical answer is of secondary (although not least!) importance. If you obtain an answer that does not make sense physically (e.g., an answer that is orders of magnitude too large), I expect you to notice it. Above all, you should understand the operation of the various circuits that we cover in class; that is, you should know how they work.

Please contact me if you are struggling with any aspect of the course. If you think that you might be dealing with test anxiety, you should review the resources available on the Exams page at the course web site. They have been prepared by professional counselors and educators and comprise a rich and proven collection of advice for managing test anxiety. You should also consider consulting Bucknell's Student Counseling Center (570-577-1604).

Finally, consider this quote from NFL Hall of Fame wide receiver Jerry Rice:

"Today I will do what others won't, so that tomorrow I can do what others can't."

Final Thoughts and Teaching Philosophy

Hard work is a necessary but not sufficient requirement for succeeding in any endeavor, especially electrical and computer engineering. In ECEG 350, effort and comprehension are both important, but the aim of this course is for you to attain the essential knowledge and skills necessary to analyze and design basic electronic circuits and systems in a professional setting. Your final course grade will depend primarily on the degree to which you achieve the stated course outcomes, not necessarily on how hard you work.

That means that the effort that you put into this course should be intentional toward understanding how fundamental electronic circuits work and how you can adapt them to solve some of the technical problems that you will encounter in your career. This course cannot cover every aspect of the solution to every future circuit problem in its entirety. There are too many variables and special constraints in the real world. Engineering is almost never about simply finding the right equation and then inserting numerical values to arrive at a design. Often the engineer is called upon to produce new designs (and sometimes to derive new equations to model them) to deal with new challenges. A successful result is much more likely if the engineer has studied thoroughly how similar problems have been solved in the past. You should therefore view this course as a way to help you develop a set of tools that you can use as a starting point to craft exciting and innovative solutions to future problems.

Next, students sometimes ask professors why they "take off" points for this or that mistake on exams or other assignments. Please understand that professors never *remove* points. Instead, we *assign* points that reflect the quality of the work. Viewed another way, when a student takes an

exam, they do not start with 100 points and, by making mistakes, lose them. Instead, they start with zero points and, by demonstrating the development of their knowledge and skills, add them. You should approach your assignments as opportunities to show me how much you have grown as an electrical or computer engineer.

ECEG 350 covers some very important fundamental material that almost every electrical or computer engineer encounters. It is a prerequisite for ECEG 351, ECEG 442, and ECEG 461 and a required course for several ECE concentrations, but beyond that the course strives to make you familiar with the building blocks of almost every electronic device in use today – both digital and analog. I therefore want to help you succeed and thrive in this course. Although some of the expectations of the university were relaxed during the health crisis a few years ago, the expectations of your future employers are likely to be the same as they have always been. Moreover, the technical problems facing society have not diminished, nor have they been put on hold. On the contrary, they could be even more demanding now. You need all of the tools that you can gather.

If it seems that I am pushing you a little more than some of your other professors, that is why. My industry and sabbatical experiences have taught me that society is going to need your skills and is going to need you to be very good at them.

That being said, if there is anything that I can do to help you, or if you feel that the pace of the course is exceeding your ability to keep up, please let me know.