ECEG 497/697 Wireless System Design Spring 2025

Course Policies and Information

Objective

This course introduces students to the analysis, design, and characterization of wireless communication circuits, systems, antennas, and other hardware. This field of study is frequently referred to as RF and microwave engineering. The course also covers some fundamentals of RF circuit layout and special issues encountered when making RF/microwave measurements. Contemporary issues in RF and microwave engineering are also considered.

Course Outcomes

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

1. Design lumped-element impedance matching networks using L, T, and pi configurations.
2. Recognize and analyze basic receiver and transmitter system architectures.
3. Predict the frequency translation properties and image response of a frequency mixer circuit.
4. Calculate the S parameters of a linear two-port network given its circuit diagram.
5. Calculate system noise figure given the gain and noise figures of individual system stages.
6. Understand the relationship between minimum detectable signal (MDS), third-order intercept (TOI or IP3), and spurious-free dynamic range (SFDR) of an amplifier or receiver system.
7. Use a Smith chart to plot impedances and to perform basic transmission line and matching network calculations.
8. Manually and/or numerically calculate important performance characteristics of commonly used antenna types.

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 1–8

Instructor

Prof. David Kelley, 570-577-1313, dkelley@bucknell.edu

Office Hours

Times will be announced. Evening office hours, if any, will likely take place via Zoom.

Textbook

Steven W. Ellingson, *Radio Systems Engineering*, Cambridge University Press, 2016.
ISBN: 978-1107068285

Recommended Text

Thomas H. Lee, *Planar Microwave Engineering: A Practical Guide to Theory, Measurement, and Circuits*, Cambridge University Press, New York, NY, 2004. ISBN: 978-0521835268

Web Site

https://www.eg.bucknell.edu/~dkelley/eceg497

Prerequisite

ECEG 390 (concurrent prerequisite) or its equivalent or permission of the instructor

Health and Safety Protocols

Class 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 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 likely to be optional but recommended if the hospital admission level for Union County is high. 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, then they *might* be recorded for the purpose of making them available to students who miss the material due to absence; however, recordings are not guaranteed. 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 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 and deliverables produced for team exercises, if any, must be your own work. General discussion of solution techniques is okay, but copying 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 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). 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 online 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 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 my 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 attendance at lectures is not specifically required for this course, I do notice when you are missing. If you struggle in the course, I will point to any absences as a likely cause. Please note that 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 be directly applicable to 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 Determination

All undergraduate students' final course grades will be computed as shown below, although an individual student's weighted exam average must be greater than 50 out of 100 points to pass the course. Significant extra credit opportunities are not likely to be provided. Exam dates will be posted at the course web site.

Professional Conduct	5%	
Homework	15%	Weighted equally; lowest two scores dropped
Mini-Projects	15%	Lowest score weighted less than other(s)
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 with as much advance notice as possible.

Students taking the graduate version of the course (ECEG 697) will be required to complete enhanced versions of the mini-projects and one or two special individual assignments. Homework for graduate students will not be graded, but voluntary completion of homework assignments is highly recommended. Detailed grading criteria for graduate students will be distributed separately.

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 undergraduate and graduate final course grades.

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−	

Professional Conduct

Everyone in the classroom 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 a 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, conduct in the classroom and/or online 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.

Please contact me if you feel that any of these policies should be adjusted. Professional expectations change often, and practices that were once considered unacceptable sometimes 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, respond to discussion prompts, and complete assigned activities on your own.

Homework assignments will be posted at the course web site, and your completed work must be submitted by the indicated deadline. Please follow the formatting guidelines listed below. They are not meant to trip you up or to test whether you can follow instructions. Instead, they help ease the strain on your hard-working grader (me!), and they help ensure that you receive proper credit:

- At the top of the first page, add your name, the course number (ECEG 497), 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."
- Trim the fringe pieces if you use paper torn from a spiral notebook.
- You are not required to use green "engineering paper."
- For homework submitted online, 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 further reduce the file size and improve contrast. Check photos for glare that makes the text difficult to read. Make sure that the submitted images have good contrast and are not too large or too small. Some course management software, like Moodle, cannot adjust page size.

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.

Usually, only a subset of the assigned homework problems will be graded. Those problems will be clearly indicated. However, 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 with this task.

Mini-Projects

This course does not have a formal laboratory section, but small hardware-oriented or simulation-based projects will be assigned. The former will require you to use laboratory facilities and/or the Maker-E. The latter will make use of *Multisim*, *EZNEC*, or other software. One or more projects could involve a combination of hardware and software. Details regarding projects and their scoring criteria will be provided later. I will offer help sessions on a regular basis to provide assistance with assigned projects.

Exams

Three in-semester exams and one final exam will be scheduled. 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.

Conflict and Lateness Policies

If you know that you will not be able to complete an assignment by its deadline or 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, a make-up opportunity will be arranged.

Absences or delays due to job interviews, religious observances, participation in 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 upcoming performances, competitions, and/or religious holidays.

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 all of an exam 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 for the first unexcused absence. Further unexcused absences will likely result in a score of zero for the exam or assignment.

A 10% per day score reduction will be imposed for homework submitted after the deadline, but 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 e-mail and on the main web page. You are responsible for knowing and adhering to any posted policies.

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; not enough or too many significant figures in numerical answer; rounding error; miscopied value.
19	15	11	7	Concept essentially understood, but solution contains one or two procedural or factual errors; concept mostly but not completely understood; incorrect form of key equation; unit prefix error (e.g., mV instead of μV); 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 (such as equations) or diagrams are provided, but the solution is essentially incorrect or missing; 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.

Attendance Policy

The decision to attend class either in person or remotely is your responsibility. Although attendance at lectures is not specifically required for this course, I do notice when you are missing. If you struggle in the course, I will point to any absences as a likely cause. Please note that 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 be directly applicable to 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.

Time Commitment

Time allotted to coursework outside of class is guided by Bucknell University’s expectations for academic engagement: “Courses at Bucknell that receive one unit of academic credit [like ECEG 497] 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** 9 hours per week beyond class time. The total includes time spent on reading, homework, help sessions, exams, and any other activity related to the course. If some aspect of the work seems to require an excessive amount of time, please let me know either directly or anonymously.

I realize that sometimes special circumstances arise in a student’s senior year, mainly because of Senior Design and possible job or graduate school interviews. Those commitments are already accounted for in the structure of the fourth-year curriculum and therefore are not excuses for neglecting course work. Nevertheless, unusually busy periods can arise during the semester, and I will attempt to minimize the demands of this course during those times.

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 also 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 need immediate mental health assistance, call the Counseling & Student Development Center at 570-577-1604; after business hours, call 570-577-1604 and choose option 2.

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 safe 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 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 ECE Department and the College of Engineering commit to supporting students expressing concerns and/or reporting bias to empower them in any follow-up actions and to ensure that they are protected from repercussions of any kind.