ECET 364 Fundamentals of Electromagnetics

Course Information

- **ECET 36400 Fundamentals of Electromagnetics**
- **CRN 26652**
- **Meeting day(s) and time(s)**. MW: 9:30AM – 10:20AM KNOY B031
- **Instructional Modality** Hybrid
- **Course credit hours: 3**
- **Prerequisites: ECET 27700, PHYS 21900, MA22200**

Instructor Contact Information

- **Name: Eric E. Hoppenjans**
- **Office: Knoy 117**
- **Phone: 496-4718**
- **ehoppen1@purdue.edu**
  Due to large amount of SPAM, ALWAYS have ECET 36400 in the subject line; (i.e. subject: ECET 36400 – lab question).

- **Student consultation hours, times, and location** Office hours will be scheduled as needed, please use Microsoft Teams to schedule an appointment.

Course Description

This course introduces the fundamentals of electromagnetics in both theory and application. Wave propagation, transmission lines, port parameters, antenna theory, and antenna design are studied. Other topics include Maxwell's equations, propagation losses, RF signal measurement, impedance matching, and Smith chart applications.

Learning Resources, Technology & Texts

- **Required texts:** Wentworth, Stuart. M. (2007). *Applied Electromagnetics, Early Transmission Lines Approach*. Wiley Publishing. ISBN: 0-470-04257-5.
- **Course materials:**
  - 3-hole binder for course notes, handouts, and laboratories
  - Compass and a straight-edge (a ruler works for this)
  - 10 sheets of Smith chart paper (6 red-only, 4 red-green) – there are color printer ready versions on Brightspace
  - ECET Parts kits from previous courses
  - Electronics tools
  - Additional components as needed to complete student-designed circuits
- **Software/web resources**
  - **Microwave Office –** Download from: https://www.cadence.com/en_US/home/company/cadence-academic-network/university-program.html
- **The SOET Help Room** supports the academic achievement of Engineering Technology students by offering a consistent, centralized space for students to interact with graduate teaching assistants affiliated with their majors. The SOET Help Room is located in DUDL 5117 and is open Monday-Thursday from 3:30pm – 8:30pm, when classes are in session. Individual tutoring in math, science and select SOET courses are also available

through the Purdue Polytechnic BEST program. Contact Benito Martinez at marti249@purdue.edu for assistance. To view a list of support services across campus, search Brightspace for SOET NEWS. Click content in the home row and select the Student Support & Services folder. If you need additional assistance locating the support you need, reach out to Dyane Roesel, Assistant Director for Student Experience, at droesel@purdue.edu.

- **The Academic Success Center**, located in Wiley Hall, Room C215, provides a variety of proactive, practical and approachable academic support services for undergraduate students.
- **Visit Ask a Librarian** to connect with helpful resources and services provided by the Purdue Libraries and School of Information Studies for course assignments and projects.
- **Use of artificial intelligence (AI) or Large Language Models (LLM)**
    - Use of AI tools to generate code for homework, laboratory exercises, exams, quizzes are not permitted.
    - The use of AI tools can help students learning and thus encouraged if used in the following ways:
        - ✓ Drafting ideas on planning for projects
        - ✓ Generating ideas on approach to a problem
        - ✓ Help improve your grammar and writing
        - ✓ Experimenting different methods to solve a problem
    - Overreliance on AI tools can reduce your opportunities to improve your critical thinking and evaluation skills. However, if used appropriately, AI tools can help in providing you opportunity to build your critical thinking and evaluation skills by studying and critiquing the information the tools produced. Critical thinking and evaluation skills are skills that you need to be successful in this course and in your career.
- **Brightspace learning management system (LMS)**

1. Access the course via Purdue's Brightspace learning management system. Begin with the Start Here tab, which offers further insight to the course and how you can be successful in it. It is strongly suggested that you explore and become familiar not only with the site navigation, but also with content and resources available for this course. See the Student Services widget on the campus homepage for resources such as Technology Help, Academic Help, Campus Resources, and Protect Purdue.
2. *Using or attempting to use unauthorized materials, information, study aids, notes, or any other device in any academic exercise will not be tolerated. Unauthorized materials may include anything which or anyone who gives a student assistance that has not been approved by the instructor in advance. Use of AI tools to generate code for homework, laboratory exercises, exams, quizzes are not permitted. Any violations to this rule will be considered misconduct and addressed in the General Issues with misconduct section below.*

Learning Outcomes

By the end of the course, you will be able to:

1. Describe the basic properties of electromagnetic fields.
2. Analyze transmission lines and their properties.
3. Understand the use of Smith Charts.
4. Understand the use of S-parameters to describe and analyze RF components.
5. Use impedance matching techniques in RF circuits.
6. Analyze and describe antenna performance.
7. Use common RF and microwave measurement laboratory equipment.

Assignments

Homework will be assigned, collected and graded. Homework is due as designated on Brigthspace. All homework will be released and collected online using Brightspace. The submitted online homework needs to be scanned into PDF (via scan

or photo). Homework must be formatted as detailed to be graded. Late homework will not be accepted, and you will receive a zero for that assignment. Homework is worth 15% of your overall grade.

- **Homework:** All homework must follow the following guidelines to be graded.
  - Homework submissions should be on engineering paper (handwritten).
  - Name, should appear at the top right corner of the page. The assignment must also include Course and Instructor information if it submitted to the instructor's mailbox.
  - Submissions comprising multiple pages must be stapled.
  - All supporting work should be included. Do not skip steps.
  - If there are multiple possible methods of solving the problem or multiple possible solutions, indicate why the selected method was used.
  - All work should be neat and legible.
  - Answers should be clearly indicated.
  - Schematics should be included in the answer for clarity.
- **Quizzes:** There are no quizzes in this course
- **Expectations:** You are expected and encouraged to work with other students and to discuss on assignments. Program files and Prelab work May Not be shared, even if you participated in the generation of the work contained in the file. If you are working with someone to produce a file, then you must reproduce that file again on your own and in a different form. Any evidence of copied files will be treated as plagiarism, (cheating) and will result in a score of 0 for all parties on that assignment. A second instance will result in failure in the course, and referral to the Dean of Students.

  It is NOT acceptable to:
  1. Obtain another student's (past or present) work and submit it (or modify it and submit it) as your own.
  2. Use another student's lab hardware and use as your own for lab check off.
  3. Work as a group and then bring identical or even modified work from a common file to lab
  4. Appear to be looking at another student's test or quiz paper (unless permitted by the instructor)

  You are required by the instructor to satisfactorily explain the operation of your code.
- **Exams:** One one-hour exams will be given in the course during regularly scheduled lecture meetings. No make-up exams will be given. Students providing documentation supporting an excused absence may use the grade received for the final exam as replacement for the missed exam. This one-hour exam is worth 25% of your overall score.
- **Labs:** The lab syllabus is provided at the end of this document.

Grading Scale

Course grades will be determined based on the following scale:

A	90.0% or higher
B	80.0% or higher
C	70.0% or higher
D	60.0% or higher
F	less than 60.0%

Course grades are determined by the following breakdown:

Homework	15%
Laboratory	35%
Midterm Exam	25%
Final Exam	25%

A student must average at least 60% on the combined exams to pass the course.

A student must average at least 60% on laboratory activities to pass the course.

Scores will be posted on Blackboard and will be updated after each exam. See the Fall 2024 Add/Drop Calendar and the 2024-2025 Academic Calendar for deadlines. For example, in a 16-week fall 2024 course, each student must have up-to-date graded feedback before Tuesday, November 19th, and again before Monday, December 2nd.

- All labs have equal weighting in the score regardless of the points assigned to it (e.g. a 70 point lab is weighted equally to an 85 point lab).

Attendance Policy

This course follows the University Academic Regulations regarding class attendance, which state that students are expected to be present for every meeting of the classes in which they are enrolled. Attendance will be taken during each class using questions with i-clicker. When conflicts or absences can be anticipated, such as for many University-sponsored activities and religious observations, you should inform me of the situation as far in advance as possible. For unanticipated or emergency absences when advance notification to is not possible, contact me as soon as possible by email or phone. For absences that do not fall under excused absence regulations (see below), this course follows the following procedures:

1. If it is an emergency, please follow the University regulations on emergent medical care (see below). Other medical care that led you to be absent from class will be considered absent. I do not need details if you are ill, your medical condition is private, do not send me the information.
2. Unless it falls under the University excused absence regulations (see below), any work due should be submitted on time via our course Brightspace.
3. The most important consideration in any absence is how it will affect your achievement of the assignment objectives and the course learning outcomes.

For cases that fall under **excused absence regulations**, you or your representative should contact or go to the Office of the Dean of Students (ODOS) website to complete appropriate forms for instructor notification. Under academic regulations, excused absences may be granted by ODOS for cases of grief/bereavement, military service, jury duty, parenting leave, or emergent medical care. The processes are detailed, so plan ahead.

Course Schedule

Course schedule is in Brightspace under Course Calendar. It contains the topics to be covered in each lecture, the lab exercise, and the assignments due before each lecture.

Academic Integrity

Students who use AI-generated writing for any portion of their assignments will be deemed in violation of the academic integrity expectations for this course. Violations can include a failing grade for the course and restrictions from further class attendance. All suspected incidents of academic dishonesty will also be referred to the Office of Student Rights and Responsibilities for further review of the student's status with the University, which may include being separated from the University

Incidents of academic misconduct in this course will be addressed by the course instructor and referred to the Office of Student Rights and Responsibilities (OSRR) for review at the university level. Any violation of course policies as it relates to academic integrity will result minimally in a failing or zero grade for that assignment, and at the instructor's discretion may result in a failing grade for the course. In addition, all incidents of academic misconduct will be forwarded to OSRR, where university penalties, including removal from the university, may be considered. Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted

anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace under University Policies and Statements.

See the University Policies and Statements section of Brightspace for guidance on Use of Copyrighted Materials. Effective learning environments provide opportunities for students to reflect, explore new ideas, post opinions openly, and have the freedom to change those opinions over time. Students and instructors are the authors of the works they create in the learning environment. As authors, they own the copyright in their works subject only to the university's right to use those works for educational purposes Students may not copy, reproduce, or post to any other outlet (e.g., YouTube, Facebook, or other open media sources or websites) any work in which they are not the sole or joint author or have not obtained the permission of the author(s).

Using or attempting to use unauthorized materials, information, study aids, notes, or any other device in any academic exercise will not be tolerated. Unauthorized materials may include anything which or anyone who gives a student assistance that has not been approved by the instructor in advance. Use of AI tools to generate code for homeworks, laboratory exercises, exams, quizzes are not permitted. Any violations to this rule will be considered misconduct and addressed in the General Issues with misconduct section below.

Review the links to the

- Office of Student Rights and Responsibilities Academic Integrity webpage
- Use of Copyrighted Materials that link to a University Policy Office webpage.

Nondiscrimination Statement

Purdue University is committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. A hyperlink to Purdue's full Nondiscrimination Policy Statement is included in our course Brightspace under University Policies and Statements.

Accessibility

Purdue University strives to make learning experiences accessible to all participants. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone at 765-494-1247.

Mental Health/Wellness Statement

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try Therapy Assistance Online (TAO), a web and app-based mental health resource available courtesy of Purdue Counseling and Psychological Services (CAPS). TAO is available to ***all students at any time*** by creating an account on the TAO Connect website, or downloading the app from the App Store or Google Play. It offers free, confidential well-being resources through a self-guided program informed by psychotherapy research and strategies that may aid in overcoming anxiety, depression and other concerns. It provides accessible and effective resources including short videos, brief exercises, and self-reflection tools.

If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 a.m.- 5 p.m.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc., sign up for free one-on-one virtual or in-person sessions in West Lafayette with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is free and can be done on BoilerConnect.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS offices in West Lafayette or Indianapolis.

Basic Needs Security

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 a.m.-5 p.m. Monday through Friday. This is a list of other resources:

- ODOS services and information portal and the Critical Need Fund.
- Student of concern reporting (anyone on campus can submit a report if they are unsure where to go or in what way they can help a student - it does not need to be an emergency).
- The ACE Campus Food Pantry (open to the entire Purdue community)
- The Center for Advocacy, Response & Education (CARE) (open to all Purdue students) "provides support and advocacy for survivors of sexual violence, dating violence, and stalking.

Emergency Preparedness

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

A link to Purdue's Information on Emergency Preparation and Planning is located on our Brightspace under "University Policies and Statements." This website covers topics such as Severe Weather Guidance, Emergency Plans, and a place to sign up for the Emergency Warning Notification System. I encourage you to download and review the Emergency Preparedness for Classrooms document.

The first day of class, I will review the Emergency Preparedness plan for our specific classroom, following Purdue's required Emergency Preparedness Briefing. Please make note of items like:

- The location to where we will proceed after evacuating the building if we hear a fire alarm.
- The location of our Shelter in Place in the event of a tornado warning.
- The location of our Shelter in Place in the event of an active threat such as a shooting.

ECET 364 Fundamentals of Electromagnetics – Lab Syllabus

Lab Rules:

- ***No Food or Drink in the room***
- ***No conductive jewelry, watches, rings, etc… are to be worn when using any electric setup.***
- ***Safety glasses are to be worn when working with any electrical setups (not required for the software-only work).***
- ***Place the RF cables back on the rack grouped by size.***
- ***Take care of your equipment and leave a clean bench***

Other Important Items:

- Bring portable memory to store data, etc… in case of network problems.
- Use a 3-ring binder for lab instructions.
- A number of PC intensive software will be used in the lab, be sure not to open too many applications at the same time. Close unused applications for optimum PC operation.
- Save data early and often.
- READ the lab instructions and come prepared to lab.

Lab Activities

- The laboratory experience associated with this course is very important:
- ***All laboratory assignments must be completed to receive a passing grade. This includes the report.***
- ***The overall lab average must be 60% or better to pass the course.***
- Attendance is required. If you will miss lab, you must make arrangements ***prior*** to your scheduled lab time to make-up the work.
- Laboratory activities are worth 35% of your overall course grade.

The following list of equipment, material and components is not 100% so read the labs to make sure you have the appropriate material.

1. Circuit breadboard
2. Breadboard hookup wires:
    a. Quantity: 5-6, long 8-12 inches for power supply hookup (banana plugs not recommended)
    b. quantity: 'lots', short lengths for circuit wiring
3. Scope Cables (minimum of 2)
4. Miscellaneous:
    a. Safety glasses

Outline of the lab period:

1. Lab period begins – all will be present and ready to work.

Late penalties for arrival:

a. 5-10 minutes late will receive a 5% overall lab deduction.
b. 10-20 minutes late will receive a 10% overall lab deduction.
c. 20-30 minutes late will receive a 15% overall lab deduction.
d. More than 30 minutes late and you will receive a 50% overall lab deduction.
e. More than 60 minutes late or miss lab – Now you have a problem that may impact your ability to pass the course.

NOTE: Additional points may be lost due to the failure to complete the lab during the allotted period.

2. Prelab is due at the beginning of lab (if the lab has one)
3. First 10 minutes of lab is the instructor's time (if needed). It will be used to explain the purpose and 'Big Picture' to make lab corrections, detail potential problems, etc.
4. The lab begins. The labs are designed to be completed in the allotted time for a 'typical' student.
5. The student may leave upon successful completion of the lab.

Prelab

Always, **READ** the lab and come prepared.

The prelab is the work that must be performed before the lab period. Most laboratory activities will require the completion of prelab material. Each student is required to perform their own prelab, which may not be shared with others in the course. Evidence of such will result in a zero on the prelab for all individuals involved. More than one incident will result in failure of the course for cheating. The points for the prelab will vary and are detailed on the lab coversheet.

Lab

The lab will be performed as outlined in the lab procedure. You may decide how to approach the lab in any way you'd like.

As the lab is performed:

- Open a Lab Data Report using Word and/or EXCEL spreadsheet. These documents will receive all the data from your lab work in a clear, detailed and organized way. It may require a table be created and data entered, calculations, screen captures, plots generated (via MATLAB or EXCEL), which are all cut and pasted into the document (EXCEL tables can be cut and pasted into Word).
- These materials are important for efficient instructor review of the material. It is also necessary for saving this information for a report, subsequent lab, or in case of lost or incorrect scoring. You will only need to print out and hand in the 'Lab Data Report' in which you have cut and pasted the results, and answers to questions/tasks of that lab.
- Check offs will be given as portions of the lab are completed and the required information is neatly and clearly placed in your documents. A check off signifies:
    - A task was properly performed or meets a given specification (within stated tolerances).
    - That answers to questions or other tasks are complete, but points assessed for correctness will be graded later. Most questions/tasks of this nature are worth 2-5 pts each.
- All the points for a given lab will be added and a percentage calculated for the final score.

Lab Data Report Format:

- The format for Data Reports is simple. REPORT all the data, measurements, plots, tables, etc that were detailed in the lab.
- All plots and tables must be properly labeled with captions. The plots must have axis labels and units. The tables must have column/row headings with units. Extra points will be deducted for improper captions, labels, units.... Material needs to be cited (author and source) if from an outside source or points will be deducted.
- Answers to questions must be complete sentences and grammatically correct. Points will be deducted for grammar.
- The data need to be organized in a coherent and logical manner. Large plots or screen captures can be reduced in size (but not tiny!)

Problems outside of the hands of students (such as equipment, PC, etc…) can be addressed by the instructor and the student. However, problems due to student capability, such as failure to bring proper equipment, failure to setup circuit (ECET 22700 'errors'), etc… will not.

Lab Report Structure

Report dues dates will be announced at the start of each lab.

- Lab reports will be written using a word processor with:
- Single spaced lines
- 12 pt. Font (Times New Roman).
- Margins: 1 inch for left and right and 1 inch for top and bottom (This is standard default for Word, just like what you are viewing now).

The lab report will follow a certain format as follows:

1. First page: The lab cover page with checkoffs for each student.
2. Second page: Start of lab report – see following section for details.
3. Attached: Prelab (if the lab required one).

Late lab report penalties:

a. 1 day late will receive a 10% overall lab report deduction.
b. 1-2 days late will receive a 25% overall lab report deduction.
c. 2-3 days late will receive a 50% overall lab report deduction.
d. More than 3 days late, now you have a problem that may impact your ability to pass this course.