

UNIVERSITY OF TEXAS AT EL PASO
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

EE4389 HIGH RESOLUTION RADAR
EE5389 RADAR SIGNAL PROCESSING
Tuesday and Thursday 9:00-10:20 PM

Instructor: Dr. Benjamin C. Flores
Online Office Hours: By appointment. Allow one day for scheduling
E-mail: bflores@utep.edu

Course Description: In the first semester of this two-course sequence, you will learn basic aspects of RADAR (Radio Detection and Ranging) theory and the signal processing required to obtain Doppler and range information from targets. In the second semester, you will learn about radar imaging techniques using wideband signals. Techniques studied include synthetic high-resolution radar, inverse synthetic aperture radar, and synthetic aperture radar.

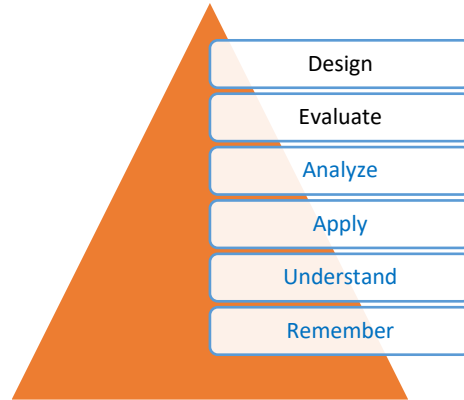
Prerequisites: EE3321 Electromagnetic Fields with a grade of "C" or better. Before starting the semester, review the following topics:

1. Fourier transform
2. Signal convolution
3. Circuit transfer function
4. Electromagnetic wave propagation

ABET: EE4389 is a senior elective course that builds on topics covered primarily in junior required courses. It is one of a menu of courses normally taken by students seeking a concentration in "fields, energy, and devices." It may also be taken as an elective by students seeking additional breath in the curriculum or students on the fast track to the MSEE.

Learning Outcomes: From an educational perspective, you are expected to *remember* (recall facts and basic concepts), *understand* (explain ideas and concepts), *apply* (use information in new situations), and *analyze* (draw connections among ideas). This is part of a taxonomy that describes your depth of knowledge as shown in the figure below.

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Undergraduate students are expected to master the four lower levels of this taxonomy. Graduate students must be able to evaluate and design radar systems.

This course is co-listed as EE4389 and EE5389. For the benefit of senior students who are on the fast track to Graduate School and wish to have a full year of radar study, the course is offered every third semester with alternating sets of learning outcomes. Students may enroll in EE4389 or EE5389 the first time, and EE5389 or EE4389 the second time to earn both undergraduate and graduate credits. You may not take the course again if the material to be covered is the same.

Consequently, by the end of the first semester, you will be able to:

Semester 1

1. Understand and apply the radar range equation.
2. Analyze radar signals in the time and frequency domains.
3. Apply Fourier Transform techniques and analyze Doppler frequency information.
4. Apply Matched Filter techniques and analyze obtain range information.

By the end of the second semester, you will be able to:

Semester 2

1. Understand radar fundamentals
2. Characterize wideband signals
3. Apply Synthetic High-Resolution techniques
4. Understand imaging concepts
5. Analyze Inverse Synthetic Aperture Radar (ISAR) systems
6. Analyze Synthetic Aperture Radar (SAR) systems

Reading Assignments: I will post selected chapters from multiple books. These materials are copyrighted so you may not share them or make multiple copies of them.

Slide presentations: I will post slides used in class on Blackboard.

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Class Attendance and Participation: Attendance is an essential component of this course. I expect you to come to all lecture sessions. You are also encouraged to participate in class. Remember these two key points:

- Attendance is associated with degree attainment
- Failing a course decreases your chances of earning a degree

Study Habits: For every week of class, you are expected to dedicate at least six (6) hours of study until you understand the material and finish your homework assignment. This is a standard expectation. Thus, you should study approximately 6 hours per week. Time on task is essential for your success!

Study Strategy: Dedicating time and effort to this course can be achieved systematically. The process is simple, but it requires your commitment. As a college student you should strive to:

1. Review assigned reading materials and slides **before** each class period.
2. Attend class and participate in discussions.
3. Solve team problems assigned in the classroom.
4. Turn in a “muddy point” note at the end of the class period.
5. Review class notes before taking quizzes.
6. Do your MATLAB assignments and turn in reports on time.
7. Reflect on what you learned and need to improve upon.

The above is a cycle that a good engineer student commits to practice. As the saying goes: **practice makes perfect**. The expectation is that you will do your best. Your final grade should reflect this effort.

Course Materials: The following items are required for the course:

- 1 ½ inch, three-ring binder to keep homework problems, exams, and MATLAB assignment.
- Graphics or scientific calculator.

Calculator Usage: Bring a scientific calculator to class.

MATLAB Projects: You will use MATLAB to perform power calculations, waveform simulations, Doppler processing, and high-resolution range processing, and imaging. You will receive a handout for each assignment and be asked to submit a report with the items described in the handout. This will include your MATLAB script, which must be your own and be ready to be tested.

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Study Groups: I encourage you to find a study partner. You may get together to discuss lectures and project assignments. However, I expect your solutions to be a truly individual effort.

Tutoring Websites: The use of tutoring websites such as chegg.com is prohibited. All work submitted for grading must be strictly your own.

Quizzes: We will have regular quizzes in lieu of homework. You may not communicate with any of your peers during quiz time or share information about the quiz after you have taken it.

Grading: Grades for each assignment and quiz will be posted on Blackboard. An unweighted average will be provided for reference. However, your final score will be determined with the following point distribution:

Quizzes	50 points
MATLAB projects	<u>50 points</u>
Total	100 points

There will be no negotiation on points earned. If you feel that a grading error was made, I will review the case *individually*. Remember you earn your grade based on the work you do.

EE4389 Graduate Credit Requirement: All projects will have an additional exercise that graduate students must complete to show additional understanding and cognitive skills.

Cell Phone Etiquette: Please set your phone to do not disturb mode before class. Use of the phone in class is prohibited unless instructed otherwise.

Note: This syllabus is subject to minor changes as determined by the instructor. Any such changes will be posted promptly.

Prepared by Prof. Benjamin C. Flores

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INSTITUTIONAL POLICY

Academic Integrity and Professional Ethics. Every college student must abide by professional and academic integrity rules. I expect nothing but the best from you. However, I will not hesitate to report all cases of misconduct to the **Office of Student Conduct and Conflict Resolution**. Check the OSCCR website for UTEP's policy on academic dishonesty. Also, carefully review the IEEE (Institute of Electrical and Electronic Engineers) code of ethics below.

Learning Disabilities. The UTEP (University of Texas at El Paso) Center for Accommodation and Support Services (CASS) was established for the purpose of providing appropriate and reasonable accommodations as mandated in Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA). If you have needs regarding learning disabilities, please help me to help you by reporting those needs the first week of classes.

Discrimination. Members of the UTEP community are protected from discrimination and harassment by State and Federal Laws. Discrimination on campus based on age, gender, race, ethnicity, genetic information, national origin, religion, veteran's status, disability, sexual orientation, or gender identity is prohibited.

Handgun Carry. HB1927 made it legal in Texas for most people 21 or over to carry a handgun in a holster without a permit both openly and/or concealed. However, open carry is prohibited on campus. The instructor reserves the right not to engage individuals or allow anyone into his office and research laboratory who carries a concealed weapon. The instructor will provide oral notice as needed. See [https://www.utep.edu/campuscarry/ Files/docs/CC Students.pdf](https://www.utep.edu/campuscarry/Files/docs/CC_Students.pdf).

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IEEE Code of Ethics

We, the members of the IEEE, in recognition of the importance of our technologies in affecting the quality of life throughout the world, and in accepting a personal obligation to our profession, its members and the communities we serve, do hereby commit ourselves to *the highest ethical and professional conduct* and agree:

1. to hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices, and to disclose promptly factors that might endanger the public or the environment;
2. to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;
3. to be honest and realistic in stating claims or estimates based on available data;
4. to reject bribery in all its forms;
5. to improve the understanding by individuals and society of the capabilities and societal implications of conventional and emerging technologies, including intelligent systems;
6. to maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations;
7. to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;
8. to treat fairly all persons and to not engage in acts of discrimination based on race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression;
9. to avoid injuring others, their property, reputation, or employment by false or malicious action; and
10. to assist colleagues and co-workers in their professional development and to support them in following this code of ethics.