
ESET 4205/4105:01L, Sensors and Instrumentation Lecture and Lab
Spring 2026

Course Syllabus

Instructor:	Maria F. Villa-Bracamonte, Ph.D. E-Mail: mbracamonte@tamus.edu
	Student emails will receive a reply within one business day.
Class Modality:	Face to Face (F2F)
Credit Hours:	3 Credits (Lecture) +1 Credit (Lab)
Meeting Time and Place:	Lec.: Tuesday 11:00 AM - 12:45 AM, Lab: Thursday 11:00 AM – 1:45 PM, Room: STEC 245
Class Duration:	01/20 – 05/07
Course Website:	https://tamus.blackboard.com
Office Hours:	Email the professor for communication to zoom meeting (Mon – Sun)

Catalog Course Description: Fundamental technology and practical applications of sensors. Capacitive, inductive, optical, electromagnetic, and other sensing methods are examined. Instrumentation techniques incorporating computer control, sampling, and data collection and analysis are reviewed in the context of real-world scenarios.

Prerequisites: ESET 3301, **Corequisite:** ESET 4105.

Course Contents: (*Subject to change based on relevance and time)

- Sensor classification and characteristics.
- Physical principles of sensing.
- Sensor materials and technologies.
- Signal conditioning and sensor interfacing.
- Sampling, Digital Devices, and Data Acquisition.
- Working principles, measurements of physical quantities and applications of different types of sensors:
 - Position, displacement, and level
 - Velocity, acceleration, and motion
 - Pressure and force
 - Temperature
 - Humidity and moisture
 - Light and radiation

Course Objectives:

- Describe the working principles of different types of sensors,
- Evaluate the technological and physical limitations of a specific sensor,
- Propose a suitable sensor for a given measurement situation,
- Design an integrated sensor system with different types of sensors.
- Explain the importance and state-of-the-art uses of sensors and instrumentation within the context of engineering, science, and technology.
- Explain technical designs using written reports and oral presentations.

Learning Outcomes:

After taking this course, students are expected to have attained the following knowledge and abilities to:

- Understand the concept of transduction and methods of extracting information from sensors;
- Analyze sensor outputs through the use of analogue circuit concepts;
- Understand typical electronic instrumentation for sensors and important concepts such as calibration and references;
- Demonstrate knowledge in the state of the art of sensors for a wide range of applications in research and commercial products;
- Demonstrate familiarity with a wide range of sensors and instrumentation from electrochemical to optical.
- design and set up measurement systems and do the tests

Required Materials:

Textbook:

- [1] J. Fraden. *“Handbook of Modern Sensors. Physics, Designs and Applications”*, Springer.
- [2] R. B. Northrop, *“Introduction to Instrumentation and Measurements”*, ISBN 9781138071902, CRC Press.
- [3] A. S. Morris and R. Langari, *“Measurement and Instrumentation: Theory and Application”*, 3rd edition, 2020, ISBN: 978-0-12-817141-7, Elsevier Inc.

Blackboard: Connect to <http://tamusa.blackboard.com>. You will have lecture notes, solutions to problems, multimedia materials, and other supplementary materials in Blackboard. All class communications will be through Blackboard, and students should monitor this several times a day.

Time Expectation for coursework: You are expected to spend 3-6 hours per week for the course. Based on the background, some student may require more time. Time spent may be longer when assignment/exams are due.

Course Grades and Policies:

- Final grades will be assigned using the weighted average of the following components.
- The instructor reserves the right to adjust the grading scale and/or weights based on the difficulty of work assigned throughout the semester.
- **Lecture Grading Policy**

- **Class works 30 %:** Quizzes 10%, Homework & Computer Assignments 20%.
- **Final Project 20%:** (Details under Final Projects Tab)
- **Exams 50%:** (15%, 15%, 20%)

- **Lab Grading Policy**

- **Attendance 10%:** it is a must.
- **Lab works 35%:** Run the experiments
- **Quizzes 10 %:** Be on time
- **Technical Reports 35%*:** Lab work must be completed to submit the technical report.
- **Technical Discussion 10%:** Discussion in lab works and technical reports.

* Students who do not attend and complete the laboratory session will not be permitted to submit the corresponding technical report.

Course grades are awarded as follows:

A: Over 90.0%; B: 80.0 ~ 89.99%; C: 70 ~ 79.99%; D: 60.0 ~ 69.99%; F: less than 59.99%.

- **HomeWorks:** to be assigned on each lecture, falling mainly into computational, analytical, and simulations exercises, in addition to research questions.

- **Lab Report:** Due every Wednesday next week. Laboratory Report Format and Guidelines + General Rubrics covered first day of Lab and can be found at blackboard as “Rubric Review”.
- **Quizzes:** quizzes will be applied at 11:05 each Thursday (duration approximately 5-10min). No late arrivals and no make-up quizzes will be allowed
- **Attendance:** After the quiz has ended, no students will be allowed to enter the classroom. Students must arrive **on time** in order to take the quiz and present lab work.
- **Final Project:** To pass this class, students must prepare a report and present it during Finals Week. Students will work in teams (if possible, 1-2 students/team). Each team will identify (or use previous) a practical electronic engineering project (e.g., research, prototype, product, or design) and submit their project plan with a timeline at week 10 to the instructor for approval. Each team will have to submit a report that describes and analyzes the main findings (Week 14-15) and present the work in Class (during finals week). The Report should not exceed 10 pages double-spaced, 12 font sizes with 1-inch margins, and the Final presentation should not exceed 25 slides. The project should demonstrate the student's ability to transfer the knowledge and skills acquired in the course to real-world applications.
- **Exams:** There will be two (3) exams during the semester: all to be taken at the scheduled date, time, and location (in Class)/ no makeup allowed! Final exams cannot be rescheduled or missed.

- **Schedule of Exam and content**

Exam# (%)	Content	Time allowed	Format	Tentative Date
Exam1 (15%)	Topics 1-5	90 minutes	Long Answer Questions	Week 6, Tuesday in Class from 11:05 am
Exam2 (15%)	Topics 6-10	90 minutes	Long Answer Questions	Week 12, Tuesday in Class from 11:05 am
Final (20%)	All topics	120 minutes	Long Answer Questions	Week 15, Tuesday in Class from 11:05 am

Examinations and assignments: There will be multiple assignments and exams during the semester. The assignments and exams will consist of conceptual multiple-choice, problem-solving, and short essay questions. The assignments /exam materials will come from lecture notes, the text, and class discussions. Questions will emphasize understanding and applications of concepts and topics covered in class. Exams will be in person during class time.

Make up and Late Assignment/exam/quiz policy: As a general rule, make-ups or late submissions will **NOT** be offered or accepted for any missed assignments/exams/quizzes. Late submissions or makeups may be accepted/administered only in extraordinary circumstances such as an excused official university activity, a severe illness, or a dire emergency. However, you must provide comprehensive documentation either before or within a few days of the missed assignment/quiz/exam.

Class conducts and civility code: Everyone in class is expected to follow all rules in the student handbook, as well as common courtesy during classroom lectures and discussions in class and online, including the following:

1. Attendance may be taken at the beginning or the end of the class. A vital part of every student's education is regular attendance of class meetings.
2. It is the students' responsibility to obtain and be able to use the required materials and software for this class.
3. Students should regularly check the Course Calendar, Announcements, and Messages (e-mail) systems in Blackboard.
4. Students should be prepared to turn in their assignments' solutions and must be uploaded to BB by their due date and time. **No late assignments will be accepted, nor are make-ups allowed.**

5. If you cannot submit answers to any assignment online and are within the deadline. You can only get credit for your work by emailing the instructor your completed assignment. As possible, take pictures/snapshots of the issue faced online so it can be addressed.
6. Student must retain copies of all assignments and graded work for verification purposes and provide it to the instructor, if necessary. Keep own copies of all computer files and e-mails till final grade is received.
7. Talking while the instructor is lecturing is extremely disruptive and discourteous to the instructor and other students.
8. Using computers or phones (except for a valid urgent need) during class for a purpose not related to class is disruptive. All cell phones and gadgets should be turned OFF and headphones removed.
9. For any questions about the exams and assignments, a student should contact the instructor, well in advance of the day they are due, so the instructor may have enough time to provide feedback.
10. All communications will be via e-mail communications to the Texas A&M University e-mail account, and students are expected to use their school provided email account. The instructor will reply to a student e-mail messages and voice messages within 2 business days (Monday-Friday).
11. For all classwork, exams, quizzes, etc., if a student is completing it off-campus, they are responsible for the availability of internet connectivity. Extensions will **not** be granted for lack of availability of internet connections.

Submission window may close or marked late, even if late by one second. Anyone violating these policies may be subject to disciplinary actions.

Broader Use of Generative AI Permitted Within Guidelines: Artificial intelligence (AI) tools, including ChatGPT, are permitted in this course for students who wish to use them. To adhere to our scholarly values, students must cite any AI-generated material that informed their work (this includes in-text citations and/or use of quotations and in your reference list). Using an AI tool to generate content without proper attribution qualifies as academic dishonesty and violates Texas A&M-San Antonio's standards of academic integrity.

Tentative Schedule

Module (Week)	Module Title	Lab	Exam/Assignment/Lab
1	Presentation, introduction and review rubric	Introduction and rubric review	
2	Overview: sensors, transducers and actuators	Lab 1: Circuits, Wheatstone bridge	
3	Performance characteristics of sensors and actuators	Lab 2: Kirchoff's laws	Lab 1 due Wednesday(04 Feb)
4	Temperature sensors and thermal actuators	Lab 3: Superposition theorem	Lab 2 due Wednesday(11 Feb)
5	Optical sensors	Lab 4: Thevenin's and Norton's theorems	HW2 due(16 Feb)/Lab 3 due Wednesday(18 Feb)
6	Electric and magnetic sensors	Lab 5: Capacitance, RL and RC circuits	Exam 1(Tuesday 24 Feb)/Lab 4 due Wednesday(25 Feb)
7	Mechanical sensors	Lab 6: RLC circuit: time- and frequency- response	Lab 5 due Wednesday(4 Mar)
8	(SPRING BREAK March9- March14)	No Lab	Lab 6 due Wednesday(11 Mar)
9	Acoustic sensors Final Project Decision Completed by students w timeline and Team and Application	Lab 7: Phasors	
10	Chemical sensors	Lab 8: Rectification and filtering, and transistor as control element	Lab 7 due Wednesday(25 Mar)/Final Project Abstract Submission due/
11	Radiation sensors	Lab 9: Temperature sensors	Lab 8 due Wednesday(01 April)
12	MEMS and smart sensors	Lab 10: Light sensors	Exam 2(Tuesday 07 April)/Lab 9 due Wednesday(08 April)
13	Interfacing methods and circuits	Lab 11: Linear position or force applications	Lab 10 due Wednesday(15 April)
14	Interfacing to microprocessors	Lab 12: Comprehensive lab	Lab 11 due Wednesday(22 April)
15	Review+ Final Project Report Due (by the end of the week)	No Lab/Final project preparation	Exam 3(Tuesday 28 Feb)/Lab 12 due Wednesday(29 April)
16	Final Project Presentation per team	No Lab	During Final Schedule each team gets 1hr to present their findings

IMPORTANT POLICIES AND RESOURCES

Academic Accommodations for Persons with Disabilities: Texas A&M University-San Antonio is committed to providing all students with reasonable access to learning opportunities and accommodations in accordance with The Americans with Disabilities Act, as amended, and Section 504 of the Rehabilitation Act. If you experience barriers to your education due to a disability or think you may have a disability, please contact Disability Support Services in the Central Academic Building, Suite 210, or at (210) 784-1335 or visit <https://www.tamusa.edu/index.html> or email us at dss@tamusa.edu. Disabilities may include, but are not limited to, attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability-related needs with Disability Support Services and their instructors as soon as possible.

Academic Learning Center: The Academic Learning Center provides free course-based tutoring to all currently enrolled students at Texas A&M University-San Antonio. Students wishing to work with a tutor can make appointments through the Brainfuse online tutoring platform. Brainfuse can be accessed in the *Tools* section of Blackboard. You can contact the Academic Learning Center by emailing tutoring@tamusa.edu, calling (210) 784-1307, or visiting the Central Academic Building, room 202.

Counseling/Mental Health Resources: As a college student, there may be times when personal stressors interfere with your academic performance and/or negatively impact your daily functioning. If you are experiencing emotional difficulties or mental health concerns, support is available to you through the Student Counseling Center (SCC). To schedule an appointment, call 210-784-1331 or visit Madla 120. All mental health services provided by the SCC are free and confidential (as the law allows). The Student Counseling Center provides brief individual and group therapy, crisis intervention, consultation, case management, and prevention services.

Crisis support is available 24/7 by calling the SCC at 210-784-1331 (after-hours select option '2'). For more information and self-help resources, please visit www.tamusa.edu/studentcounseling

Emergency Preparedness: JagE Alert is Texas A&M University-San Antonio's mass notification. In the event of an emergency, such as inclement weather, students, staff and faculty, who are registered, will have the option to receive a text message, email with instructions and updates. To register or update your information visit: <https://tamusa.bbcportal.com/>. More information about Emergency Operations Plan and the Emergency Action Plan can be found here: <https://www.tamusa.edu/about-us/campus-information/safety/university-police-department/documents/emergency-operations-plan.pdf> and <https://www.tamusa.edu/about-us/campus-information/safety/university-police-department/documents/emergency-action-plan.pdf>. Download the SafeZone App for emergencies or call (210) 784-1911. Non-Emergency (210) 784-1900

Financial Aid and Verification of Attendance: According to the following federal regulation, 34 CFR 668.21: U.S. Department of Education (DoE) Title IV regulation, a student can only receive Title IV funds based on Title IV eligibility criteria which include class attendance. If Title IV funds are disbursed to ineligible students (including students who fail to begin attendance), the institution must return these funds to the U.S. DoE within 30 days of becoming aware that the student will not or has not begun attendance. Faculty will provide the Office of Financial Aid with an electronic notification if a student has not attended the first week of class. Any student receiving federal financial aid who does not attend the first week of class will have their aid terminated and returned to the DoE. Please note that any student who stops attending at any time during the semester may also need to return a portion of their federal aid.

Writing, Language, and Digital Composing Center: The Writing, Language, and Digital Composing Center supports graduate and undergraduate students in all three colleges as well as faculty and staff. Tutors work with students to develop reading skills, prepare oral presentations, and plan, draft, and revise their written assignments. Our language tutors support students enrolled in Spanish courses and students composing in Spanish for any assignment. Our digital studio tutors support students working on digital projects such as eportfolios, class presentations, or other digital multimedia projects. Students can schedule appointments through JagWire under the Student Services tab. Click on “Writing, Language, and Digital Composing Center” to make your appointment. The Center offers face-to-face, synchronous online, and asynchronous digital appointments. More information about what services we offer, how to make an appointment, and how to access your appointment can be found on our website at <https://bit.ly/WLDCCenter>.

Meeting Basic Needs: Any student who has difficulty affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live, and believes this may affect their performance in the course, is urged to contact the Dean of Students (DOS@tamus.edu) for support. Furthermore, please notify the professor if you are comfortable in doing so. This will enable them to provide any resources they may possess.

Military Affairs: Veterans and active-duty military personnel are welcomed and encouraged to communicate, in advance if possible, and special circumstances (e.g., upcoming deployment, drill requirements, disability accommodations). You are also encouraged to visit the Patriots’ Casa in-person room 202, or to contact the Office of Military Affairs with any questions at military.va@tamus.edu or (210)784-1397.

Religious Observances: Texas A&M University-San Antonio recognizes the diversity of faiths represented among the campus community and protects the rights of students, faculty, and staff to observe religious holidays according to their tradition. Under the policy, students are provided an opportunity to make up any examination, study, or work requirements that may be missed due to a religious observance provided they notify their instructors before the end of the second week of classes for regular session classes.

The Six-Drop Rule: Students are subject to the requirements of Senate Bill (SB) 1231 passed by the Texas Legislature in 2007. SB 1231 limits students to a maximum of six (6) non-punitive course drops (i.e., courses a student chooses to drop) during their undergraduate careers. A non-punitive drop does not affect the student’s GPA. However, course drops that exceed the maximum allowed by SB 1231 will be treated as “F” grades and will impact the student’s GPA.

Statement of Harassment and Discrimination: Texas A&M University-San Antonio is committed to the fundamental principles of academic freedom, equality of opportunity and human dignity. To fulfill its multiple missions as an institution of higher learning, A&M-San Antonio encourages a climate that values and nurtures collegiality and the uniqueness of the individual within our state, nation, and world. All decisions and actions involving students and employees should be based on applicable law and individual merit. Texas A&M University-San Antonio, in accordance with applicable federal and state law, prohibits discrimination, including harassment, on the basis of race, color, sex, religion, national origin, age, disability, genetic information, veteran status, sexual orientation, gender identity, gender expression, or pregnancy/parenting status. Individuals who believe they have experienced harassment or discrimination prohibited by this statement are encouraged to contact the appropriate offices within their respective units.

Texas A&M University-San Antonio faculty are committed to providing a safe learning environment for all students and for the university as a whole. If you have experienced any form of sex- or gender-based discrimination or harassment, including sexual assault, sexual harassment, domestic or dating violence, or stalking, know that help and support are available. A&M-San Antonio’s Title IX Coordinator can support those impacted by such conduct in navigating campus life, accessing health and counseling services, providing academic and housing accommodations, and more. The university

strongly encourages all students to report any such incidents to the Title IX Coordinator. Please be aware that all A&M-San Antonio employees (other than those designated as confidential resources such as counselors and trained victim advocates) are required to report information about such discrimination and harassment to the university. This means that if you tell a faculty member about a situation of sexual harassment or sexual violence, or other related misconduct, the faculty member must share that information with the university's Title IX Coordinator (titleix@tamusa.edu, 210-784-2061, CAB 439K). If you wish to speak to a confidential employee who does not have this reporting requirement, you can contact the Student Counseling Center at (210) 784-1331 or visit them in Madla 120.

Pregnant/Parenting Students: Texas A&M-San Antonio does not require a pregnant or parenting student, solely because of that status or issues related to that status, to (1) take a leave of absence or withdraw from their degree or certificate program; (2) limit the student's studies; (3) participate in an alternative program; (4) change the student's major, degree, or certificate program; or (5) refrain from joining or cease participating in any course, activity, or program at the University. The university will provide reasonable accommodations to pregnant students that would be provided to a student with a temporary medical condition and that are related to the health and safety of the student and the student's unborn child. These could include maintaining a safe distance from substances, areas, and activities known to be hazardous to pregnant individuals and their unborn child; excused absences because of illness or medical appointments; modified due dates for assignments; rescheduled tests/exams; taking a leave of absence; and being provided access to instructional materials and video recordings of lectures for excused absences, if these would be provided to any other student with an excused absence. Pregnant/parenting students are encouraged to contact the Title IX Coordinator with any questions or concerns related to their status (titleix@tamusa.edu; 210-784-2061; CAB 439K).

Texas A&M-San Antonio has also designated the Title IX Coordinator as the liaison officer for current or incoming students who are the parent or guardian of a child younger than 18 years of age. The Title IX Coordinator can provide students with information regarding support services and other resources.

Students' Rights and Responsibilities: The following statement of students' rights and responsibilities is intended to reflect the philosophical base upon which University Student Rules are built. This philosophy acknowledges the existence of both rights and responsibilities, which is inherent to an individual not only as a student at Texas A&M University-San Antonio but also as a citizen of this country.

Students' Rights

1. A student shall have the right to participate in a free exchange of ideas, and there shall be no university rule or procedure that in any way abridges the rights of freedom of speech, expression, petition, and peaceful assembly as set forth in the U.S. Constitution.
2. Each student shall have the right to participate in all areas and activities of the university, free from any form of discrimination, including harassment, on the basis of race, color, national or ethnic origin, religion, sex, disability, age, sexual orientation, gender identity, gender expression, genetic information, or veteran status in accordance with applicable federal and state laws.
3. A student has the right to personal privacy except as otherwise provided by law, and this will be observed by students and University authorities alike.
4. Each student subject to disciplinary action arising from violations of university student rules shall be assured a fundamentally fair process.

Students' Responsibilities

1. A student has the responsibility to respect the rights and property of others, including other students, the faculty and staff, and the administration.
2. A student has the responsibility to be fully acquainted and compliant with the University Student Rules found in the Student Handbook, Student Code of Conduct, on our website, and

in the University Catalog.

3. A student has the responsibility to recognize that student actions reflect upon the individuals involved and upon the entire University community.

Students are expected to exhibit a high level of honesty and integrity in their pursuit of higher education. Students engaging in an act that violates the standards of academic integrity will find themselves facing academic and/or disciplinary sanctions. Academic misconduct is any act, or attempt, which gives an unfair advantage to the student. Additionally, any behavior specifically prohibited by a faculty member in the course syllabus or class discussion may be considered as academic misconduct. For more information on academic misconduct policies and procedures please review the [Student Code of Conduct](#).

Important Dates:

January 20	First day of class
March 9-14	Spring Break – No classes
April 4	Study Day – No classes
April 17	Last day to drop with an automatic “W”
May 01	Last day to withdraw from the University
May 04	Last day of classes
May 05	Study Day – No classes
May 6-12	Final exams

The complete academic calendar is available online:

<https://www.tamusa.edu/academics/academic-calendar/index.html>