SYLLABUS
EENG 4124: Embedded and Real-time Systems
(Required Course - Fall 2025)

COURSE INSTRUCTOR
Dr. Yuyao Wang

LAB INSTRUCTOR
Dr. Yuyao Wang

COURSE & LAB SCHEDULE

Days	Time	Location
Monday	10:00 am – 10:50 am	MY 131
Tuesday		
Wednesday	10:00 am – 10:50 am	MY 131
Thursday		
Friday	10:00 am – 10:50 am	MY 131
Thursday*	1:30 pm – 03:20 pm	MY 140

Lab sessions are indicated with an asterisk.

OFFICE HOURS

Days	Time	Location
Monday	11:00 am – 12:00 am	MY 137
Tuesday	11:00 am – 12:00 am 3:00 pm – 4:30 pm	MY 137
Wednesday	11:00 am – 12:00 am 3:00 pm – 4:30 pm	MY 137
Thursday		
Friday		

MSU CATALOG DESCRIPTION

This course provides a comprehensive range of topics from microcontroller architecture and GPIO programming to real-time operating systems and interrupt-driven design. It covers fundamental concepts of embedded systems including peripheral interfacing, communication protocols (UART, SPI, I2C), and timing-critical system design. The course encompasses theoretical foundations and practical experiments by focusing on understanding embedded C programming with different design approaches such as bare-metal programming, RTOS-based development, and interrupt-driven architectures. The lab sessions involve hands-on programming with STM32CubeIDE and STM32 development board to explore the complete embedded system design process, progressing from bare-metal programming to FreeRTOS-based system implementation.

COURSE PRE-REQUISITES

EENG/MENG 2204: ELECTRONICS

Course Resources:
Hardware: STM32F429I EVAL BOARD.
Software: STM32CubeIDE Software.

TEXTBOOK

"Beginning STM32: Developing with FreeRTOS, libopencm3 and GCC", Second Edition, *Warren Gay,* Apress.

SUPPLEMENTAL MATERIAL

Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C: Fourth Edition, *Yifeng Zhu*, E-Man Press LLC.

LIST OF TOPICS COVERED

• Microcontroller Architecture	• Input Capture and Output Compare
• Embedded C programming	• Communication Protocols (UART, I2C)
• GPIO Control and Digital I/O	• Task Management in FreeRTOS
• Interrupt Handling	• Message Queue
• Timer and Counter Programming	• Semaphore

Additional material may be covered as time permits.

SPECIFIC GOALS OF INSTRUCTION

Table 1: A detailed list of course objectives matched with the ABET outcomes (1-7).

COURSE OBJECTIVES	ABET OUTCOMES*						
	1	2	3	4	5	6	7
Ability to configure and control GPIO pins for embedded I/O operations (hw, lab, exam)	X					X	X
Ability to implement timer-based applications and PWM generation (hw, lab, exam)	X					X	X
Ability to design interrupt-driven embedded systems (hw, lab, exam)	X					X	X
Ability to implement communication protocols (UART, SPI, I2C) (hw, lab, exam)	X					X	X
Ability to design ADC-based sensor interfaces and data acquisition systems (hw, lab, exam)	X					X	X
Ability to design input capture and output compare with complemented outputs(hw, lab, exam)	X					X	X
Ability to analyze and design FreeRTOS-based real-time systems (hw, lab, exam)	X					X	X
Ability to implement task management and scheduling algorithms (hw, lab, exam)	X					X	X
Ability to design inter-process communication mechanisms and synchronization (hw, lab, exam)	X					X	X

*Table 2: Detailed descriptions of the ABET outcomes (1-7) listed in Table 1.

ABET Outcome	DESCRIPTION
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2	an ability to apply engineering design to produce solutions that meets specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3	an ability to communicate effectively with a range of audiences.
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

COURSE ORGANIZATION AND STUDENT PERFORMANCES ASSESSMENT

- Lecture Format

  This course consists of three 50-minutes sessions per week. The class will be spent mostly explaining and discussing concepts and designing example digital logic systems. Lectures will not be used to communicate the entire textbook course content and thus students should focus on the topics covered in the class.

- Attendance

  Attendance is required for each student. Absences of more than five lectures without proofs of legitimate excuses will result in a failing grade. **For each absence without proofs of acceptable excuses there will be 1 point off from Attendance & Class performance. If you are over 30 minutes late for the class, you are still allowed to sit in the class, but 1 absence will be counted.**

- Student Attitude

  Once class starts, the use of cell phones, reading of newspapers, conducting private discussions, using the computer (unless requested by the instructor), working on anything that is not directly related to the course, and making derogatory remarks about your classmates or instructor will not be accepted and may result in your dismissal from the class. **Each time you are caught will result in 1 point off from Attendance & Class performance. Total grade for Attendance & Class performance is 5 points at beginning and it could become negative.**

- Homework

  Homework will be assigned based on covered topics. It will be turned in each week, unless specified by the instructor. **Homework must be turned in at the beginning of class. Once class starts, late homework will be graded 80% of the full grade. If you arrived late, your homework will also be counted as late. Late homework will only be accepted until the end of due day.** However, if you copied from your classmates, you would receive zero points.

- Exams

  There will be two midterm exams and one final exam. Exam will be closed book and cheat sheet is not allowed. **Each exam is based on the course materials developed between two consecutive exams and possibly lab material if exist.** Students are expected to take the exam on the scheduled date and time it is given. However, if for some acceptable reason the student is not able to do so, then he must inform the instructor in advance in writing. The instructor will then decide whether he will be allowed to take a makeup exam, depending on the validity of his excuse. There is only one chance for makeup exam no matter what.

- Evaluation Method

  Your performance will be tested regularly throughout the semester by exams and homework assignments. There will be two exams. While homework assignments may contain a number of problems, it may be the case that only a subset of problems will be graded. However, you must attempt all problems. Do not try to guess which (if any) problems will not be graded.

- Midterm Progress Report

  In order to help students keep track of their progress, a Midterm Progress Report will be provided for each at-risk student through WebWorld. The grades reported will not be reflected on the students' transcript; nor will they be calculated in the cumulative GPA. However, at-risk students should put more effort and seek out tutoring.

- Evaluation Table

Midterm 1	15%
Midterm 2	20%
Homework & Lab	30%
Attendance & Class performance	5%
Final Exam	30%

*Bonus point in any case will only apply to those with a final grade lower than C.

GENERAL GUIDELINES

- Plan on spending at least 5 hours outside of class to study the material and to work on homework assignments, and lab experiments. Do not wait until the last day to start working on your assignment, or prepare for the exam.
- Utilize the office hours throughout the semester to seek explanations whenever you have questions.
- In engineering, neatness is a must, not a luxury. Be advised that you will be penalized for lack of neatness.
- You are encouraged to study in group but have to write your own homework.
- Generative AI can assist with understanding theories but approach its answers with caution. Do not rely on AI for hardware design or homework, as it may provide incorrect information, and you will be responsible for any resulting penalties.

CONFLICT RESOLUTION

a. The student should contact the instructor face to face or via e-mail if there is an issue with the course or the instructor. The faculty and the student will discuss this face to face or via email. Hopefully, a resolution is reached on the issue.

b. The student should notify the faculty via email again if the issue still did not get resolved after the first encounter or communication.

c. The student can then contact the Chair of the McCoy School of Engineering, Dr. Desai, face to face or via email, (raj.desai@msutexas.edu), and discuss this issue. Dr. Desai will discuss the issue at hand with the faculty member. Dr. Desai will discuss the result of this discussion with the student. Hopefully, a resolution is reached on the issue after this.

d. The student should notify the Chair via email if the issue still did not get resolved.

e. The Chair will contact the Dean and try to resolve the conflict. In case the conflict deals with the student grade, she will forward the case to the Grade Appeals Committee if necessary.

GENERAL EDUCATION STATEMENT

Students in this course must demonstrate their competency in oral and written communication through written project tasks assignments. They must also demonstrate their ability to use the English language.

ACADEMIC INTEGRITY POLICY

Scholastic dishonesty will not be tolerated and will be prosecuted to the fullest extent. You are expected to have read and understood the current issue of the student handbook regarding student responsibilities & rights, and the intellectual property policy information about procedures and what constitutes acceptable on-campus behavior. Any form of plagiarism will not be accepted and will be heavily reprimanded.

DISABILITY SUPPORT SERVICES

Students registered with Disability Support Services should have a letter verifying their disability and the appropriate accommodations.

DISCLAIMER STATEMENT

Information contained in this syllabus, other than grading, late assignments, and attendance policies, may be subject to change with advance notice, as deemed appropriate by the instructor.