EE 310 Digital Systems/Embedded Control-27184
3 (2, 2) [Semester Credit Hour (Lecture, lab)]

COURSE SYLLABUS – SPRING 2024

INSTRUCTOR INFORMATION

Instructor: Gerald Patrick Carter
                  Distinguished Lecturer, Electrical Engineering
                  Department of Engineering and Technology

Office Location: AG/ET 216
Office Hours: Tuesday (9:00am – 11:30am)
                  Thursday (9:00am – 11:30am)
Office Phone: 903-886-5706
Office Fax: 903-886-5960 (Inform instructor when fax is sent)
University Email Address: patrick.carter@tamuc.edu
Preferred Form of Communication: e-mail
Communication Response Time: 24 hours (weekdays) to email typically

COURSE INFORMATION

Course Format: The class consists of Theory Lectures and Laboratory exercises.
        Lecture: 2 hours per week (typically Tuesdays)
        Lab: 2 hours per week (typically Thursdays)

Class Meeting Schedule: 1/10/2024 through 5/10/2024

Class Meeting Dates: Tuesday (4:40 PM – 6:40 PM)
                          Thursday (4:40 PM – 6:40 PM)
Classroom: AG/ET 214

The syllabus/schedule are subject to change.

Materials – Textbooks, Readings, Supplementary Readings

Textbook(s) Required:

<u>**Course theory part:**</u> AVR Microcontroller and Embedded Systems: Using Assembly and C, (2017 – 2nd Edition) Mazidi, Naimi & Naimi ISBN: 978-0997925968.

<u>**Course Practical Part (Lab Exercises):**</u> Lab Manual/Experiments provided by the instructor. Students will use the lab workstations and/or their personal laptops to support programming exercises using the Arduino UNO.

Software Required:
- Microsoft Office - MS Word, Excel, PowerPoint
- Arduino Integrated Design Environment (free) – Runs on your laptop, Windows PC or Apple Mac device
- Atmel Studio 7 IDE (free) – Runs on your Window PC. Apple MAC requires running the app with Virtual Machine.

Optional Texts and/or Materials:

Breadboard, wire cutters, pliers, Microcontroller, breadboard wire, 9V battery. Additional or supplemental materials may be identified by the instructor during course execution

Course Description

This course introduces the hardware and software architecture of the AVR Microcontrollers and their applications. It also includes embedded system types, programming the microcontroller in assembly and C, serial and parallel data transfer, and interfacing I/O devices. Practical applications using Arduino and other devices will be developed through Lab exercises and course project design.

Prerequisites: EE 210 Digital Circuits with a minimum grade of C.

Student Learning Outcomes
After successfully completing the course, students will be able to:
1. Recognize the major components of a microprocessor and microcontroller-based systems
2. Describe the difference between a microprocessor and a microcontroller
3. Analyze Assembly Language and C language programs for the AVR microcontroller, and debug errors in syntax and logic.
4. Illustrate program logic flow using flowcharts and develop assembly and C language programs from flowcharts.
5. Interface a variety of I/O devices to the microcontroller by incorporating ADCs and DACs.

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6. Use appropriate Hardware and Software tools in the design, implementation, debugging, and testing of microcontroller-based systems
7. Develop and design interactive real-time applications with the AVR microcontroller
8. Perform experiments/course project independently as well as in a group.
9. Write a technical lab report.

COURSE REQUIREMENTS

Minimal Technical Skills Needed

- Working knowledge and basic skills in using Microsoft Office products Word, Excel, and PowerPoint.
- Working knowledge and basic skills at software programming in Assembly Language and/or C++ programming language or similar programming languages such as Python, MatLab, and MS-Basic
- Working knowledge and basic skills using electrical engineering lab equipment including breadboards, power supplies, oscilloscopes, multi-meters, and signal generators.
- Working knowledge and basic skills in application of electrical engineering laws from Physics (Ohm's Law and Kirchoff's Voltage & Current Laws).
- Working knowledge and basic skills in the application of Boolean Algebra and related Boolean laws and rules.

Instructional Methods

The instructional methods in this course include lectures, class discussion, course project, written assignments, problem solving, writing a lab report, lab exercises, open ended problems, case study, and simulation assignments using software.

Instruction will be based on the course textbook, additional online materials (free) and lab manual/materials/instructions provided by the Instructor.

Student Responsibilities or Tips for Success in the Course

. **Attendance of Lecture and Labs:**

TAMU-C is committed to providing measures to protect students and faculty from exposure to COVID-19. We will follow published TAMU-C COVID-19 Guidelines and revise operating approaches if/when needed during the semester to comply with published guidelines.

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If you feel you are experiencing symptoms or have been directly exposed to COVID-19, click on the following link to access A&M-Commerce Covid 19 Information, https://new.tamuc.edu/coronavirus/. Contact your instructor as soon as possible to inform your professor of your status.

Within COVID-19 Guidelines, attendance is a requirement for this course. The instructor will take attendance at the beginning of each class lecture and lab.

Class Attendance Requirement (one lateness = 1/2 absence) and points deductions for unexcused absences are provided below:

# of Unexcused Absences	0 – 3	4	5	6	7	>7
Points Deduction	0	-5	-10	-20	-30	F

Lecture and Laboratory Session Format:
- Lecture sessions will be live face-to-face and typically occur on the first session of the week. Deviations from this schedule will be communicated via email and/or D2L.
- Laboratory sessions will be live face-to-face and typically occur on the second session of the week. Deviations from this schedule will be communicated via announcement in class, email and/or D2L.
- Published TAMU-C COVID-19 Guidelines for classroom capacities will be maintained throughout the semester.

Laboratory Report Formatting and Submissions:

MS Office-compatible Laboratory Report Templates are provided on D2L. Use of the supplied templates is mandatory. Failure to use and follow the template provided will result in lowered grades for laboratory report submissions.

Unless directed and/or approved by the instructor, ONLY MS Office-compatible formats (.doc, .docx, .rtf, .xls, .xlsx, .ppt and .pptx) will be accepted for assignments and submissions. NO OTHER DOCUMENT OR FILE FORMATS WILL BE ACCEPTED.

Failure to comply with required document formats will result in late or rejected assignments (zero credit).

Note: Many students do not fully utilize the power within MS Word to ensure spelling and grammar are correct, which is a requirement for submissions. MS Word, PowerPoint and Excel can assist the user with providing automatic grammar and spell checking. There are other grammar and spelling checkers beyond the MS Office family that are equally (and in some cases more) effective. The use of the spelling and grammar checkers, page and section breaks, and APA templates is highly encouraged PRIOR to submission of assignments and will in general result in higher grades on their

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lab assignments.

APA Formatting is required for all reports assigned during this class. Non-adherence to APA formatting will result in points deduction on the assignment.

Note Also: On an exception basis only, other specific formats may be dictated by the instructor based on assignment and will be coordinated with/by the instructor prior to submission to assignment drop boxes.

Report Submissions: Microsoft Word, Excel, PowerPoint, or Project files will be placed in the assigned drop boxes in D2L in the accepted formats only (identified above).

GRADING

Final grades in this course will be based on the following scale:

A = 90%-100%
B = 80%-89%
C = 70%-79%
D = 60%-69%
F = 59% or Below

Total points corresponding to the final letter grades
A = 90-100 Points
B = 80-89 Points
C = 70-79 Points
D = 60-69 Points
F = 59 >   Points

Weights of the assessments in the calculation of the final letter grade.

Assessment task	Due Time	Weight
Homework (8)	~ Every 2 weeks	16 %
Lab Exercises (8)	~Every 2 weeks	16 %
Quizzes (4)	3, 5, 10, 12	16 %
Midterm Exam	8	20 %
Final Design Project	15	12 %
Final Exam	16	20 %
	TOTAL:	100 %

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Assessments

Homework Assignments: Homework Assignments are due at the posted time/date. Unless otherwise noted in the particular assignment, Homework is to be delivered electronically as a SINGLE FILE in the appropriate D2L dropbox. No late submissions will be accepted. Some homework assignments will include the submission of simulation files created in MultiSim and/or other file formats as required and identified in the assignment (object code or executable file formats, for example).

Any file that is flagged as infected with malware or viruses will be receive a grade of zero. The instructor will use Norton Internet Security, and the student is advised to use something at least as good as NIS.

Exams and Quizzes: The major examinations and quizzes will be performed as old-fashioned paper and pencil exercises. Quizzes and Exams will be closed book, closed notes.

Laboratory Exercises and Reports:

In support of the learning process, Laboratory Exercises provide the student with hands-on application of the concepts and knowledge gained in the lecture portion of the class. Through laboratory experiments, students apply 8-bit AVR microcontroller hardware and software, specifically ATmega328 via Arduino Uno, to solve technical problems. Students will develop practical skills through experiments using Arduino Microcontroller, I/O devices, Sensors, Motors, wireless communication devices, etc. This lab will also provide students with hands-on experience in implementing real world applications using AVR ATmega328 microcontroller, assembly and C language.

Pre-labs (reading, study, basic circuit/solution design, lab preparation) must be completed prior to coming to lab. Students will be turned away from the Lab if the Pre-lab is not complete. Lab circuits must be built during Lab on an empty breadboard. They may not be built prior to the Lab period.

There are 8 laboratory experiments scheduled to be performed in the semester. Should need arise where less than 8 labs are performed during the semester, the omitted exercises will be given the average grade of all prior completed lab experiments, thereby maintaining the overall grade weighting for the Laboratory Exercises as defined above.

Lab Teams of 2 students (3 maximum) will be assigned by the instructor prior to the first laboratory experiment.

Each Lab Team will submit one combined lab developed and created by the Lab Team

The syllabus/schedule are subject to change.

within 1 week after completion of the lab experiment session. Laboratory Reports will be submitted to the appropriate D2L Lab Assignment folder or drop-by the due date/time. All team members are expected to contribute to the lab report and will receive the same grade for their combined report. Late submissions will not be accepted.

Each lab group will be provided an Arduino Uno breadboard, wires and tools, and will be responsible for maintaining and returning the supplies at the end of the course. At the end of each lab, you will be asked to demonstrate your functioning circuit to the Instructor using the Arduino hardware.

A Formal Lab Report should enable someone else to duplicate your work and obtain the same results without reference to any other documents. This does not mean that you should append data sheets to your report but that the schematics and parts layout should be clear and accurate.

Formal Lab Reports should follow the same approach used in the lab, which is a Hypothesis/Test sequence. In Prelab, you will be asked to design a circuit to perform a specific function. During the lab time, lab groups will build circuits, demonstrate their working circuit and collect test data to show how the circuit performed. Test data and photos of the circuits will be used in the group Lab Report.

The Lab Report must be constructed using the Laboratory Report Template provided on D2L, strictly following the formatting requirements as presented in the Lab Report Template. Lab groups will submit their Lab Report to the designated D2L folder by the due date/time designated on D2L.

Final Design Project: Students will be divided into Final Design Project Groups that are required to complete a course design project highlighting the knowledge gained through this course. The project should demonstrate the student's ability to link the theoretical knowledge and practical skills acquired in the course to real-world applications. Students will work in a group up to four students **as assigned by the instructor**.

The Final Design Project consists of multiple deliverables:
1) **Final Design Project Proposal (Group Submission)** Students will submit their project proposal at week **10** to the instructor for approval in the dropbox on D2L. The project proposal is worth 1% of the final grade for the course.
2) **Final Design Project Demo/Presentation/Report (Group Submission)** This is worth 10% of the final grade for the course. Group Powerpoint presentations and report submissions are to be provided on D2L by due date/time. The Final Design Project Demo/Presentation consists of:
   a. **Final Design Project Demonstration** – Project Groups will present a WORKING demonstration of their final design projects. This will be a live demonstration before the class (no D2L submission)
   b. **Final Design Project Presentation** – Project Groups will present a a

The syllabus/schedule are subject to change.

powerpoint presentation before class highlighting the design, construction, and testing process for their final design project. This will be a powerpoint presentation using the template found on D2L.

c. **Final Design Project Report** – Project Groups will deliver a comprehensive report that captures group experiences in words and pictures concerning the design, construction, and testing of their project.

3) **Final Design Peer Review (Individual Submission)** This is worth 1% of the final grade for the course. All students are required to evaluate the performance of all group members including themselves. Each individual is required to submit the Peer Review form (provided on D2L) to the designated Peer Reviews folder on D2L by the due date/time.

Lab Safety Training: Although not a graded assignment, students registered for this course must complete all required lab safety training prior to entering the lab and undertaking any activities. Once completed, Lab Safety Training is valid for the remainder of the same academic year (i.e., through the following August) and must be completed anew in subsequent years. There are no exceptions to this University policy. Failure to complete the required training will preclude participation in any lab activities, including those for which a grade is assigned.

TECHNOLOGY REQUIREMENTS

LMS

All course sections offered by Texas A&M University-Commerce have a corresponding course shell in the myLeo Online Learning Management System (LMS). Below are technical requirements

LMS Requirements:
https://community.brightspace.com/s/article/Brightspace-Platform-Requirements

LMS Browser Support:
https://documentation.brightspace.com/EN/brightspace/requirements/all/browser_support.htm

Zoom Video Conferencing Tool
https://inside.tamuc.edu/campuslife/CampusServices/CITESupportCenter/Zoom_Account.aspx?source=universalmenu

ACCESS AND NAVIGATION

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You will need your campus-wide ID (CWID) and password to log into the course. If you do not know your CWID or have forgotten your password, contact the Center for IT Excellence (CITE) at 903.468.6000 or helpdesk@tamuc.edu**.**

Note: Personal computer and internet connection problems do not excuse the requirement to complete all course work in a timely and satisfactory manner. Each student needs to have a backup method to deal with these inevitable problems. These methods might include the availability of a backup PC at home or work, the temporary use of a computer at a friend's home, the local library, office service companies, Starbucks, a TAMUC campus open computer lab, etc.

COMMUNICATION AND SUPPORT

If you have any questions or are having difficulties with the course material, please contact your Instructor.

Technical Support

If you are having technical difficulty with any part of Brightspace, please contact Brightspace Technical Support at 1-877-325-7778. Other support options can be found here:

https://community.brightspace.com/support/s/contactsupport

Interaction with Instructor Statement

The instructor's preferred method of communications is via email. Responses during weekdays should typically be within 24 hours.

If there is an urgent matter to be addressed and the Instructor is not available, contact the Department Admin Brittani Fasci at 903-886-5474.

Office hours are as posted in this syllabus and on the Instructor's office door. To avoid potential schedule conflict, or to schedule a visit beyond normal office hours, an appointment is highly recommended. Contact the instructor in person or via email to schedule a time/date for meeting. As an alternate, you can contact the Department Admin, Brittani Fasci at 903-886-5474 to schedule an appointment.

Grading of assessment materials will typically be completed and posted within 7 days of the assessment item.

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COURSE AND UNIVERSITY PROCEDURES/POLICIES

Course Specific Procedures/Policies

Syllabus Change Policy

The syllabus is a guide. Circumstances and events, such as student progress or inclement weather, may make it necessary for the instructor to modify the syllabus during the semester. Any changes made to the syllabus will be announced in advance.

University Specific Procedures

Student Conduct

All students enrolled at the University shall follow the tenets of common decency and acceptable behavior conducive to a positive learning environment. The Code of Student Conduct is described in detail in the Student Guidebook. http://www.tamuc.edu/Admissions/oneStopShop/undergraduateAdmissions/studentGuidebook.aspx

Students should also consult the Rules of Netiquette for more information regarding how to interact with students in an online forum: https://www.britannica.com/topic/netiquette

TAMUC Attendance

For more information about the attendance policy please visit the Attendance webpage and Procedures 13.99.99.R0.01 http://www.tamuc.edu/admissions/registrar/generalInformation/attendance.aspx

http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/academic/13.99.99.R0.01.pdf

Academic Integrity

Students at Texas A&M University-Commerce are expected to maintain high standards of integrity and honesty in all of their scholastic work. For more details and the definition of academic dishonesty see the following procedures:

Undergraduate Academic Dishonesty 13.99.99.R0.03
Undergraduate Student Academic Dishonesty Form

http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/documents/13.99.99.R0.03UndergraduateStudentAcademicDishonestyForm.pdf

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[Graduate Student Academic Dishonesty Form](#)

http://www.tamuc.edu/academics/graduateschool/faculty/GraduateStudentAcademicDishonestyFormold.pdf

http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/undergraduates/13.99.99.R0.03UndergraduateAcademicDishonesty.pdf

Students with Disabilities-- ADA Statement

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you have a disability requiring an accommodation, please contact:

Office of Student Disability Resources and Services
Texas A&M University-Commerce
Velma K. Waters Library Rm 162
Phone (903) 886-5150 or (903) 886-5835
Fax (903) 468-8148
Email: studentdisabilityservices@tamuc.edu

Website: [Office of Student Disability Resources and Services](#)

http://www.tamuc.edu/campusLife/campusServices/studentDisabilityResourcesAndServices/

Nondiscrimination Notice

Texas A&M University-Commerce will comply in the classroom, and in online courses, with all federal and state laws prohibiting discrimination and related retaliation on the basis of race, color, religion, sex, national origin, disability, age, genetic information or veteran status. Further, an environment free from discrimination on the basis of sexual orientation, gender identity, or gender expression will be maintained.

Campus Concealed Carry Statement

Texas Senate Bill - 11 (Government Code 411.2031, et al.) authorizes the carrying of a concealed handgun in Texas A&M University-Commerce buildings only by persons who have been issued and are in possession of a Texas License to Carry a Handgun. Qualified law enforcement officers or those who are otherwise authorized to carry a concealed handgun in the State of Texas are also permitted to do so. Pursuant to Penal Code (PC) 46.035 and A&M-Commerce Rule 34.06.02.R1, license holders may not carry a concealed handgun in restricted locations.

For a list of locations, please refer to the [Carrying Concealed Handguns On Campus](#)

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document and/or consult your event organizer.

Web url:
http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/34SafetyOfEmployeesAndStudents/34.06.02.R1.pdf

Pursuant to PC 46.035, the open carrying of handguns is prohibited on all A&M-Commerce campuses. Report violations to the University Police Department at 903-886-5868 or 9-1-1.

A&M-Commerce Supports Students' Mental Health

The Counseling Center at A&M-Commerce, located in the Halladay Building, Room 203, offers counseling services, educational programming, and connection to community resources for students. Students have 24/7 access to the Counseling Center's crisis assessment services by calling 903-886-5145. For more information regarding Counseling Center events and confidential services, please visit **www.tamuc.edu/counsel**

AI use policy [Draft 2, May 25, 2023]

Texas A&M University-Commerce acknowledges that there are legitimate uses of Artificial Intelligence, ChatBots, or other software that has the capacity to generate text, or suggest replacements for text beyond individual words, as determined by the instructor of the course.

Any use of such software must be documented. Any undocumented use of such software constitutes an instance of academic dishonesty (plagiarism).

Individual instructors may disallow entirely the use of such software for individual assignments or for the entire course. Students should be aware of such requirements and follow their instructors 'guidelines. If no instructions are provided the student should assume that the use of such software is disallowed.

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In any case, students are fully responsible for the content of any assignment they submit, regardless of whether they used an AI, in any way. This specifically includes cases in which the AI plagiarized another text or misrepresented sources.

13.99.99.R0.03 Undergraduate Academic Dishonesty

13.99.99.R0.10 Graduate Student Academic Dishonesty

Department or Accrediting Agency Required Content

Student Outcomes (ABET):
The EE program must have documented student outcomes that support the program educational objectives. Attainment of these outcomes prepares graduates to enter the professional practice of engineering. Student outcomes are outcomes (1) through (7), plus any additional outcomes that may be articulated by the program.

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 meet 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 judgments, 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.

This course will assess the achievement of the following student outcomes as defined by the Department Chairperson: 2, 5, 6, and/or 7.

COURSE OUTLINE / CALENDAR

The syllabus/schedule are subject to change.

The instructor reserves the right to adjust the schedule in order to serve the needs of the class and any changes will be communicated in a timely manner.

Course Theory/Lecture Schedule:

Topics Covered (Schedule Subject to Change)

Week	Dates	Topics	Chapter	Assignment/Exams
1	1/11 1/16	Introduction to Computing; Microprocessors and Microcontrollers fundamentals; Intro to AVR Microtrollers (Ch 1)	Ch 0 Ch 1	
2	1/23	Microcontroller Architecture and Assembly Language Programming	Ch 2	
3	1/30	Microcontroller Architecture and Assembly Language Programming	Ch 2	HW1 Due
4	2/6	AVR Instruction Set	Ch 3	**Quiz 1**
5	2/13	Assembly language programming	Ch 5	
6	2/20	AVR IO Port programming	Ch 4	HW2 Due
7	2/27	Advanced Assembly language programming; AVR Addressing Modes	Ch 6	**Quiz 2**
8	3/5 3/7	AVR Programming in C	Ch 7	**Midterm Exam** (3/7)
		Spring Break (3/11 – 3/15)		
9	3/19	AVR Programming in C	Ch 7	HW3/ Project Proposal Submission Due
10	3/26	AVR Timers and Interrupt programming; Serial port programming	Ch 9, 10, 11	
11	4/2	AVR Timers and Interrupt programming; Serial port programming	Ch 9, 10, 11	**Quiz 3**
12	4/9	IO Interfacing; LCD and keypad	Ch 12	HW4 Due
13	4/16	Interfacing A/D and D/A Converters, Sensors	Ch 12	
14	4/23	Interfacing with motors & relays, PWM programming	Ch 14 & 16	HW5 Due Project Prototype
15	4/30	Quiz 4, Project Demo/Presentation Dead Days – May 1-3	Ch 17 & 18	**Quiz 4** Project Demo & Presentation
16	5/7	**Tuesday 5/7/24, 4:40PM – 6:40PM**	ALL	**FINAL Exam**

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Laboratory Schedule:

Topics Covered (Schedule Subject to Change)

Wk	Lab #	Dates	Lab #	Experiment
1		1/11		Lecture – No Lab
2	1	1/18	1	Introduction to the Arduino Microcontroller platform. Introduction to Atmel Studio 7.
3	2	1/25	2	Essential C Language Programming + Basic experiment with Arduino Uno and LEDs/Switches + Traffic Lights simulation
4	3	2/9	3	Interfacing Digital and Analog IO Devices to the Arduino board (LDR, Potentiometer, DC motor, Servo motor)
5	4	2/16	4	DC Motor Speed control using PWM + Interfacing with Analog Inputs
6	5	2/23	5	DC Motor Direction and Speed control using H-bridge + Interfacing with Ultrasonic Sensor
7	6	3/2	6	Temperature Sensing, Serial Monitor, and LCD display
8		3/9		**MIDTERM EXAM**
				Spring Break (3/11 – 3/15)
9	7	3/23	7	Color Sensing with TSC2300 and Arduino Uno
10	8	3/30	8	Wireless Comms using Bluetooth and XBee modules –
11		4/6	9	**Lab Makeup Day or Final Project Workday**
12		4/13	10	**Lab Makeup Day or Final Project Workday**
13		4/20		**Lab Makeup Day or Final Project Workday**
14		4/27		Final Project Workday
15		5/4		Final Project Presentation Day
16		5/11		**Tuesday 5/7/24, 4:40PM – 6:40PM – FINAL EXAM**

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