



EE 101: Digital Control with Embedded Systems

LABORATORY SYLLABUS – ALL SECTIONS

Instructor – Contact: Michael Goodheart MSEE, michael.goodheart@uvm.edu

Office Hours: Tu. 10am – 11am, Votey 309b and by appointment

Teaching Assistants - Contact & Lab Sections Covered:

Patrick Fiske – GTA patrick.fiske@uvm.edu B&D	Eli Kerr - GTA eli.kerr@uvm.edu A&C
Khang Tran – TA khang.tran@uvm.edu B&D	Kevin Zuniga-Cuellar - TA kevin.zuniga-cuellar@uvm.edu A&C

Lab meetings: Votey 332

A (a01) Monday, 2:20 – 4:50 pm	C (a03) Wednesday, 2:20 – 4:50 pm
B (a02) Tuesday, 6:00 – 8:30 pm	D (a04) Thursday, 6:00 – 8:30 pm

Summary: Fundamentals of microcontrollers and embedded systems with sensor and actuator applications. Topics include intro to embedded C programming, semiconductor theory, digital logic, data acquisition/control, magnetics, rotating machines and communications techniques. The lab component provides hands-on microcontroller sensor/actuator integration experience along with “C” programming practice.

Learning Outcomes: At the end of these labs, you will be able to:

- 1) Develop and debug “C” programs for the Arduino (UNO) using basic “C” constructs and selected libraries.
- 2) Understand how basic semiconductor devices (diodes, transistors), logic devices, magnetics, AC/DC machines work and how to use them in an Embedded system.
- 3) Understand and apply the concepts of Data Acquisition and Control within an embedded system.
- 4) Integrate “smart” hardware into your embedded system.
- 5) Confidently build and debug embedded systems circuits in a lab environment.
- 6) Produce and execute a test plan that reflects evaluation of lab exercise requirements,
- 7) Communicate effectively using EE and Embedded Systems specific vocabulary.

Week 1	Tu	14-Jan	No Lab
	W	15-Jan	
	Th	16-Jan	
	M	20-Jan	

Week 2	Tu	21-Jan	No Lab this day. Come in during Wednesday, Thursday or Monday lab. Arduino Setup
	W	22-Jan	
	Th	23-Jan	
	M	27-Jan	
Week 3	Tu	28-Jan	Programming exercise
	W	29-Jan	
	Th	30-Jan	
	M	3-Feb	
Week 4	Tu	4-Feb	Switch Debounce and interrupts
	W	5-Feb	
	Th	6-Feb	
	M	10-Feb	
Week 5	Tu	11-Feb	Temperature sensor, structures, Third party library, RGB diode readout. Monday, 17 Feb lab section to use Friday or any other lab time this week.
	W	12-Feb	
	Th	13-Feb	
	M	17-Feb	
Week 6	Tu	18-Feb	BJT (photocell) and FET drivers (drive motor with pseudo pwm)
	W	19-Feb	
	Th	20-Feb	
	M	24-Feb	
Week 7	Tu	25-Feb	Serial to Parallel conversion, LEDs and visual persistence (images)
	W	26-Feb	
	Th	27-Feb	
	M	2-Mar	
Week 8	Tu	3-Mar	No Labs (Lab times can be used for catch-up). Coordinate with your Lab TA
	W	4-Mar	
	Th	5-Mar	
	M	9-Mar	
Week 9	Tu	10-Mar	No Labs. Spring Break
	W	11-Mar	
	Th	12-Mar	
	M	16-Mar	
Week 10	Tu	17-Mar	Ultrasonics sensor with LCD readout Receive project requirements
	W	18-Mar	
	Th	19-Mar	
	M	23-Mar	
Week 11	Tu	24-Mar	Solenoid and Strain Gauge
	W	25-Mar	
	Th	26-Mar	
	M	30-Mar	

Week 12	Tu	31-Mar	Compass Motor Project Proposal/Plan Due
	W	1-Apr	
	Th	2-Apr	
	M	6-Apr	
Week 13	Tu	7-Apr	Stepper and Servo
	W	8-Apr	
	Th	9-Apr	
	M	13-Apr	
Week 14	Tu	14-Apr	Bluetooth communication
	W	15-Apr	
	Th	16-Apr	
	M	20-Apr	
Week 15	Tu	21-Apr	Project Time
	W	22-Apr	
	Th	23-Apr	
	M	27-Apr	
Week 16	Tu	28-Apr	Project Demos Project Report Due. Monday lab section may use Friday or any other lab time this week for Demos
	W	29-Apr	
	Th	30-Apr	
	M	1-May	

Grading: The lab grade represents 25% of the total course grade (see Lecture Syllabus for details)

Each active lab period (lab activity & report combined) result in 8 points. This means that you can earn a total of 104 points but only 100 points (= 100%) will be carried over to the overall course grade. The project will count for two lab periods or 16 points. Find the table below on what you have to do to earn 8 points per lab.

	Single lab	Project
Pre-Lab Document (Planning)	2 points	6
Execution	2 points	4
Report	4 points	6
TOTAL	8 points	16

Details of the “single lab” elements above.

Details of the “project” elements above.

On time at arrival at Lab: Self-explanatory. Lab time is valuable and finite. Be considerate of other class use and of your TA’s time.	On time at arrival at Lab: You are on your own here. Of course, if you are late for the project demo
Pre-Lab Document: You must prep before lab. Read and understand the objectives and requirements. Write Pseudo Code and first pass Software. Devise test plan(s). Lab time should be for circuit construction, exercise debug and demo. The pre-lab document is your pseudo-code. Turn in this document at the start of your lab.	Planning: Elements of the project plan are outlined in the project instruction sheet. Project Description 2pts Project Time line 2pts Project test plan 2pts

No pre-lab document	0pts	
Messy, marginal, document	1pts	
Neat, well thought out document	2pts	
Execution: Proper execution of all lab exercises as witnessed by TA. All exercise requirements met. (... but not exceeded (scope creep)). Test plan(s) executed and data collected.		Execution: Proper execution of your plans. Delivery on Plans and Requirements 4pts How well did you make the dates committed to in the development plan? How thorough was your test plan coverage? Did you meet all requirements?
Report: Create and submit a lab report consistent with directions provided within the "Write-up" section of each lab instruction. The report will be collected at the beginning of the next lab. -1pt/24hr late submission.		Report: Create and submit a project report consistent with directions provided within the project instruction sheet. Report is due at your Demo Lab. Project description 2pts (goals, function, operation description) Project realization 2pts (Schematics, SW listings, Project plan vs actual, Test plan results) Project conclusion 2pts (Delivery on requirements, Difficulties, Recommendations)

Grade Review Policy: All graded work should be reviewed promptly by the students. Any questions in regards to potential grading errors should be brought to the attention of the instructor within one week's time after the assignment is reviewed in class or solutions are posted. Please clearly document in writing what you believe the error to be and attach that to the original work. After one week's time, no score adjustments will be made. While final exams will not be returned to the students, students are welcome to review their work against a solution. Other than in the case of grading errors on the final exam, no final course grades assigned will be altered. Throughout the semester, the course instructor will endeavor to keep you abreast of your standing in the class. Students requiring more feedback should review their performance through, e.g., Blackboard or by contacting the instructor.

Note on Academic Honesty and Student Conduct: Discussions between students are encouraged, as these deepen the understanding of class topics, but dishonesty in all its forms is not tolerated. The four types of academic dishonesty are: plagiarism, cheating, collusion and fabrication. All types will be reported. Visit the UVM code of Academic Integrity <https://www.uvm.edu/policies/student/acadintegrity.pdf>

Note on Personal Conduct in Class: Faculty, teaching assistants and students shall always use respectful language in verbal and written communications. Any type of discrimination based on race, religion, gender, disability, age, national origin, ethnicity, ancestry, sexual orientation, gender identity, or gender expression is not tolerated. Bias reports are encouraged to be submitted here: www.uvm.edu/deanofstudents/bias_response_program . This classroom is a practice for your future careers, where the ability to work in teams is mandatory, therefore be attentive to your way of conduct and communication.

Note on Resources Available to Students: Academic performance is important but should not come at the expense of health. The University provides students with various resources that address mental and physical wellness and health needs. Check out the gym, the natatorium, group classes, talk to a counselor, get your annual physical exam, find answers to nutritional questions, visit the library for some light reading, get help writing a cover letter and resume, be part of student clubs! Strive to find a balanced schedule that works for you. Additionally, any student with a documented disability interested in utilizing accommodations should contact SAS, the office of Disability Services on campus. SAS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations. For more details go to www.uvm.edu/access and <https://www.uvm.edu/health>

Course Evaluations: In the first half of the course, you will be asked to participate in an anonymous survey regarding your course experience. This may lead to changes in future modules during this semester. Should changes be adopted, you will be informed as soon as possible. At the end of this course, you are expected to complete an evaluation of the course. The evaluations will be anonymous and confidential, and the information gained, including constructive criticisms, will be used to improve the course for future offerings.

Disclaimer: Note that this syllabus might change throughout the semester. Should this occur, you will be notified with the exact changes.