

EE 101: Digital Control with Embedded Systems

LECTURE SYLLABUS

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

Office hours: Tu. 10 am – 11am (Votey 309b), and by appointment

Class meetings: Tu & Th, 8:30 – 9:45am, Innovation Hall E105 (1hr 15min)

Required textbooks: “Principles and Applications of Electrical Engineering”, Giorgio Rizzoni, 6th edition
ISBN 978–0–07–352959–2
“Arduino Programming in 24 Hours”, Richard Blum, ISBN 978-0-672-33712-3

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 this course, you will be able to:

- 1) Identify and describe the building blocks of a microcontroller and of an embedded system.
- 2) Develop and debug “C” programs for the Arduino (UNO) using basic “C” constructs and selected libraries.
- 3) Understand how basic semiconductor devices (diodes, transistors), logic devices, magnetics, AC/DC machines work and how to use them in an Embedded system.
- 4) Understand and apply the concepts of Data Acquisition and Control within an 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.

Important Dates:

Last day to add class without instructor permission	17 Jan
Add/Drop, Audit Deadline	27 Jan
Last day to withdraw	27 Mar

Week 1	Tu	1	14-Jan	MG Intro. Syllabus discussion. EE101 coverage. EE100 review
	Th	2	16-Jan	Microcontroller basics, Microcontroller programming, Arduino dev. environment
	Lab			No Lab
Week 2	Tu	3	21-Jan	Software Dev. Expectations, Arduino C basics, program setup, Structured commands, Loops
	Th	4	23-Jan	Arrays, Strings, Data Structures, Functions
	Lab		1	Arduino Setup
Week 3	Tu	5	28-Jan	Pointers, Storage, Libraries
	Th	6	30-Jan	Simple Digital I/O, Interrupts, Debugging Techniques
	Lab		2	Programming exercise

Week 4	Tu	7	4-Feb	Semiconductor Basics, Diodes and Zeners
	Th	8	6-Feb	Diode Applications, BJTs
	Lab		3	Switch Debounce and interrupts
Week 5	Tu		11-Feb	Exam1 Review
	Th		13-Feb	Exam 1
	Lab		4	Temperature sensor, structures, Third party library, RGB diode readout
Week 6	Tu	9	18-Feb	Exam 1 Handback, FETs
	Th	10	20-Feb	Digital Logic, Number Systems, Boolean Algebra, K-Maps
	Lab		5	BJT (photocell) and FET drivers (drive motor with pseudo pwm)
Week 7	Tu	11	25-Feb	Combinational Logic, Sequential Logic
	Th	12	27-Feb	Data Acquisition
	Lab		6	Serial to Parallel conversion, LEDs and visual persistence (images)
Week 8	Tu		3-Mar	Holiday - Town Meeting Day
	Th	13	5-Mar	Data Control
	Lab			Monday catchup lab
Week 9	Tu		10-Mar	No Class. Spring Break
	Th		12-Mar	No Class. Spring Break
	Lab			No Class. Spring Break
Week 10	Tu	14	17-Mar	Electricity and Magnetism, Mag circuits, Mag materials (Receive Project Requirements)
	Th	15	19-Mar	Transformers, Moving Iron Transducers, Moving Coil Transducers
	Lab		7	Ultrasonics sensor with LCD readout
Week 11	Tu		24-Mar	Exam 2 Review
	Th		26-Mar	Exam2
	Lab		8	Solenoid and Strain Gauge
Week 12	Tu	16	31-Mar	Exam 2 Handback, Rotating Machines1 - DC Machines
	Th	17	2-Apr	Rotating Machines2 - AC Machines
	Lab		9	Compass Motor (Project Proposal/Plan Due)
Week 13	Tu	18	7-Apr	Rotating Machines3 – Steppers and Servos, Analog communications intro
	Th	19	9-Apr	Analog and Digital Communications, Embedded Communications methods
	Lab		10	Stepper and Servo
Week 14	Tu	20	14-Apr	Distributed IO, Advanced Topics 1
	Th	21	16-Apr	Advanced Topics 2
	Lab		11	BLE communications
Week 15	Tu		21-Apr	Buffer, Exam3 Review
	Th		23-Apr	Exam 3
	Lab			Project Time
Week 16	Tu	22	28-Apr	Exam3 Handback, Course Summary and Review
	Th		30-Apr	Final Prep
	Lab			Project Demos (Project Report Due)

Final Exam Time/Date

04 May-2020 10:30a – 1:15p E105

Grading:

A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
97%+	93%+	90%+	87%+	83%+	80%+	77%+	73%+	70%+	67%+	63%+	60%+	60%-

Labs + Project	19% + 6%
Homework	10%
JIT Quiz	5%
Midterms 1/2/3	ea. 20%
Final	20%

Labs: See lab syllabus for details.

Homework: Homework consists of daily reading assignments and weekly problem assignments. Problem assignment and collection dates are highlighted in lecture schedule above. Homework is due on Black Board one week after it was assigned, before beginning of class. Example, if HW was assign during class on Tuesday, it is due the following week, Tuesday 10:00am.

Exams and Final: A two sided hand written note sheet is permitted (no photo copy). Bring calculators. Lowest score out of 4 is dropped. Additionally, if you are happy with your midterms, you can opt not to take the comprehensive final exam.

JIT Quizzes: Short (10-15 min) quizzes taken just before each lecture. The quiz is enabled by 6pm the day before lecture and is taken via blackboard. Stats will be available at the start of lecture. These quizzes encourage reading assignment participation and help to tune coverage of the day's lecture material

Homework Late Submission Policy: -20% of maximum possible points per late day. Additionally, 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.