COURSE SYLLABUS
ELEC 3040 – ELECTRICAL SYSTEM DESIGN LABORATORY
ELEC 3050 – EMBEDDED SYSTEM DESIGN LABORATORY
SPRING SEMESTER, 2019

INSTRUCTORS:
  Victor P. Nelson, Office: Broun 326, Email: nelsovp@auburn.edu
  John Y. Hung,   Office: Broun 227, Email: hungjoh@auburn.edu

LAB OVERVIEW MEETINGS: 3-3:50 p.m. Monday in Broun 238
LABORATORY SESSIONS (in Broun 320) and Teaching Assistants:
  Section 002: 12:30-2:20 p.m. Thursday;   TAs Victor Nelson & John Hung (emails above)
  Section 003: 3:30-5:20 p.m. Tuesday;   TAs Andrea Walker, aew0056@auburn.edu
                    Graham McClelland, gsm0013@auburn.edu
  Section 004: 3:00-4:50 p.m. Wednesday; TAs Joe Driscoll, jwd0023@auburn.edu
                    Graham McClelland, gsm0013@auburn.edu
  Section 005: 12:30-2:20 p.m. Tuesday;   TA Daylon Hester, dgh0010@auburn.edu

PREREQUISITES:
  ELEC 3040:   ELEC 2220 - Computer Systems
            ELEC 3030 – RF Systems Lab
            ELEC 3500 – Control Systems (Co-requisite)
  ELEC 3050:   ELEC 2210 – Digital Electronics
            ELEC 2220 - Computer Systems

TEXTBOOK: *ELEC 3040 & 3050 Laboratory Manual*
          On-line at http://www.eng.auburn.edu/~nelsovp/courses/elec3040_3050

REFERENCES: ELEC 2220 text/notes (general computer/microcontroller concepts).
          Other reference documents on the ELEC 3040/3050 course web page:
          http://www.eng.auburn.edu/~nelsovp/courses/elec3040_3050

CANVAS: All lab grades will be posted on the course CANVAS site. Other materials
          may also be posted on CANVAS from time to time.

COMPONENTS: Each team will be assigned a kit containing an EEBOARD, cables, and
          keypad. **Each team should purchase a microcontroller board** before the
          third lab session (see information on the course web site.)

Course Goals:

Design an electronic system containing both hardware and software elements. Interface devices to a computer system and integrate hardware and software in the design and application of an embedded computer system. The application will be digital control of a dc motor, including user interface, motor driver, speed/position measurement, control algorithms and implementation issues. Practice in written and oral technical communication, development and documentation of an engineering design, and exposure to cross-functional issues including teaming and ethical decision making.

Laboratory Schedule and Exercises:
1.	Software development and debugging with MDK-ARM for the ARM Cortex-M3 based *STM32L100C-Discovery* board; EEBOARD platform; engineering documentation.
2.	Parallel inputs/outputs; C program design and debug
3.	Debugging with test instruments (oscilloscope, logic analyzer)
4.	Interrupt setup and service routines in C
5.	Keypad parallel I/O interface
6.	Real-time operation with programmable timer and interrupts.
7.	PWM waveform generation with the programmable timer.
8.	Drive circuit for dc motor
9.	Motor speed sensing from tachometer signal frequency.
10.	Motor speed sensing from tachometer signal amplitude.
11.	Motor characterization (step response).
12.	Monday session: Engineering ethics. Lab - Work on feedback controller.
13.	Monday session: Effective communication. Lab - Continue work on feedback controller.
14.	Monday session: Submit ethics paper & peer evaluation *(schedule on course web page)*. Final Project presentations and demos in lab *(schedule on course web page)*.

Grading:

I. Project success/final demonstration	20%	
II. Project Communication Skills:		
Bi-weekly reports	5%	Grading Scale:
Engineering ethics paper	5%	A = 90% or greater
Midterm written report	5%	B = 80% - 89%
Revised written report	15%	C = 70% - 79%
Final oral presentation	10%	D = 60% - 69%
III. Weekly design & conduct of experiments:		F = Below 60%
Lab notebooks	10%	
Lab performance (GTA assigned)	10%	
Lab performance (from status reports)	5%	
Teamwork	10%	
IV. Professionalism	5%	

Laboratory notebook

Each student must maintain an engineering lab notebook (7.5" x 9.75" composition book), detailing all aspects of his/her laboratory activities throughout the semester. This is not a "formal" document, i.e. neatness, spelling, etc. are not graded. What is important is that this book contain all lecture notes, details of all hardware and software designs, and all experimental procedures designed and attempted, including preliminary designs, debugging efforts, observations of experimental results, calculations, hardware design sketches, software designs, etc. This includes both "good" and "bad" items. This notebook must be submitted to your GTA at the conclusion of your lab period in the weeks in which the notebooks are to be collected, *according to the schedule in Table A below*. Notebooks will be returned in lecture the following Monday.

<u>Weekly laboratory reports</u>
On alternate ***Fridays (by 3 p.m.), according to the schedule on the course web page***, each team is to submit a status report to the course instructor (maximum two pages, double-spaced, plus attachments), written in memorandum style. Team members are to alternate turns writing the team reports (each student will write three such reports over the semester). Failure to submit all reports will result in a grade of incomplete. Factors considered in the evaluation of these reports will include, but not be limited to, technical content, correct spelling, proper grammar, proper format, and neatness. Half of the report grade will be assigned to the team, based on reported progress; the other half of the grade will be assigned to the individual, based on quality of writing. Reports must be typed. ***Include (as needed) supporting data, schematics and software listings from that week's experiments.*** One letter grade will be deducted for each calendar day that a lab report is late. The report should contain the following transmittal information on the first page (*do <u>not</u> add a cover sheet*.)

    TO: Drs. John Y. Hung and Victor P. Nelson
    FROM: The Dream Team, <u>Alec Baldwin</u> and Tina Fey (***Both names; <u>author nnderlined</u>***)
    SECTION: Thursday 3:30 **(your section day and time)**
    DATE: Date of Submission
    SUBJECT: What is discussed in this report.

<u>Design report and revised design report</u>
Every student will submit a typed design report on one element of the semester project. Each student will be expected to incorporate instructor feedback on the design reports into a revised design report. Reports are to be submitted in accordance with the **schedule on the course web page**. More details regarding the design report will be provided at future laboratory meetings. One letter grade will be deducted for each calendar day that a report is late.

<u>Oral presentation</u>
Each laboratory group will make an oral presentation on the final project during the final lab session. More details regarding the presentation will be provided at future laboratory meetings.

<u>Teamwork</u>
The design project will be done in two-person teams. However, team members are to maintain individual lab notebooks, and are expected to contribute equally to the project. This means that both team members will prepare for each lab, participate in the lab experiments, and contribute to the reports. Teamwork will be evaluated by the GTA, the instructor, and by a peer review at the end of the semester. Each team member should do all designs individually, with the team then merging the designs to resolve any differences between them.

<u>Professionalism</u>
Factors considered in the determination of this component of your grade will include but not be limited to attendance, tardiness, preparedness for each lab session, and lab participation and performance. Attendance at all lectures and laboratory meetings is mandatory. One point (of the five points for this element) will be deducted for each absence from lecture or lab, or each instance of coming late or unprepared to lab. Exceptions will be made for university-approved activities or documented emergencies. Absences for other reasons must be coordinated with the instructor ***in advance***.

<u>Special Accommodations</u>
Students who need special accommodations are requested to make an appointment to see the instructor the first week of the semester. Bring your memo from the Program for Students with Disabilities to this meeting.

Table A. Course Calendar Overview (subject to change)
See course web page for class dates, due dates of reports, and other deliverables.

Week #	Status report due**	Notebook due	Lecture and Lab activity
1	A*, B*	Yes*	Course Introduction. Development system hardware and software; documentation. Lab: C programming and debugging exercise
2	A		Designing and debugging C programs; Digital inputs/outputs
3		Yes	Debugging with oscilloscope and logic analyzer
4	B		Interrupt setup and service routines in C
5		Yes	Keypad interfacing and control
6	A		Programmable timer and interrupts
7		Yes	Pulse width modulation (PWM)
8	B		dc motor drive
-	-	-	**No labs this week: Spring Break**
9	Design Report (A,B)		Speed sensing from tachometer signal frequency
10		Yes	Speed sensing from tachometer signal amplitude
11			Motor characterization: find parameters of plant model.
12	Revised Report (A, B)	Yes	Lecture: Engineering Ethics Lab: Work on final motor-control project.
-	-	-	No labs this week: Thanksgiving Holiday
13	Ethics report (A, B)		Lecture: Communication skills Lab: Continue work on final project.
14			Lecture: Submit peer evaluations. Lab: Oral presentations and project demos

  ** A = First member of the team; B = Second member of the team
  * Work will be evaluated for purposes of feedback, but no grade assigned.