ECE 830: Embedded Cyber-Physical Systems

http://d2l.msu.edu/

Credits: 3

INSTRUCTOR:
Prof. Nihar R. Mahapatra
E-mail: nrm@egr.msu.edu

Please note:
• Office hour and TA information is available on course D2L site.
• Python programming will be used extensively in lab assignments. There are many online learning resources available if you are not already familiar with it.
• Tuesday, Oct. 25, 2022 is a break day and Thursday, Nov. 24, 2022 is a holiday. There will be no classes on these days.
• Labs will start the week of Sep. 12, 2022.

Course Information

Prerequisite:
ECE 331 or equivalent, basic programming (equivalent to that covered in CSE 231), operating system (UNIX and Windows), and application software skills. Background in probability and statistics equivalent to that covered in STT 351.

Course Materials:
• Course Website: You can access course materials by logging onto the MSU D2L website using your MSU NetID at: http://d2l.msu.edu. For help using D2L, check: http://help.d2l.msu.edu. Monitor the course website regularly and frequently for information concerning the course. Course-related information will be communicated via D2L. You should set your D2L Internet e-mail address to an account that you check frequently. Please direct any e-mails to me to my egr e-mail address: nrm@egr.msu.edu. Always use “ECE 830-Section#” (i.e., ECE 830-001 or ECE 830-730 as applicable) at the beginning of the subject line of your e-mail so I do not miss it by chance.

Course Overview:
This course will cover principles of design, specification, modeling, and analysis of embedded cyber-physical systems.

Topics:
The course will cover a broad range of topics in embedded cyber-physical systems. These include: Modeling continuous and discrete dynamics of embedded cyber-physical systems (CPS). Hybrid systems. Composition of state machines. Concurrent models of computation. Design and implementation of CPS including sensors and actuators, embedded processors, Internet of Things (IoT), cloud IoT, multitasking, and scheduling. Analysis and verification of CPS. Emerging topics in CPS. Time constraints may restrict coverage of some of these topics.
Grading:
Homework assignments (absolute weighting): 5%
Quizzes (all quiz problems weighted equally): 5%
4 Checkpoint evaluations (equally weighted): 10%
2 Exams (equally weighted): 45%
Lab assignments (absolute weighting): 25%
Project assignments (absolute weighting): 10%

Homework Assignments:
Homework will be assigned throughout the semester. Typically, there will be one short homework assignment per lecture module, except for introductory lecture modules. Homework assignments will be absolutely weighted. They will be graded based on effort and completeness only, and solutions will be provided so students can check their own work.

Quizzes:
There will be pop quizzes held throughout the semester to encourage active participation in the learning process and in keeping pace with the course material. Pop quizzes will be conducted using D2L and they will be graded based on a combination of participation and correctness. All quiz problems will be equally weighted. There will be no makeups for missed quizzes. For excused and documented absences, please email the instructor prior to a lecture to discuss options.

Checkpoint Evaluations:
Checkpoints are mini exams administered using D2L. Checkpoint dates will be announced ahead of time. Four checkpoints will be given: two midway between exams to highlight important material and two just before exams to help focus exam study. Checkpoints will be graded on correctness only. All checkpoints will be equally weighted. There will be no makeups for missed checkpoints. For excused and documented absences, please email the instructor prior to the checkpoint to discuss options.

Exams:
Two exams, equally weighted, will be given during the semester. Exam dates will be announced ahead of time. The first exam will take place near the middle of the semester and its syllabus will cover roughly the first half of the course material. The second exam will take place near the end of the semester and its syllabus will cover the remaining half of the course material. There will be no final examination. Exams will be administered via D2L.

Lab Assignments:
A number of labs will be assigned to reinforce concepts covered in lectures. The programming language used will be Python. The first lab will introduce Python programming so all students, regardless of their programming background, can acquire the necessary Python programming skills for the subsequent labs. Students are welcome to explore Python programming resources available online. Instructions specific to labs will be posted on D2L. Lab assignments will be absolutely weighted.

Project Assignments:
Projects will be assigned to explore topics related to embedded CPS, including those not covered in lectures, so students acquire a more expansive exposure to the field of embedded CPS. Instructions specific to projects will be posted on D2L. Project assignments will be absolutely weighted.
ECE 430 vs. ECE 830:
Note that ECE 430 and ECE 830 have common lectures, homework, exams, and some similarity in labs. ECE 430 is primarily meant for senior ECE undergraduate students, while ECE 830 is geared primarily toward ECE graduate students. ECE 430 is a 4-credit course, while ECE 830 is a 3-credit course. ECE 830 is not open to students with credit in ECE 430. If you are an undergraduate student who wants to enroll in ECE 830 instead of in ECE 430, contact the instructor and your undergraduate advisor at the beginning of the semester. Enrolling in ECE 830 may satisfy one of your major elective course requirements and/or satisfy course requirements for the M.S. and Ph.D. programs in ECE at MSU.

Course Policies and Procedures:
- Late assignments will not be accepted.
- Any handwritten submissions must be neat and easily legible.
- Instructions specific to any assignment will be noted therein.
- Any grading concerns must be brought to the attention of the instructor/TA within two working days after the item in question is returned, unless otherwise specified.
- While studying together is encouraged, work on all assignments and tests must be your own. Students must observe a high standard of academic integrity and appropriate classroom behavior. The Department of Electrical and Computer Engineering expects all students to adhere to MSU’s Policy on Integrity of Scholarship and Grades. This policy includes the statement “...completion of original academic work by the student to whom it is assigned, without unauthorized aid of any kind.” In this course, any violation of academic integrity (cheating in any form) will result in a 0 score for the assignment for all students concerned, and may also result in a 0 grade for the course, and possibly further disciplinary actions by the department, college, or university.
- Makeup exams will be considered only under unusual circumstances. Students must bring a request for a makeup to the course instructor well in advance of the regularly scheduled exams.
- Incompletes will be awarded only with documented evidence of serious health problems.
- All students should obtain a DECS computer account for use in their assignments. Procedures for requesting an account are available on the DECS website.
- The MSU policy on religious holidays is designed to respect every student’s religious practices while ensuring that students continue to make normal academic progress. If you will miss a class due to a religious holiday, you need to contact the instructor well in advance of a religious holiday to discuss making up any missed work.
- Students requiring accommodation under the Americans with Disabilities Act (ADA) should contact the MSU’ Resource Center for Persons with Disabilities (RCPD) and bring their Verified Individualized Services and Accommodations (VISA) form to the instructor as near the beginning of the term as possible.
- Based on suggestions from MSU Academic Governance: As members of the learning community, students are expected to respect the intellectual property of course instructors. All course materials presented to students are copyrighted and subject to the condition that students may not record lectures or any other classroom activities nor share them with others without advance permission from the instructor; lecture note taking is permitted. Any student in violation of this condition may face academic disciplinary sanctions.
- COVID-specific policies and notes:
  - For university policies related to COVID-19, please refer to the FAQ on the issue.
- In the event of a switch to online classes, labs will be adjusted.

**Course Grading Scale:**

\[
\begin{align*}
[90, 100] & \rightarrow 4.0, [85, 90) \rightarrow 3.5, [80, 85) \rightarrow 3.0, [75, 80) \rightarrow 2.5, [70, 75) \rightarrow 2.0, [60, 70) \rightarrow 1.5, [50, 60) \rightarrow 1.0, [0, 50) \rightarrow 0.
\end{align*}
\]

Note: the notation “\([x, y)\)” stands for the interval containing all values greater than or equal to \(x\) and less than \(y\). Once your final course score out of 100 is computed, the above original course grading scale will be used (with some of the cut-offs potentially lowered depending upon class performance and at the discretion of the instructor) to determine your final course grade.