ECE 387: Introduction to Robotic Systems
Course Syllabus – Spring 2021

1. **Instructor:** Dr. Stanley Baek
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2. **Course Goals:** Provide cadets with fundamental knowledge and skills to design and control robotic systems.

3. **Course Prerequisite:** ECE 382 and knowledge of any programming language (Matlab, C/C++, Python)

4. **Grade Distribution and Policy:**

a. The grade distribution for this course is shown in the chart below.

Grade	Grade
93 ≤ A ≤ 100	77 ≤ C+ < 80
90 ≤ A- < 93	73 ≤ C < 77
87 ≤ B+ < 90	70 ≤ C- < 73
83 ≤ B < 87	60 ≤ D < 70
80 ≤ B- < 83	0 ≤ F < 60

b. **Weighting**: The overall weighting of the graded items is:

	Prog	Final
GRs	25%	25%
Labs	25%	25%
Homework	30%	30%
Projects	20%	20%

5. **Late Policy:**
   - The cutoff for on-time submission is 07:30 am on the due date.
   - Late days are counted in 24-hour periods. Submitting between 07:30 am on the due date and 07:30am the next day is one day late, and so on.
   - You are given 5 grace days (self-granted extensions) which you can use to give yourself extra time without penalty.
   - Instructor-granted extensions are only considered after all grace days are used and only given in exceptional situations.
   - Late work handed in when you have run out of grace is **discounted 30% for the first day late and 10% per day late thereafter**.
   - Every assignment has a hard deadline; **4 days past the original due date**.
   - Late submissions (penalty or not) are not accepted after the hard deadline or after the solution to the assignment is published. No late submissions (penalty or not) will be accepted for the assignments right before GRs.

6. **Course Text:** There is no required textbook for ECE 387. Reading materials/labs are posted on the Teams site.

7. **Course Website:** All files are conveniently distributed via the **Teams** site.

8. **Laboratories:** Labs are held in 2E36 (or 2E48), but may include a prelab assignment that must be done before coming to class. The labs tend to be very hardware intensive and will probably require debugging to isolate and fix problems. In-class time is your primary chance to get active help for these problems so the more you prepare outside of class, the more successful you'll be. The 53 minutes go by extremely fast - don't waste them!

9. **Extra Instruction (EI):** You are encouraged to seek EI early and often. Schedule EI with an instructor if you are having difficulty with the course material. You must have read the assignment and attempted the homework before requesting EI. Note: You are responsible for material if you miss class, so get notes from someone in your section. For example, you miss the lesson where the instructor announces a quiz for the next lesson or the instructor assigns homework due next lesson. Even though you missed the lesson, you are still responsible for the quiz, homework, or any other assignments made. It is in your best interest to check with your classmates after an absence. After you've read the assignment, attempted the homework, and checked with your classmates, you may then schedule EI if you have difficulty with the material—not to make up a class you missed.

10. **CAS Policy:** For CAS notification, email your instructor *prior to your absence* and include the lesson number, the date, and the reason for your absence. It is your responsibility to check your SCA to see if instructor permission is required. If it is, you must make the request prior to your absence. If you miss class, you are responsible for all material (e.g. assignments, notes, announcements, handouts, etc.) covered in class. Please check with another cadet in your section to find out what you missed.

    When a cadet is absent on the day that an assignment is due, or on the date of a quiz or GR, the cadet is responsible for meeting the following standards:

a. **Scheduled Absence:** If a cadet will miss any graded event due to a scheduled absence such as an SCA, sport team trip, or scheduled lasik surgery, the cadet is expected to complete all work BEFORE the absence.
b. **Unscheduled Absence:** If a cadet misses a graded event for an unscheduled reason such as AOC approved bedrest or a family emergency, the cadet must complete all work on the first full class day that they return to duty in order to avoid a late penalty. For example, if a cadet is on AOC bedrest for a GR on M17 and can return to duty on T17 or M18, the cadet is expected to make up the work by M18.
c. **Unique Circumstances:** For circumstances that do not fall under either of these broad categories (e.g. concussion protocol), the cadet is expected to communicate early and often with the instructor. The instructor and course director will work with the cadet on a course of action.

11. **Collaboration Policy:** Unless specifically directed otherwise, the collaboration policy for this course is:

a. For all assignments in this course, unless otherwise noted on the assignment, you may work with anyone. We expect all graded work, to include code, lab notebooks, and written reports, to be in your own work. Copying another person's work, with or without documentation, will result in NO academic credit. Furthermore, copying without attribution is dishonorable and will be dealt with as an honor code violation.
b. All help received on work submitted for grading must be documented in accordance with the course documentation policy.
c. GRs are individual effort**.** No collaboration is allowed while taking these exams. All electronic devices (phones, smart watches, computers, tablets, etc.) must be placed out of sight for the duration of the event. If any electronic device is seen during the event, the student will receive a zero for that effort.
d. While working on projects, you may collaborate only with your own team and with the ECE 387 instructor.
e. For graded homework assignments and labs, you may collaborate with any other cadet currently enrolled in ECE 387. You may also reference the posted answers and solutions.

12. **Documentation Policy:** In accordance with the Dean's policy for documentation, all ECE 387 assignments must have a documentation statement. For group projects, you are not required to document collaboration within your own team, as such collaboration is expected and authorized. The documentation statement should be clearly identified with the word "Documentation." If you did not collaborate, then the statement "Documentation: None,"

is appropriate. Assignments without a documentation statement are incomplete and may be returned to the student for completion. The assignment will then be assessed the appropriate penalty according to the late work policy. Your instructor may assess a 1-day-late penalty (up to 25%) in lieu of returning the assignment. In this case, a documentation statement must still be received, before the grade can be posted.

Schedule

Lesson	Topic	Reading	Due
1	What is a robot? How do we classify?		
2	Forward Kinematics: Planar Manipulator		
3	Inverse Kinematics: Existence & Uniqueness		
4	Inverse Kinematics (cont.)		
5	Manipulator Dynamics		
6	Manipulator Dynamics Example		
7	**Lab #1**: Introduction to Lynxmotion ALD5 Manipulator		
8	Manipulator Simulation		
9	Joint Actuator Gearing		
10	Manipulator Control: Computed Torque + PD-Control		
11	Manipulator Control: Computed Torque + PID-Control		
12	**Lab #2**: Simulation of Closed-Loop Planar Manipulator		
13	Trajectory Planning: Polynomial Expressions		
14	Trajectory Planning: Higher-Order Polynomial Expressions		
15	**Lab #3**: Robot Arm Pick and Place		
16	**GRADED RECORD #1**: Lessons 1-14		
17	Mobile Robots: Forward Kinematics for Differential Drive		
18	Mobile Robots: Line and Arc Motion; Inverse Kinematics		
19	Mobile Robots: Inverse Kinematics (cont.)		
20	**Lab #4**: Introduction to Roomba Programming		
21	Path Planning and Obstacle Avoidance: Dijkstra's Algorithm		
22	Maze Solving: Modified Flood Fill Algorithm		
23	Mobile Robot Localization: Triangulation & Trilateration		
24	Mobile Robot Odometry Models		
25	Mobile Robot: Kalman Filtering		
26	Mobile Robot: Extended Kalman Filtering		
27	Sensors I: Encoders, IR, Ultrasonic, Laser, Contact		
28	Sensors II: Accelerometer, Gyro, GPS		
29	**GRADED RECORD #2**: Lessons 17-27		
30	**Lab #5**: Introduction to Lego EV3 Programming		
31	Sensors III: Compass, Beacons		
32	Vision Systems: Image Capture with CCD Camera		
33	Images in MATLAB: RGB, Grayscale, B&W		
34	Image Segmentation: Thresholding, Filtering, Edge Detection		
35	**Lab #6**: Webcam Image Processing		
36	Hough Transform: Line Detection		
37	Image Geometry: Camera Model		
38	Image Geometry: Planar Homography		
39	Feature Detection		
40	Course Review		