**ECE 387: Introduction to Robotic Systems**

**Spring 2018**

1. **Instructors**

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1. **Course Goals and Objectives**

Cadets shall:

* 1. Apply forward and inverse kinematic analysis and dynamic analysis to planar manipulators and mobile robots
  2. Simulate planar manipulators and mobile robots using Matlab/Simulink
  3. Derive computed torque controls and perform trajectory/path planning for planar manipulators and mobile robots
  4. Understand mobile robot odometry challenges and the purpose of Kalman Filters
  5. Understand the principles of operation and characteristics of various robot sensors
  6. Understand image capture with a CCD camera

1. **Prerequisite Course**: Familiar with any programming language
2. **Course Materials and Resources**

**Course Text**: None

**Web Page**: TBD

**Software**: Python

1. **Grades**

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| --- | --- |
| **Grade** | **Grade** |
| 90 ≤ A ≤ 100 | 74 ≤ C+ < 77 |
| 87 ≤ A- < 90 | 70 ≤ C < 74 |
| 84 ≤ B+ < 87 | 67 ≤ C- < 70 |
| 80 ≤ B < 84 | 60 ≤ D < 67 |
| 77 ≤ B- < 80 | 0 ≤ F < 60 |

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| --- | --- | --- |
|  | Prog Points | Final Points |
| **HW** | (5) 25 | (6) 30 |
| **GRs** | 100 | 100 |
| **Labs** | (2) 40 | (3) 60 |
| **Quizzes** | (2) 20 | (2) 20 |
| **Final Project** |  | 100 |
| **TOTAL** | 185 | 310 |

1. **Late Policy**: If you are expecting to miss class on the day an assignment is due, you shall turn in your assignment prior to your departure. Your instructor may grant a no-penalty turn-in extension for absences resulting from illness or other legitimate extenuating circumstances. Cadets shall coordinate late submittals in advance. The late policy for the Department of Electrical and Computer Engineering is as follows:

**How Late? Max Penalty Max Grade**

< 1 day 25% 75%

2 day 50% 50%

3 day 75% 25%

> 3 day 100% 0%

1. **Extra Instruction (EI)**: It is best to schedule a time after class, via email, or by phone, though walk-ins are always welcome. Please try to maximize your visit time by having specific questions. It is best to review the text, notes, and homework prior to the meeting.
2. **Attendance Policy**: Inform your instructor of absences in advance via email. Please include the reason for the absence and any relevant SCA. Check the SCA to see if instructor permission is required and if it is, make the request prior to the absence. You will be given an Unexcused Absence in CAS if you fail to get permission.
3. **Class Absences**: Due dates for all homework assignments, quizzes, labs, exams and presentations are listed on the syllabus. If you plan on missing a class, turn in the work *before the absence* or find another way to submit it on time. After missing class, it is your responsibility to get notes from a classmate and to determine if any new coursework was assigned.
4. **Collaboration and Documentation Policy**: You may receive help from any DFEC faculty member or any student currently enrolled in ECE387. Document *all help received* on work submitted for grading IAW DF policies, or “none” if your work was completely individual effort.
5. **Homework**: Turn in assignments at the start of class. Late penalties commence from the point where your instructor collects the assignments. **All homework is to be done individually**.
6. **Exams**: Both exams are closed book; however, equation sheet(s) will be provided if needed.
7. **Laboratory Analysis**: Labs will be performed in teams of approximately 3. Whether post-lab work is done individually or in teams will be announced by the instructor.
8. **Quizzes**: Short graded quizzes will be given periodically throughout the semester and will be announced in class. Your instructor will announce whether an equation sheet will be provided for the quiz and which lecture material will be assessed.
9. **Final Project**: The final project will focus on the Roomba robot, controls, computer vision, and path planning.
10. **Classroom Etiquette**:
    1. Computers should normally be in tablet mode unless the instructor specifically requests you to perform an internet search or use simulation software
    2. Food or drink is NEVER allowed if lab equipment is out
    3. Dean-approved drinks are allowed at the classroom desks; Food is NOT allowed in the classroom
    4. No sleeping – please treat classroom time with professionalism
    5. Keep chit chatting to a minimum to avoid distracting your fellow cadets or the instructor
    6. Questions are always welcomed and encouraged
    7. You will actively engage practice problems given during class and, where instructed, work with your peers to answer the questions

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| Lesson | Topic | Quiz | HW | Due |
| 1 | Intro & Overview, What is a robot? |  |  |  |
| 2 | Git & Linux |  |  |  |
| 3 | Python |  | 1 Linux |  |
| 4 | Python |  | 2 Git |  |
| 5 | Python |  | 3 Python |  |
| 6 | Lab 1: linux, git, and python |  |  | Lab1: EOC |
| 7 | Kinematics: Introduction | Linux/git/python |  |  |
| 8 | Forward Kinematics |  |  |  |
| 9 | Inverse Kinematics |  |  |  |
| 10 | Robot Arm Control |  | 4 Kinematics |  |
| 11 | Lab 2: Robot Arm |  | 5 Control |  |
| 12 | Lab 2: Robot Arm | Kinematics |  | Lab2 EOC |
| 13 | Roomba Overview |  |  |  |
| 14 | Roomba Sensors |  |  |  |
| 15 | Roomba Sensors |  |  |  |
| 16 | Roomba Sensors |  |  |  |
| 17 | Lab 3: Sensor Calibration |  |  |  |
| 18 | GR 1 |  |  |  |
| 19 | Image Processing |  |  |  |
| 20 | Image Processing |  | 6 IP | Lab3: BOC |
| 21 | Image Processing |  |  |  |
| 22 | Computer Vision |  |  |  |
| 23 | Computer Vision |  | 7 CV |  |
| 24 | Computer Vision |  |  |  |
| 25 | Computer Vision |  | 8 CV |  |
| 26 | Kalman Filter | IP/CV |  |  |
| 27 | Detection and Tracking |  |  |  |
| 28 | Lab 4: Detection and Tracking |  | 9 CV | Lab4: EOC |
| 29 | Mobile Robots |  |  |  |
| 30 | Controls |  |  |  |
| 31 | Path Planning |  | 10 Controls |  |
| 32 | Path Planning |  |  |  |
| 33 | INS |  | 11 Planning |  |
| 34 | INS |  |  |  |
| 35 | Lab 5: Roomba | Mobile Robots |  |  |
| 36 | Lab 5: Roomba |  |  | Lab5: EOC |
| 37 | GR2 |  |  |  |
| 38 | Final Project |  |  |  |
| 39 | Final Project |  |  |  |
| 40 | Final Project |  |  |  |