# EEL 5934- Control of Marine and Aerial Vehicles – Spring 2019

*Modifications to this syllabus may be required during the semester. Any changes to the syllabus will be posted on the course web site and will be announced in the classroom.*

1. **Class Time:** MWF Period 4 (10:40 am – 11:30 am)
2. **Class Location:** BLK 0315
3. **Final Exam Time & Date:** No Final Exam
4. **Pre-requisites**: Undergraduate level control theory background, vector calculus, linear algebra, basic mechanics, and differential equations. Undergraduate level dynamics course would be of great help but not required.
5. **Course Objectives:** This course introduces the basic theory and practical aspects of control aquatic and aerial vehicles. The first part of the course will cover basic materials while the later part of the course introduces a selective introduction to the state-of-the-art research problems currently under investigation.
   The first part of the course covers topics such as the basic of aquatic and aerial vehicle terminology, kinematics and dynamics of moving frames, vehicle dynamics, aero and hydrodynamic forces, nonlinear equations of motion and linearization, maneuvering tests, fundamental of controls (stability concept, transfer matrix, state space representation, PID, sliding mode, and adaptive controllers for AUVs, etc), Control design, sensors for aircrafts and marine vehicles, Kalman filter, autopilot design via successive loop closure, state estimation, guidance, path planning. This year, the second part of the course is more focused on advanced topics and could cover materials from

   - Estimation and control of attitude for small vehicles: Geometry of attitude, sensors and measurement, attitude kinematics and dynamics, control and estimation.
   - Control of underactuated system of a micro aerial vehicle: Nullspace and range of linear systems, Least squares
   - Sensors for MAVs: Sampling & Aliasing, Noise Modelling, Vibration Isolation, Barometers, Pitot tubes, MARGs (Magnetometers, Accelerometers, Rate Gyroscopes), Magnetometer Errors & Calibration
   - Distributed sensory systems for aquatic and aerial applications: general theory and design, sensor placement methods, sensor fusion techniques, example from fish lateral line sensory system, applications in wall or wake detection, and submarine disturbance rejection,

6. **Instructor:** Kamran Mohseni, Ph.D.
   a. Office location: NEB 141
   b. Office Hours: Immediately after the class on Wednesdays. 11:30am – 12:30. Please let me know ahead of time that you are planning to visit during the office hours.
   c. Instructor Email for this tourse: mohseni@ufl.edu Please allow at least 48 hours for a response. Please note that I do not do HW by emails. Please come to my office hours. **Make sure that the subject of your email starts with EEL 5934** so your email does not get filtered out.
   d. Web site: canvas

7. **Teaching Assistants** Not sure we have a TA this semester (depends on the number of students at the end of the first week)
    a. TA Name: Kevin Nelson
    b. TA Office: PS&T 215
    c. TA Office Hours: Monday and Wednesday 11:30 am -12:30
    d. TA Email: kjnelson@ufl.edu

- **Textbooks**: There is no required textbook for this course. Here are some recommended books
    **a.** T.L. Fossen, Handbook of marine craft hydrodynamics and Motion Control, Wiley Publications, 2011.
    **b.** R.W. Beard and T.W. Mclain, Small unmanned aircraft theory and practice, Princeton University Press, 2012.

  If you need some refreshing of your memory on undergraduate level materials on control and dynamics you could consult any of the following books:
    a. N.S. Nise, Control Systems Engineering, Wiley.
    b. R.C. Dorf and R.H. Bishop, Modern Control Systems, Prentice Hall.
    c. R.C. Hibbler, Engineering Mechanics: Dynamics, Prentice-Hall.
- **Assessment Methods and Grading**:
  The grades are based on a term long project and homework. There is no formal exam. The HW sets will cover about 40% of the grade while the course project will cover 70% of the final grade. There will be several HW sets and they will be graded. Students are required to answer all questions, but only one/two problems might be graded in each HW set at random. If a student feels that an exam or homework is graded unfairly, or if there is an error in the grading, it should be brought to the attention of the TA/Lecturer within two weeks after the graded material is handed back. Scores will not be reconsidered beyond two weeks after they are handed back. More information will be provided in the classroom about the course project.

  Students will have the option to select one out of two available projects. One project is focused on control of a micro aerial vehicle developed in the group while the second project is focused on the control of a bioinspired underwater vehicle. HW sets will not be collected after their due dates. If a student feels that an exam or homework is graded unfairly, or if there is an error in the grading, it should be brought to the attention of the TA/Lecturer of the course grader within two weeks after the graded material is handed back. Scores will not be reconsidered beyond two weeks after they are handed back.
- **Make-up Policy:** No late assignments will be accepted.
- **Honesty Policy** – All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others. Using unauthorized materials (eg solutions from previous years or downloaded on the web are violations of the honor code).
- **Grading**: HW sets 40%, course project 70%. Note that HW sets will be collected and randomly 1 or 2 problems will be graded for each HW sets.

## Notes on Homework Sets and Their Solutions

**Policies/Procedures:**

1. Homework assignments are passed during the lectures
2. Homework is due at the start of the lecture on the following week after assigning the HW.
3. Homework will be given back to you in the following two weeks.
4. You are expected to return solutions to all HW sets. However, grading might be conducted only on selected problems.
5. Students are encouraged to discuss the general principles involved in the homework sets with one another, but the solution of each problem must be completed individually.

**Format**

1. Use 8.5" x 11" paper and write on one side.
2. Write down your name on the 1st page and on every subsequent page. The naming format should be: **First Name Last Name**
3. Do not use pages torn from a spiral notebook.
4. Use a stapler (no exceptions). Do not staple over the problem numbers, allow a 1" margin so that it's visible when the pages are stapled.
5. Start each problem on a new page.
6. Put the problems in numerical order.
7. Attach a listing of any computer program(s) used in the solution.
8. Use good penmanship, as illegible writing cannot be graded.