<table>
<tr><td rowspan="4"></td><td colspan="3">Course Code and Name :
MCE 484 Aerial Robotics</td><td colspan="4">Department:
Mechanical Engineering Department</td><td>Semester
Spring</td></tr>
<tr><td colspan="7">Methods of Education</td><td>Credit (ECTS)</td></tr>
<tr><td>Lecture</td><td>Recitation (Etude)</td><td>Lab Work</td><td>Mini Projects</td><td>Homework</td><td>Other</td><td>Total</td><td rowspan="2">5</td></tr>
<tr><td>42</td><td>10</td><td>-</td><td>80</td><td>15</td><td>-</td><td>147</td></tr>
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Language	English
Compulsory/ Elective	Elective
Prerequisites	-
Course contents	State representation of an aerial robotic platform in hypothetical 2D and realistic 3D settings, various representations of a 3D rotation, angular velocity of a rigid body, linear and nonlinear control of an aerial platform, differential flatness, position and trajectory controllers, time parameterized paths, path planning, A-star algorithm, graph search, RRT, Bayes filter, family of Kalman filters, particle filter, Monte Carlo localization
Course objectives	This course is designed for students interested in robotics research with particular emphasis on VTOL platforms. The purpose of the class is to expose the students to the mathematical foundations of dynamical models of VTOL platforms and their control, planning as well as noise filtering techniques used in state estimation. The students are expected to develop programming skills through projects to fly a VTOL platform in simulation or in a controlled laboratory setting.

Learning outcomes and competences

At the end of a semester the students are expected to be equipped with the following techniques:

- Equation of motion of a multi-rotor VTOL platform
- State-space representation of a robot
- Linear and nonlinear control techniques
- Path and trajectory planning
- Bayes filter, Kalman Filter (KF), Extended KF, Unscented KF, particle filter

The students will also be able to fly a drone in a simulation environment and/or a controlled laboratory setting.

Textbook and/or references

References:

1. Thrun, Sebastian. "Probabilistic robotics." *Communications of the ACM* 45.3 (2002): 52-57.
2. Choset, Howie M., et al. *Principles of robot motion: theory, algorithms, and implementation*. MIT press, 2005.
3. Corke, Peter. *Robotics, vision and control: fundamental algorithms in MATLAB® second, completely revised*. Vol. 118. Springer, 2017.
4. Särkkä, Simo. *Bayesian filtering and smoothing*. Vol. 3. Cambridge University Press, 2013.

Assessment criteria

	If any, mark as (x)	Percentage (%)
Midterm exams		
Quizzes	x	5
Homework	x	10
Projects	x	55
Term paper		
Laboratory work		
Other		
Final exam	x	30

Course plan

Week	Subject
1-2	Position and rotation representations, rigidbody transformations, homogeneous transformations, angular velocity
3-4	Quadrotor dynamics, platform with extra payloads, state space representation
5-6	Linear controller, nonlinear control, differential flatness
7-8	Position and trajectory controllers, time parameterized paths
9-11	Path planning, motion planning, A*, graph search, RRT
12-14	Bayes filter, KF, EKF, UKF, PF, Monte Carlo localization

Instructor	Dr. Tolga Özaslan