

MECH4810 – Unmanned Aviation Vehicle

Course Code: MECH 4810	Course Title: Unmanned Aviation Vehicle
Required Course Or Elective Course: Elective Course	Terms Offered (Credits): Fall 23-24, 3 credits
Faculty In Charge: Hongyu YU	Pre-Requisites: MECH3680
Course Structure: Lecture and labs – 3 hours per week, Rm 5566, Lift 27-28, TuTH 9:00-10:20AM	
Reference Material: Reg Austin, Unmanned Aircraft Systems: UAVS Design, Development and Deployment, 2010 (Online access available through HKUST library)	
Course Description: <ol style="list-style-type: none"> 1. Elective course for BEng in Aerospace Engineering. 2. The course contains both class lectures and lab projects. 3. This course will introduce UAVs that are capable to operate remotely or autonomously. The knowledge of the mechanics, control and applications of the flight system and the design of UAVs (especially quadrotors) will be explored. 4. The assembly, control, and flight of quadrotors will be conducted through labs. 	
Course Topics: <ol style="list-style-type: none"> (1) Introduction to UAVS: history, components and categories (2) Launching and recovery (3) Control and control systems (4) Sensors and payload, and UAVs' functions for sensing and avoidance (5) Quadrotors' mechanics, control, planning, and system design (6) UAV regulations, human factors in the system, and legal and ethical issues (7) UAV flighting, design, and building 	
Course Objectives: (correlated program objectives)	<ol style="list-style-type: none"> 1. Fundamental understanding of unmanned aerial systems for MAE students to partially fulfill Program Objectives (P-O1, P-O3, P-O5). 2. Understanding and analyzing system requirements, control and payload selection for UAV's different applications. (P-O1, P-O3, P-O4); 3. Understanding the environmental and social consequences and impact of UAV technology development. (P-O2, P-O4, P-O5).
Course Outcomes: (correlated course objectives and program outcomes)	<p>On successful completion of this course, students will be able to:</p> <ol style="list-style-type: none"> A. Understand basic concepts, history, classification, applications and social impacts of unmanned aviation vehicles [1,2,3] (POC1, POC3, POC7, POC8, POC9, POC10); B. Understand and analyze basic requirements and specs for UAV's system, including control, sensing and payloads [2](POC1, POC4, POC5, POC7, POC8, POC9); C. Recognize, analyze and assemble UAV systems [1,2](POC1, POC3, POC 4, POC5); D. Understand the state of art of UAV and envision future trend of UAVs [3](POC1, POC7, POC8,POC9, PIC11)

Assessment Tools: (correlated course outcomes)	<u>Assessment:</u> Project 1 DJI drone video shooting 15 % [A, D] Project 2 Drone building and flight experiment [A, B, C, D] 40% Attendance 3% Homework 8% Midterm 34 % [A, B, C, D]	
Tentative course schedule on lectures	Topic	Lectures
	1, Introduction, flight safety + DJI drone intro + project intro	1, 2
	2, Launching and Recovery, grouping + receiving drones+ video design	3, 4
	3, Control systems, Sensors, communication, navigation, payload, homework 1	5, 6
	4, drone building arrangement, intro to quadrotors, and filming checking	7, 8
	5, video showing	9
	6, Quadrotors (Control, planning, and estimation)	9,11,13,15,17,19
	Drone assembling	10, 12, 14 in AE lab
	Drone flying	16,18,20,22,24,26 in the lab
	Midterm	21 (Nov. 14th)
	SLAM, Regulations, human factors, and Future UAVs	23,25
	Presentation	TBD

Lecture		Lecture	
1 (05/09)	Intro to class and UAV	2 (07/09)	Safety, intro to project 1, intro to DJI drone
3 (12/09)	Grouping, collection of drones, group video scheme design	4 (14/09)	Launching and Recovery,
5 (19/09)	Control systems, homework 1	6 (21/09)	Sensors, communication, navigation, payload,

7 (26/09)	drone building arrangement, Quadrotors (Intro, mechanics, system),	8 (28/09)	Video filing checking, Video editing, Project 2 intro
9 (03/19)	Quadrotor control, homework 2	10 (05/10)	collection of materials, Assembling
11 (10/10)	Video shows, Quadrotor control	12 (12/10)	Assembling
13 (17/10)	Quadrotor control homework 3,	14 (20/10)	Assembling
15 (24/10)	Quadrotor control,	16 (26/10)	Flying
17 (31/10)	Quadrotor control	18 (02/11)	Flying
19 (07/11)	Quadrotor control, homework 4	20 (9/11)	Flying
21 (14/11)	Midterm	22 (16/11)	Flying
23 (21/11)	SLAM	24 (23/11)	Flying
25 (28/11)	Regulations, human factors, and Future UAVs	26 (30/11)	Flying (optional)
		TBD	Presentation

Policy

- 1- All communication will go through Canvas. You should check your emails, which are associated with your Canvas account, regularly at least once a day. Or you should log in your Canvas account regularly at least once a day. It is your responsibility to accept and respond to the communication from the instructor and TA in time.
- 2- Exams and Finals: Except for a conflict with another examination (which must be given at the time listed for it in the time schedule), or for students who have 3 or more exams on the same day, no changes can be made to the examination schedule without prior approval of the Dean. I will not support such requests unless they involve circumstances beyond a student's control. Airline reservations and work schedules are within the student's control.
- 3- Exams: There are no make-up tests. If you miss a test due to a medical reason, please provide a note from your doctor. Otherwise, you will get a zero.
- 4- NO Late assignments. If you miss a deadline for assignments due to a medical reason, please provide a note from your doctor.
- 5- Attendance is required. We will have 10 times random attendance checking during lectures and tutorials. If the record shows 8-10 times attendance, the student will receive the full 3% mark, 6-7 times: 2.5%, 5 times: 2%, 4 times: 1.5%, 3 times: 1%, 2 times: 0.5%, 0-1 times: 0%. If you have a special reason and cannot attend the class, please send me an email asking permission before the class. Attendance for labs will also be counted toward the individual person's lab score.
- 6- Peer review will be performed for all two projects.

ACADEMIC DISHONESTY! ZERO tolerance

Academic honesty is expected of all students in all examinations, papers, reports, homeworks and academic transactions and records. There will be zero tolerance for dishonesty in this class. Formal

procedure will be triggered automatically once a suspected behavior has been discovered. For more information, see <http://acadreg.ust.hk/generalreg.html>

BEng in Aerospace Engineering (4-year program)

Program Objectives:

- P-O1. Be able to communicate and perform as an effective engineering professional in both individual and team-based project environments,
- P-O2. Have an international outlook with clear perspectives on the Pearl river Delta and Greater China,
- P-O3. Be able to research, design, develop, test, evaluate and implement engineering solutions to problems that are of complexity encountered in professional practice and leadership,
- P-O4. Clearly Consider the ethical implications and societal impacts of engineering solutions,
- P-O5. Continuously improve through lifelong learning.

Program Outcomes:

- POC1. Ability to identify and formulate problems in multidisciplinary environment with an understanding of engineering issues and constraints
- POC2. Ability to design and conduct experiments as well as analyze and interpret data
- POC3. Ability to apply knowledge of mathematics, science, and engineering for problem solving in aerospace engineering and related sectors or for further education in a research career
- POC4. Ability to develop specification and to design system, component, or process to meet needs
- POC5. Ability to understand the design, operation, and maintenance of aircraft components and systems
- POC6. Ability to use modern engineering tools, techniques, and skills in engineering practice
- POC7. Ability to communicate effectively
- POC8. Ability to function in multi-disciplinary teams and provide leadership
- POC9. Broadly educated with an understanding of the impact of engineering solutions on issues such as economics, business, politics, environment, health and safety, sustainability, and societal context
- POC10. Clear understanding of professional and ethical responsibilities
- POC11. Recognition of the need for life-long learning and continuing education
- POC12. International outlook with knowledge of contemporary issues