Introduction to Drone Technology

Fall Semester 2024

SDU UAS Center

V2024-09-05 Kjeld Jensen, SDU UAS Center, kjen@mmmi.sdu.dk

Agenda for today

08:15 – 09:00	Welcome, student expectations, course introduction, student teams
09:15 – 10:00	Module theory
10:15 – 12:00	Module exercises

Student expectations

Please go to this link and type in your expectations for this course:

https://kjen.dk/go/idt/expect

Learning objectives

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Knowledge

Having completed this course the successful student possesses knowledge on an introductory level about:

- Multirotor Unmanned Aerial System (UAS), Unmanned Aerial Vehicle (UAV), power system, flight controller, attitude sensing
- UAV positioning and navigation based on Global Navigation Satellite System (GNSS)
- UAS wireless communication systems
- UAS safety & risk assessment

https://odin.sdu.dk/sitecore/index.php?a=fagbesk&id=148118&listid=18920&lang=en

Learning objectives

Skills

Having completed this course the successful student is able to:

- Apply robotics competencies to the design and development of UAS

https://odin.sdu.dk/sitecore/index.php?a=fagbesk&id=148118&listid=18920&lang=en

Learning objectives

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Competences

Having completed this course the successful student is able to:

- Participate in finding technical applicable solutions to the design and development of UAS subsystems and payload modules
- Contribute to the development in research and industrial UAS projects

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Teaching philosophy

“I consider myself a facilitator of learning rather than a classroom leader. In short this means that I will seek to encourage and facilitate your learning to the best of my ability. At the same time I expect you to take the lead and the responsibility for your own learning. This influences the agenda for each module and especially the lab exercises.”

Course plan

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Course plan updated 2024-08-06

Kjeld Jensen kjen@mmmi.sdu.dk

Course modules

Date	Location	Time	Teacher	Module	Content
Sep 6th	U171	8.15-12.00	Kjeld	1	Course startup, UAV attitude estimation
Sep 13th	U171	8.15-12.00	Kjeld	2	Global Navigation Satellite System
Sep 27th	U171	8.15-12.00	Kjeld	3	Radio communication theory
Oct 4th	U171	8.15-12.00	Guy & Kjeld	4	UAS safety & risk assessment
Oct 11th	U171	8.15-12.00	Oscar	5	Flight controllers, C2 links
Nov 1st	U171	8.15-12.00	Ivan	6	UAV attitude failure detection
Nov 8th	U171	8.15-12.00	Kjeld	7	UAS positioning & navigation, course midterm evaluation
Nov 15th	U171	8.15-12.00	Kjeld	8	Drone radio antennas
Nov 22th	HCAA	8.45-15.45	Oscar & Frederik	9	UAS flight controllers & UAV, power system, prototype building
Nov 29th	HCAA	8.45-15.45	Oscar & Frederik	10	UAV calibration, indoor flight tests
Dec 6th	HCAA	8.45-15.45	Oscar & Frederik	11	Autonomous navigation, outdoor flight tests
Dec 13th	HCAA	8.45-15.45	Oscar, Frederik & Kjeld	12	Outdoor autonomous flight tests, course final evaluation

Prerequisites

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The course is mandatory to students at the Master in Robotics specializing in DAS. This defines the course level, and it is assumed that you have a background comparable to a bachelor in robotics especially concerning programming, embedded systems and sensor technology. If your line of study is different you may thus find the course challenging in terms of the prerequisites.

There will be no text book for this course. Some materials and references will be provided along with the course notes for the modules.

To conduct the exercises you will need to bring your computer. The exercises have been tested to work on Ubuntu (22.04) and some requires Ubuntu, so you should either have Ubuntu installed on your hard drive or be able to run Ubuntu from a USB flash drive, or in VirtualBox or VMware.

Work load

This is a 5 ECTS course which is equivalent to approximately 135 hours.

We will spend 48 hours during 12 modules of each 4 lessons

This leaves you about 7 hours per module for working on assignments and self-study.

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Exam

- Oral exam
- The laboratory reports must be handed in on time and in accordance with requirements specified at the beginning of the semester.
- Grading is based on an individual oral examination covering the theory presented in the course lectures and the laboratory exercises. The laboratory reports form the starting point of the exam and is part of the assessment.
- Grading: 7-point grading scale

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Laboratory reports

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There may be times during the semester where you for some reason are unable to participate in the laboratory work and report writing. To this end I will accept that your name is missing on maximum 2 of the reports submitted during the semester. If you fail to contribute to more than 2 reports, I will report to the study administration that you do not meet the examination conditions.

Please notice that failing to contribute to a report during the semester does not exclude you from being questioned in the related theory and laboratory exercises conducted at the exam.

Laboratory reports

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Front page

Please make this a separate page that includes the below information and nothing else:

- Module name
- date
- All participating student's full name and SDU email address

Laboratory reports

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General requirements:

- Report length is 2-3 pages plus the front page. Any pages beyond this will not be read
- Pages must be A4 format, single column and have 2 cm margins.
- Font must be Times New Roman, Liberation Serif or similar at 12pt
- Page numbering must be present but no other headers or footers on the pages
- Add photos, images, sketches, tables etc. as applicable
- Add publications at the end and web links as footnotes as applicable
- Use of LLM’s for writing reports is forbidden...

Use of LLM’s in this course

LLM’s are Large Lange Models such as ChatGPT and CoPilot

Allowed

We acknowledge and encourage that you use LLM’s to support your software development tasks in this course

Forbidden

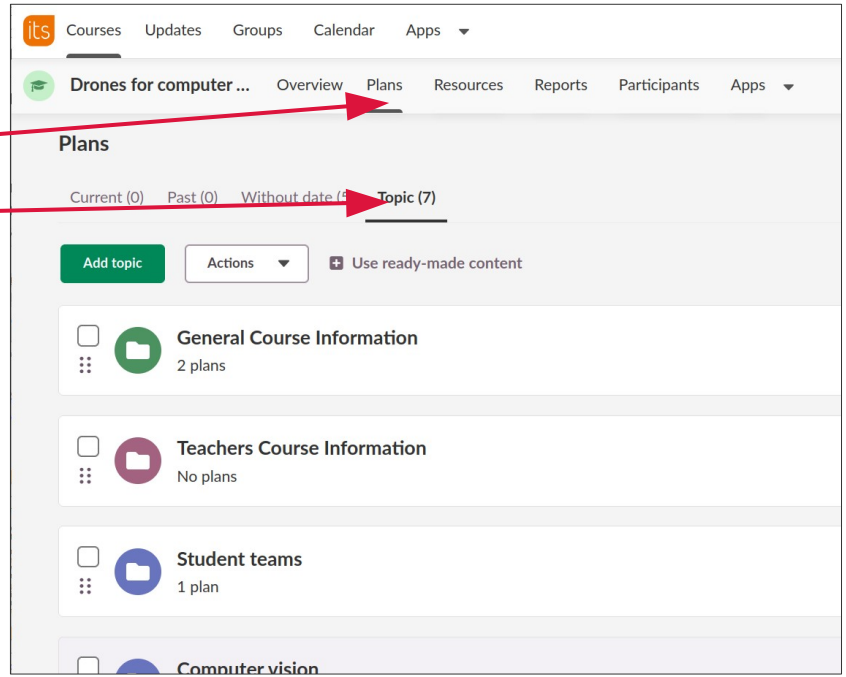
Use of LLM’s while writing the reports is forbidden

itslearning

You will find announcements, course information and materials, report submission etc. at SDU's learning platform itslearning

https://sdu.itslearning.com

Always click Plans and then Topic to find our materials



Teachers & instructors

Kjeld Jensen
Associate Professor
Course leader

Oscar Schofield
Engineer
Drone construction
& operations

Photo and video consent

During classes we may take some photos and videos of you as students in educational settings.

Our purpose is to use this material for future teaching materials, public presentations, social medias etc. We will only use the material for university related purposes and we will not sell the material.

Should you prefer that we don’t use any photos or videos where you appear in a portrait style for such purposes, please email kjen@mmmi.sdu.dk and we will make sure to exclude this material.

Student teams

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You will be working in teams of 3 students. Please start by filling out this form:

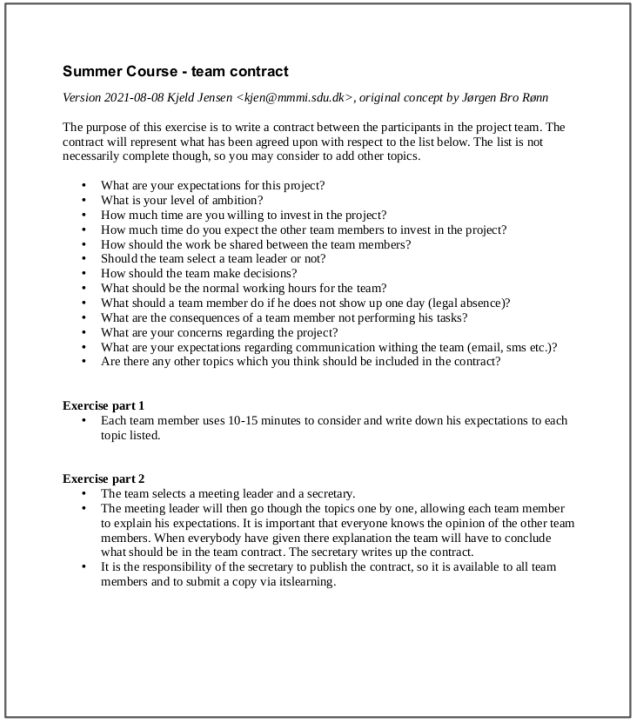
https://kjen.dk/go/idt/group

Team contract

To facilitate a good collaboration within the teams, we will conduct a team contract exercise.

The exercise is available at itslearning

Please submit the result of the team contract via itslearning by today



Summer Course - team contract

Version 2021-08-08 Kjeld Jensen <kjen@mmmi.sdu.dk>, original concept by Jørgen Bro Rønn

The purpose of this exercise is to write a contract between the participants in the project team. The contract will represent what has been agreed upon with respect to the list below. The list is not necessarily complete though, so you may consider to add other topics.

- What are your expectations for this project?
- What is your level of ambition?
- How much time are you willing to invest in the project?
- How much time do you expect the other team members to invest in the project?
- How should the work be shared between the team members?
- Should the team select a team leader or not?
- How should the team make decisions?
- What should be the normal working hours for the team?
- What should a team member do if he does not show up one day (legal absence)?
- What are the consequences of a team member not performing his tasks?
- What are your concerns regarding the project?
- What are your expectations regarding communication withing the team (email, sms etc.)?
- Are there any other topics which you think should be included in the contract?

Exercise part 1

- Each team member uses 10-15 minutes to consider and write down his expectations to each topic listed.

Exercise part 2

- The team selects a meeting leader and a secretary.
- The meeting leader will then go though the topics one by one, allowing each team member to explain his expectations. It is important that everyone knows the opinion of the other team members. When everybody have given there explanation the team will have to conclude what should be in the team contract. The secretary writes up the contract.
- It is the responsibility of the secretary to publish the contract, so it is available to all team members and to submit a copy via itslearning.