MECH1907 – Introduction to Aerospace Engineering

Fall 2023–2024

Course Description

1 General Information

Course instructor: Rhea P. LIEM, Associate Professor of the Department of Mechanical and Aerospace Engineering (MAE)

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Teaching assistants: Mr. Richard Yan Ho LOUIE and Mr. Huu Canh NGUYEN (Chris)

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- Office hours: By appointment

Lectures: Monday (09:00–10:20) and Wednesday (09:00–10:20).

- Lecture venue: Rm. 5583 (Lift 29/30, 5/F)

Feel free to contact the course instructor and TA's if you have any questions or concerns! We'll be happy to help you.

Notes:
All questions about course contents **MUST** be posted in the Discussions Forum on Canvas. Past experience told us that many students often had similar questions, so we would have a common place to share all those questions and answers, to help ensure consistency and completeness. The course instructor and TA's will check the Forum from time to time and we strive to give you speedy responses. While other students are strongly encouraged to join the discussion and chip in with solutions/opinions to questions posted in Forum, we will make sure to give the right answers or confirm the right answers (from other students) to make things clear. All non-sensitive and non-confidential questions sent via e-mails to the course instructor and TA's will not be entertained and students will be referred to the Discussions Forum instead.

2 Course Objectives

The main objective of this course is to give an overview of topics pertaining to aerospace engineering. The focus will be mainly on aeronautical engineering (atmospheric vehicles), with topics covering aerodynamics, structures, aircraft performance, thermodynamics, and propulsion (engine). Students will also be introduced to the non-engineering aspects of the field, including systems engineering, airline industry, environmental impacts of aviation, policy and regulations. Students are welcome to suggest relevant topics to be discussed in class, and will be accommodated whenever appropriate.

True to the course title, the materials covered will only be at **an introductory level**. Courses covering further details are also offered by MAE (e.g., MECH3620–Aircraft Design, MECH3640–Aerodynamics, MECH3650–Aircraft Structural Analysis, MECH3670–Aircraft Performance and Stability, to name a few).

We certainly hope that more and more students get more interested and passionate about this cool field! ✈

3 Textbook and Reference Materials

The main textbook for this course the *Introduction to Flight* by John D. Anderson, Jr. The latest edition is the 9$^{\text{th}}$ (available in Course Reserve), but you can also find some earlier editions in the HKUST library. The content should be more or less the same, i.e., it should not matter which edition you use. You can find some pdf file of the earlier edition online too.

The lecture note slides (in pdf format) will be prepared and uploaded to Canvas per topic, instead of per lecture. So make sure you are aware of when we finish a topic and start a new one. The notes are **intentionally made incomplete**; some derivations, equations, figures are purposely left out and will only be covered in class. So make sure you come to class with a notebook or papers to jot those down during lecture! If you have to miss any lectures for legitimate reasons, let me or the TA know and we will help you out.

4 Course Assessments

It has been a tradition in our course to encourage **active participation** from students during lectures and to provide a **comfortable learning environment** for students. Students' opinions and inputs are very important to us and to this course, so please actively participate in this course, speak up, and together we will make this course even more fun than usual! The course assessment methods are described briefly as follows:

Participation in "students' talk time" We will open the first few minutes of each lecture to give opportunities for students to speak up, either about the courses (feedback, suggestions—don't leave your complaints to when it'd be too late to fix anything) or about anything interesting in our field, such as:

- Recent news in aviation (e.g., the retirement of jumbo jets)
- Any new discoveries or intriguing discussion in aerospace engineering (e.g., engine-less flying vehicles, electric/hybrid aircraft, solar-powered UAV, etc)
- Any interesting discussion from the previous lectures
- ...

Essentially, please share what interest you. Some of the discussion points can be included into lecture contents, whenever appropriate.

Take-home quizzes There will be four take-home quizzes in total:

1. Quiz 1: Fluid dynamics
2. Quiz 2: Aerodynamics, thermodynamics, and propulsion
3. Quiz 3: Standard atmosphere, aircraft performance and mission analysis
4. Quiz 4: Aircraft structures and materials technology

The quizzes are typically released a few days before the due date (see the provisional schedule in Table 2). **The quizzes are conducted online on Canvas.**

Homework We will have three homework assignments, with formats similar to that of the final exam. The topics covered are:

1. HW1: Calculus, fundamental thoughts, fluid dynamics
2. HW2: Aerodynamics, thermodynamics, propulsion
3. HW3: Standard atmosphere, aircraft performance, structures, materials

The provisional schedule is given in Table 2. **All homework assignments require hard-copy submissions.**

Midterm assignment—guided self-learning assignment Students will pick a topic (among the list provided) and perform a self-study/exploration. The final submission will be in the form of short term paper/short video/presentation slides/poster of each student's choosing. More details to be provided later.

Final exam The final exam will contain both computational and conceptual questions (typically in a 7:3 ratio). In the final exam, students are expected to demonstrate their understanding and mastery not only on the subject matters but also on how they (e.g., aerodynamics and propulsion) are interrelated with each other.

Class participation This includes enthusiasm, questions asked, questions answered, class attendance, punctuality, involvement in discussions forum, and in-class behavior (yes, I do observe closely).

The overall numerical grade for this course will be computed using the weighting factors shown in Table 1 below.

Assessment	**Weightings**
Quizzes	10%
Homework assignments	20%
Midterm assignment	25%
Final exam	40%
Students' talk time + class participation	5%
TOTAL	100%

Table 1: Grade weighting factors.

5 Course Schedule

Table 2 shows the provisional schedule for Fall 2023/24. Some minor adjustments might be made as needed, but the overall structure should not change much. **As an important stakeholder in the course, each student is welcomed to give suggestions on topics to be covered and on how to improve the course overall**. Please contact us anytime if you have any suggestions, feedback, or even complaints.

Lecture	Date	Lecture Topic	Other schedules
1	Sept 4	Introduction	
2	Sept 6	Introduction	
3	Sept 11	Basic Maths and Physics Overview	Class survey [optional] due
4	Sept 13	Fundamental thoughts	
5	Sept 18	Fluid dynamics	
6	Sept 20	Fluid dynamics	HW1 out
7	Sept 25	Fluid dynamics	Quiz 1 out
8	Sept 27	Aerodynamics	Quiz 1 due, Midterm topic
-	Oct 2	The day following National Day	
9	Oct 4	Aerodynamics	HW1 due
10	Oct 9	Basic thermodynamics	
11	Oct 11	Introduction to propulsion system	HW2 out
12	Oct 16	Introduction to propulsion system	Quiz 2 out
13	Oct 18	Standard atmosphere	Quiz 2 due
-	Oct 23	Chung Yeung Festival	
14	Oct 25	Aircraft performance & mission analysis	HW 2 due
15	Oct 30	Aircraft performance & mission analysis	Exercise problem set out
16	Nov 1	Aircraft performance & mission analysis	Quiz 3 out
17	Nov 6	Aircraft structures	Quiz 3 due
18	Nov 8	Aircraft structures	HW3 out, Midterm due
19	Nov 13	Materials technology	
20	Nov 15	Materials technology	Quiz 4 out
21	Nov 20	Recap tutorial: in-class Q&A, exercise discussion	Quiz 4 due
22	Nov 22	Recap tutorial: in-class Q&A, exercise discussion	HW3 due
23	Nov 27	Introduction to systems engineering & aviation industry	
24	Nov 29	Course review	
-	**TBD**	**-**	**FINAL EXAM**

Table 2: MECH 1907 Fall 2023/24 provisional course schedule. Note that the schedule for final exam is not out yet. It will be announced once it is released by the university.

6 Homework Format

All homeworks are **individual assignments**. Group discussions with classmates are encouraged (see Section 7), but each student must submit his/her own work. Late submissions will incur a **late penalty** of 10% of total grade per day, for at most two days.

The homework you turn in would reflect the quality of your work and the effort you put into this course, so make sure that you take it seriously (and it is for your own good too!). Here are some guidelines for the homework submissions:

1. Neatness is considered in the final grading. Make sure your work is neat and well organized.
2. For each question involving calculations and/or equations, state clearly:
   (a) GIVEN: what information is provided in the question
   (b) ASKED: what the question asked you to solve
   (c) ANSWER: your answer to the question
3. Clearly indicate your final results by underlining your answers or putting a box around your answers.
4. State the unit clearly in the solution, including the final answer. It is part of a good engineering practice, and will help you identify any math errors.
5. When presenting your answers, you must **discuss your approach to solving them** (i.e., the rationale behind your answers), instead of only writing down the equations and numbers. State any assumptions clearly.

7 Collaboration Policy

You are encouraged to discuss with your classmates on how to solve the homework problems (feel free to use the Discussions Forum on Canvas too), and to have a deeper understanding of the course materials. However, **copying is not permitted** and a **zero-mark penalty** would be given for any misconduct. You still have to do your homework on your own, after the constructive discussions with your friends. Note that we are very strict about the honor code and academic integrity, and we practice **no tolerance** for any cheating and other academic misconducts.

✈ ✈ ✈ ENJOY THE COURSE! ✈ ✈ ✈