COURSE OUTLINE FOR STUDENTS AT NTU

Academic Year	2020	**Semester**	2
Course Coordinator	Assistant Professor Ng Bing Feng		
Course Code	MA1701		
Course Title	Introduction to Aerospace Engineering		
Pre-requisites	Nil		
No of AUs	3		
Contact Hours	Lectures: 39 hours		
Proposal Date	October 2020		

Course Aims

This course aims to provide you with a historical perspective of aerospace engineering, and fundamental knowledge in core competencies in aerospace engineering in the subjects of aerodynamics, propulsion, flight mechanics, structures and materials, as well as aircraft support systems. You will also be exposed to flight engineering and integrated system platforms and gain an overview of local strengths in aerospace engineering.

Intended Learning Outcomes (ILO)

Upon the successful completion of the course, you would be able to:

1) describe the historical development and summarise progress made to date in the aerospace field,
2) explain the basic concepts of aerodynamics, propulsion, flight mechanics, aircraft materials and structure, aircraft support systems.
3) connect different scope of aerospace engineering topics for a holistic description of flight
4) illustrate the importance of industry 4.0 and point out related state-of-the art technology and concepts,
5) break down engineering problems and solve them methodologically
6) develop a good level of competence in team work and presentation skills through group project.

Course Content

	Topic	**Hours**
1.	**Aviation history and aircraft anatomy** Historical Perspective of Aerospace Engineering; Aerospace Clusters, Buoyancy and Powered Flights, Principal Anatomy of Airplane.	2
2.	**Introduction to Aerodynamics** Standard Atmosphere; Governing Equations; Terminology; Phenomena; Types of Flows; Wind Tunnels & Measuring Speed; Airfoils.	5
3.	**Introduction to Propulsion** Basic Concepts; Propeller; Reciprocating Engine; Jet Propulsion & the Thrust Equation; Turbojet Engine; Gas Turbine & Turbofan Engines; Ramjet & Scramjet; Rocket Engines.	5
4.	**Flight Performance** Aircraft Performance; Performance curves for thrust and power; Drag components; steady level flight and analysis, accelerated flight and analysis, landing and taking-off phases; gliding flight	4
5.	**Stability and Control** Equilibrium; concepts of static and dynamic stability	3

6.	**Introduction to Helicopters** Rotary wing Aerodynamics of hover, climbing and forward flights, Autorotation of Rotors, Helicopter Performance and Controls.	4
7.	**Computing skills** Introduction to solving aerospace problems through computational means - Matlab	2
8.	**Industry 4.0 and related state-of-the-art aerospace topics** MRO and NDT, Fluid power, Unmanned air systems, etc.	5
9.	**Introduction to Local Aerospace Engineering** Distribution, strengths and weakness of local aerospace engineering, Investigation of local aerospace industry	3
10.	**Introduction to Aerospace Structures & Materials** Basic Concepts of Physics of Solids; Basic Materials Characterization; Major Aircraft Structural Components; Wings, Fuselage, Empennage, Nacelle, Pylon-Laminated Composites, Failure Analysis of Aerospace Materials.	6

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested (ILO 1 – 6)	Related Programme LO or Graduate Attributes (from EAB SLO a – l)	Weighting	Team/Individual	Assessment rubrics
1. Continuous Assessment 1: Quiz	1-3,5	a,b	30	Individual	
2. Continuous Assessment 2: Individual Project	2,3,5	c,d,e	15	Individual	
3. Continuous Assessment 3: Quiz	1-3,5	a,b	30	Individual	
4. Continuous Assessment 4: Group Project	1-6	a,b,d,f,g,h,i,j,k	25	Team	
Total			100%		

The list for the Engineering Accreditation Board Student Learning Outcomes is as follows:

a) **Engineering knowledge:** Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems
b) **Problem Analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c) **Design/development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate

consideration for public health and safety, cultural, societal, and environmental considerations.

d) **Investigation:** Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
e) **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f) **The engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g) **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for the sustainable development.
h) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i) **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
j) **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k) **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l) **Life-long Learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Formative feedback

At the end of the Quiz, a session will be conducted to go through the entire quiz, identifying common mistakes and showing the grade distribution. Students are allowed to see their scripts.
For the individual project, students will get back their submissions
For the group project, students get feedback after their presentation through Q&A

Learning and Teaching approach

Approach	**How does this approach support students in achieving the learning outcomes?**
Lecture	To convey concepts and reinforce learning outcomes. Teaching students to apply the knowledge of mathematics, engineering fundamentals to the solution of complex engineering problems
Individual project	To create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
Group project	To facilitate and encourage teamwork, communication and project management to reinforce engineering concepts through mini research project

Reading and References

Textbook

1. Anderson J D, Introduction to Flight. McGraw-Hill, Boston, 7th Edition, 2011.

References

1. Barnard R H, & Philpott D R, Aircraft flight, 4th Edition, Prentice Hall, 2010
2. Andersen J.D., Aircraft Performance and Design. McGraw Hill , 1999.
3. Kermode A C., Mechanics of Flight, Eds. Barnard R.H. and Philpott, Longman, 1996.
4. D.F. Garrett, Aircraft Systems & Components, Jeppesen Sanderson Inc., 1991.
5. I. Moir and A. Seabridge, Aircraft Systems, 3rd Ed, John Wiley and Sons Ltd., Wiley, 2008.
6. A. Esposito, Fluid Power with Applications, 7th Ed, Pearson Prentice Hall, 2009.

Course Policies and Student Responsibilities

As a student of the course, you are required to abide by both the University Code of Conduct and the Student Code of Conduct. The Codes provide information on the responsibilities of all NTU students, as well as examples of misconduct and details about how students can report suspected misconduct. The university also has the Student Mental Health Policy. The Policy states the University's commitment to providing a supportive environment for the holistic development of students, including the improvement of your mental health and wellbeing. These policies and codes concerning students can be found in the following link.
http://www.ntu.edu.sg/SAO/Pages/Policies-concerning-students.aspx

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, and collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Ng Bing Feng	N3.2-02-78	6790 4163	bingfeng@ntu.edu.sg
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6) develop a good level of competence in team work and presentation skills through group project.

Planned Weekly Schedule

Week	Topic	Course LO (ILO 1 – 6)	Readings/ Activities
1	Overview, aircraft history and anatomy	1-5	Textbook Chap 1,2.6
2	Aerodynamics	2-5	Textbook Chap 2-5
3	Aerodynamics	2-5	Textbook Chap 2-5
4	Propulsion	2-5	Textbook Chap 9
5	Flight performance **CA2** release and briefing	2-5	Textbook Chap 6
6	Stability and Control / UAV	2-5	Textbook Chap 7
7	Rotary wing and space flight	2-5	Textbook Chap 8
8	Aircraft structures and materials	2-5	Lecture notes
9	Aircraft structures and materials **CA1**	2-5	Lecture notes
10	Aircraft structures and materials, NDT, Fluid power	2-5	Lecture notes Garrett. Chap 5, 9, 12, 14 Moir Chap 2,4,5,7 Esposito Chap 2, 3
11	Aircraft structures and materials, NDT, Fluid power	2-5	Lecture notes Garrett. Chap 5, 9, 12, 14 Moir Chap 2,4,5,7 Esposito Chap 2, 3
12	**CA3/CA4**	6	Individual and group presentations
13	**CA4**	6	group presentations