Subject Description Form

Subject Code	ME578
Subject Title	Aircraft Design
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Exclusion: AAE5203 Aircraft Design and Certification
Objectives	To provide students with the key knowledge relevant to the process and principle of flight vehicle design, and the capacity to formulate the design requirements for a flight vehicle using modern engineering tools; to provide students with the opportunity to conduct flight vehicle system design studies from aerodynamics, propulsion, structure, stability, and performance perspectives; to develop management skills in teamwork and develop skills in carrying out detailed design tasks.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. understand fundamental concepts and constraints during a flight vehicle design process; b. evaluate common flight vehicle configurations; c. design and layout flight vehicle major components; d. understand aerodynamic, structural and engine characteristics; e. identify key design features of different types of flight vehicles; f. design and sizing flight vehicles that meets certain requirements; g. develop a simple design program; h. understand airworthiness and safety;
Subject Synopsis/ Indicative Syllabus	***Introduction to Aircraft Design:*** Design method and basic requirements. Evolution of aircraft design and its performance: a brief history. Overview of aircraft design cycle and process. ***Aircraft Configuration:*** Advantages and drawbacks of conventional and alternative configurations. Considerations for special aircraft. Primary considerations for fuselage, wing, and tail design. ***Jet propulsion:*** Basic considerations in the analysis of jet propulsion. Gas-turbine engines. Inter-cooling. Reheating. Regeneration. Ideal jet-propulsion cycles. Modifications to turbojet engines. ***Aerodynamic consideration of aircraft design:*** Fundamentals of aerodynamics. Flow separation. Friction and pressure drag. Parallel flow over flat plate and wings. Airfoils. Finite wings. Drag and lift. Lift-to-drag ratio. Dependence of lift and drag on the angle of attack. Flapped airfoils. End effects of wing tips. Induced drag. ***Structural consideration of aircraft design:*** Fundamentals of aerospace structures. Airframe basics. Aerospace materials. Stiffened panels. Trusses. Buckling. ***Sizing and Costing:*** Internal layout. Structures and weight. Geometry constraints. Sizing equation. Weight fraction method. Weight and balance. Cost analysis. Elements of life-cycle cost. Cost-estimating methods. Operations and maintenance costs. Cost measures of merit. ***Main Components Selection and Design:*** Selection and design of main components such as fuselage, wing, tail, and landing gear. Calculation and design of control surfaces such as aileron, elevator, and rudder. ***Airworthiness and Safety:*** Airworthiness requirements. Load factor determination. Aircraft safety. Airframe loads. Designing against fatigue. Prediction of aircraft fatigue life. ***Project practice:*** A design project will be carried out for students to learn the aircraft

<table>
<tr><td></td><td>design process through practice.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>Lectures are used to deliver the fundamental knowledge in relation to aircraft design (outcomes a to h).

Tutorials are used to illustrate the application of fundamental knowledge to practical situations (outcomes a to h).
<table>
<tr><td rowspan="2">Teaching/Learning Methodology</td><td colspan="8">Intended subject learning outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td></tr>
<tr><td>Lecture</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Tutorial</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Final examination</td><td>√</td><td>√</td><td></td><td>√</td><td>√</td><td></td><td></td><td>√</td></tr>
<tr><td>Design project</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
</table></td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="8">Intended subject learning outcomes to be assessed</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td></tr>
<tr><td>1. Design project 1</td><td>25 %</td><td>√</td><td>√</td><td></td><td></td><td>√</td><td></td><td>√</td><td></td></tr>
<tr><td>2. Design project 2</td><td>25 %</td><td></td><td></td><td>√</td><td>√</td><td></td><td>√</td><td></td><td>√</td></tr>
<tr><td>3. Design project presentation</td><td>10 %</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>4. Final examination</td><td>40 %</td><td>√</td><td>√</td><td></td><td>√</td><td>√</td><td></td><td></td><td>√</td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="8"></td></tr>
</table>
Overall Assessment:
0.6 x Continuous Assessment + 0.4 x End of Subject Examination

The group project is used to assess all aspects of the course content as well as the students' capacities of self-learning and problem-solving and effective communication skill in English so as to fulfill the requirements of being aircraft design engineers.</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture</td><td>24 Hrs.</td></tr>
<tr><td>▪ Tutorial/Case Study</td><td>15 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Course work</td><td>42 Hrs.</td></tr>
<tr><td>▪ Self-study</td><td>25 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>106 Hrs.</td></tr>
</table></td></tr>
<tr><td>Reading List and References</td><td>1. D. Raymer, Aircraft Design: A Conceptual Approach. American Institute of Aeronautics and Astronautics, Inc., 2018.
2. S.A. Brandt, et al., Introduction to Aeronautics: A Design Perspective, American Institute of Aeronautics and Astronautics Inc., 2015.
3. J. Anderson, Introduction to Flight. McGraw Hill, 2015.</td></tr>
</table>