Subject Description Form

Subject Code	AAE3001
Subject Title	Fundamentals of Aerodynamics
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	**Pre-requisite:** AMA2111 Mathematics I **OR** AMA2112 Mathematics II
Objectives	This subject will provide students with 1. To develop students' knowledge in the fundamentals of aerodynamics; and 2. To provide student's insight on airflow characteristics flowing through the aircraft; and 3. To develop the students' capability in designing aerofoil with the consideration of different wind factors.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Identify, formulate and solve problems in aviation engineering by applying knowledge of fundamentals of aerodynamics (including aerodynamics primarily in inviscid and incompressible flow); and b. Use the techniques, skills and modern computational and information technology necessary to analyze aerodynamics, lift and drag on simple geometries and thin airfoils.
Subject Synopsis/ Indicative Syllabus	**Introduction to Aerodynamics -** Aerodynamic variables, forces and moments. **Review of Fluid Mechanics -** • **Basic Concepts of Fluid Mechanics** – Properties of a fluid; Streamlines, streaklines, and pathlines; Angular velocity, vorticity, and strain; Compressibility; Types of flow – continuum versus free molecule flow, inviscid versus viscous flow, incompressible versus compressible flow, and Mach number regimes; An introduction to viscous boundary layers. • **Fluid Statics** – Fluid pressure; Pascal's law and pressure-height relation; Buoyancy. • **Fundamental Principles and Equations** – Control volumes and fluid elements; Substantial derivative; Reynolds transport theorem; Continuity equation; Momentum equation; Energy equation; Euler's equation. • **Dimensional Analysis** – Buckingham Pi theorem; Flow similarity; Dimensionless numbers: Mach, Reynolds, Prandtl, and Froude numbers. **Inviscid, Incompressible Flow -** Bernoulli equation; Flow in a duct – Venturi and low- speed wind tunnel; Pitot tube measurement of airspeed; Irrotational flow; Circulation; Stream function and velocity potential; Laplace equation and elementary solutions – uniform flow, source, sink, doublet, non-lifting and lifting flow over cylinder, vortex flow; Kutta-Joukowski theorem on circulation and lift.

Incompressible Flow over Airfoils - Airfoil nomenclature and characteristics; Kutta condition; Circulation and lift; Kelvin's circulation theorem and starting vortex; Thin airfoil theory; Viscous airfoil drag.

Incompressible Flow over Finite Wings - Downwash and induced drag; Vortex system on finite wing; Laws on vortex motion; Prandtl's lifting-line theory.

Viscous, Incompressible Flow - Boundary-layer properties; Boundary-layer equations; Blasius solution.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures, projects, tutorials, and homework assignments.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for aerodynamics.
3. Technical/practical examples and problems are raised and discussed in class.
4. Experiments or projects are used to evaluate the lift and drag of streamline objects and airfoils.

Teaching/Learning Methodology	Intended subject learning outcomes to be covered	
	a	b
1. Lectures	✓	✓
2. Projects	✓	✓
3. Tutorials	✓	✓
4. Homework assignments	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed	
		a	b
1. Homework assignments	20%	✓	✓
2. Tests	20%	✓	✓
3. Projects	20%	✓	✓
4. Examination	40%	✓	✓
Total	100%		

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Overall Assessment:

0.4 × End of Subject Examination + 0.6 × Continuous Assessment

Examination is adopted to assess students on the overall understanding and the ability of applying the concepts. It is supplemented by the tests and

	assignments which provide timely feedbacks to both lecturers and students on various topics of the syllabus.	
Student Study Effort Expected	Class contact:	
	▪ Lectures	33 Hrs.
	▪ Tutorials	6 Hrs.
	Other student study effort:	
	▪ Self-study	67 Hrs.
	Total student study effort	**106 Hrs.**
Reading List and References	1. Munson, B.R, Young, D. F., Okiishi, T. H., Huebsch, W. W., Fundamentals of Fluid Mechanics, John Wiley & Sons, 7th edition, 2012. 2. Anderson, J. D., Fundamentals of Aerodynamics, McGraw-Hill, 6th edition, 2016. 3. Bertin, J. J., Cummings, R. M., Aerodynamics for Engineers. Pearson, 6th edition, 2013.	

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