Subject Description Form

Subject Code	AAE6201
Subject Title	Advanced Computational Fluid Dynamics
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	N/A
Objectives	1. To provide students with advanced knowledge of computational fluid dynamics (CFD). 2. To develop students' capability to numerically analyse canonical flow problems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. obtain in-depth knowledge of CFD particularly in the compressible flow regime. b. get familiar with modern CFD techniques. c. perform numerical analysis of canonical flow problems.
Subject Synopsis/ Indicative Syllabus	**Partial differential equations** – Mathematical classification; Well-posed problem; Model equations; Euler equations; Navier–Stokes equations **Finite differences** – Error; Consistency; Stability; Upwind schemes; Flux splitting schemes; Flux-difference splitting schemes; Advection upstream splitting method (AUSM); Weighted essentially non-oscillatory (WENO) schemes; Compact schemes; Total variation diminishing (TVD) and slope limiters **Time-marching techniques** – Runge–Kutta methods; Lower-upper symmetric Gauss–Seidel (LU-SGS) method; Point relaxation method; Line relaxation method; Generalized minimal residual method **Other CFD techniques** – Finite-volume method; Grid generation; Boundary conditions; Parallel computing **Case studies** – Application of the numerical techniques to canonical aerodynamic problems

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorials, projects, and homework assignments.
2. The lectures/tutorials aim at providing students with integrated knowledge of CFD.
3. Technical/scientific problems and examples will be raised in projects and homework assignments to develop students' skills of numerical analysis.

Teaching/Learning Methodology	Intended subject learning outcomes		
	a	b	c
1. Lectures/tutorials	√	√	√
2. Projects	√	√	√
3. Homework assignments	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)		
		a	b	c
1. Projects	30%	√	√	√
2. Tests	20%	√	√	√
3. Examination	50%	√	√	√
Total	100%			

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

1. The assessment is comprised of 50% continuous assessment (projects and tests) and 50% examination.
2. The continuous assessment consists of projects and tests. They are used to evaluate the progress of students' study, assist them in self-monitoring of fulfilling the respective subject learning outcomes, and enhance the integration of the knowledge learnt.
3. The examination is used to assess the knowledge acquired by the students for understanding and analysing the problems critically and independently; as well as to determine the degree of achieving the subject learning outcomes.

Student Study Effort Expected

Class contact:	
▪ Lectures	33 Hrs.
▪ Tutorials	6 Hrs.

	Other student study effort:	
	▪ Self-study	33 Hrs.
	▪ Projects/homework assignments	50 Hrs.
	Total student study effort	122 Hrs.
Reading List and References	1. Anderson D. A., Tannehill, J. C., Pletcher R. H., Munipalli R., and Shankar V. (2020). *Computational Fluid Mechanics and Heat Transfer*. CRC Press, 4th edition. 2. Anderson J. D. (1995). *Computational Fluid Dynamics: The Basics with Applications.* McGraw-Hill, 1st edition. 3. Ferziger J. H., Perić M., and Street R. L. (2020). *Computational Methods for Fluid Dynamics*. Springer, 4th edition.	

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