MCEN90008 Fluid Dynamics

Credit Points:	12.50
Level:	9 (Graduate/Postgraduate)
Dates & Locations:	This subject is not offered in 2014.
Time Commitment:	Contact Hours: 36 hours of lectures, 12 hours of tutorials and up to 10 hours of practical work. Total Time Commitment: 200 hours
Prerequisites:	See below

Subject	Study Period Commencement:	Credit Points:
COMP20005 Engineering Computation	Semester 1, Semester 2	12.50

and one of

Subject	Study Period Commencement:	Credit Points:
MCEN30018 Thermodynamics and Fluid Mechanics	Semester 1, Semester 2	12.50

OR

Subject	Study Period Commencement:	Credit Points:
MAST20029 Engineering Mathematics	Summer Term, Semester 1, Semester 2	12.50

OR both of -

Subject	Study Period Commencement:	Credit Points:
MAST20009 Vector Calculus	Semester 1, Semester 2	12.50
MAST20030 Differential Equations	Semester 2	12.50

Corequisites:	None
Recommended Background Knowledge:	None
Non Allowed Subjects:	MCEN30004 Thermofluids 2 and MCEN30005 Thermofluids 3
Core Participation Requirements:	For the purposes of considering request for Reasonable Adjustments under the Disability Standards for Education (Cwth 2005), and Students Experiencing Academic Disadvantage Policy, academic requirements for this subject are articulated in the Subject Description, Subject Objectives, Generic Skills and Assessment Requirements of this entry. The University is dedicated to provide support to those with special requirements. Further details on the disability support scheme can be found at the Disability Liaison Unit website: http://www.services.unimelb.edu.au/disability
Contact:	**nhu@unimelb.edu.au (mailto: nhu@unimelb.edu.au)**
Subject Overview:	**AIMS** This subject builds upon previous introductory fluids courses, providing students with the basic skills necessary to calculate fluid flows around bodies. Broadly speaking the course is divided into two units; Unit 1: potential flow and Unit 2: compressible flow. These could

	equally be described as subsonic and supersonic aerodynamics respectively. Fluid flows have broad reaching applications in many engineering systems and examples as broad as building ventilation, mixing, as well as meterological applications are considered in unit 1. The supersonic course is more firmly concentrated on aeronautical / astronautical applications. Both units will start from the basic equations of motion governing fluid flow, and build a useable set of tools that enable the students to calculate flow fields in potential and supersonic flows. This approach will give students a clear sense of the origins of the tools that they use, and also a clear sense of the limitations. Such knowledge is necessary since these theories provided much of the backbone to early computational fluid dynamics packages used in industry. The two units are strongly linked by the same goal. Throughout the potential flow unit, we build slowly from first principles, proving the utility of potential flow solutions, adding building block flows until eventually the course culminates with a demonstration of how these techniques can be used to calculate the flow (and lift coefficient) of subsonic airfoils. The supersonic unit follows a similar approach, building from first principles, until we eventually develop a set of tools that enables the calculation of the flow (and lift coefficient) of supersonic airfoils. In doing so, students will be introduced to many aspects of supersonic aircraft design. **INDICATIVE CONTENT** This subject introduces students to analysis techniques used in subsonic and supersonic flows. Topics covered include (Unit 1) basic introduction to inviscid flow with and without vorticity; concepts and analysis using stream function and velocity potential; incompressible viscous flow past bodies with vortex shedding; magnus effect; complex velocity potential; (Unit 2) speed of sound; aerodynamic heating; normal and oblique shock waves; expansion fans; theories of thin airfoils; shock expansion theory; boundary layer and shock wave interactions; the `sound barrier'; experimental techniques.
Learning Outcomes:	**INTENDED LEARNING OUTCOMES (ILO)** Having completed this unit the student is expected to be able to: 1 - Use complex velocity potential analysis to solve a variety of inviscid flow problems including incompressible flow past airfoils 2 - Use Matlab to find numerical solutions of certain more complicated flow situations 3 - Understand the basic features of subsonic airfoils, including lift, drag and stall 4 - Apply shock expansion theory to the solution of flow in a variety of situations including prediction of lift and drag of two-dimensional bodies in supersonic flow 5 - Apply Ackeret or linear theory to thin airfoils 6 - Understand the basic features of supersonic airfoil designs and appreciate the differences between subsonic and supersonic airframe design.
Assessment:	One 3-hour end of semester written examination (60%) Assignment reports of up to 2000 words each (20% total) due before week 10 of semester Two practical laboratory reports of equal weight, each up to 2000 words, scheduled throughout the semester (20% total) Intended Learning Outcome (ILOs) 1 and 3 to 6 are addressed in the examination and two of the assignments. ILO 2 is addressed throughout the laboratories and assignments. ILO 3 is addressed in the laboratory
Prescribed Texts:	TBA
Breadth Options:	This subject is not available as a breadth subject.
Fees Information:	Subject EFTSL, Level, Discipline & Census Date, http://enrolment.unimelb.edu.au/fees
Generic Skills:	On completion of the subject students should have the following skills - # Ability to apply knowledge of science and engineering fundamentals # Ability to undertake problem identification, formulation, and solution # Ability to utilise a systems approach to complex problems and to design and operational performance # Ability to communicate effectively, with the engineering team and with the community at large

	# Ability to function effectively as an individual and in multidisciplinary and multicultural teams, as a team leader or manager as well as an effective team member
Notes:	**LEARNING AND TEACHING METHODS** The subject will be delivered through a combination of lectures and tutorials. Students will also complete two experiments which will reinforce the material covered in lectures.
Related Majors/Minors/ Specialisations:	B-ENG Mechanical Engineering stream Master of Engineering (Mechanical with Business) Master of Engineering (Mechanical)