UNSW Course Outline

ZEIT2602 Hydraulic Engineering - 2024

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General Course Information

Course Code : ZEIT2602
Year : 2024
Term : Semester 2
Teaching Period : Z2
Is a multi-term course? : No
Faculty : UNSW Canberra
Academic Unit : School of Engineering and Technology
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : UNSW Canberra at ADFA
Campus : UNSW Canberra
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course covers fundamental aspects of fluid mechanics and hydraulics. It contains a review of the fundamental equations of fluid mechanics, an expansion of the methods of momentum analysis known from thermofluids, and a detailed discussion of the powerful technique of

dimensional analysis, which allows the systematic discovery of parameter sets that govern the characteristic features of a flow. Special emphasis will be given to friction effects in fluid flows.

The course then examines several important applications in civil engineering, including friction and minor losses in single pipelines and pipe networks, pump-pipe systems and open channel flow; the latter will include friction losses and conservation of energy and momentum principles.

Course Aims

The primary aim of this course is to impart knowledge and understanding of fluid mechanics and hydraulics, including frictional fluid flow.

Students will have the experience of acquiring non-intuitive knowledge, which is not immediately accessible, enabling them to apply it to unknown situations that arise in engineering practice.

This fits into the underlying purpose of the whole program – to teach students how to learn.

A parallel aim is to demonstrate that theories developed in fluid mechanics, albeit complex and occasionally apparently esoteric, can inform us about fluids in “the real world”.

Relationship to Other Courses

Prerequisite: ZEIT1503

This course builds on ZEIT1503 (Engineering Mechanics) and ZEIT2500 (Thermofluids). The present course assumes knowledge of basic dynamics and thermodynamics principles, including fluid statics and control volume balance for momentum and energy. This course links the thermodynamic properties of a fluid with fluid behaviour when subject to external forces. It is the foundation for follow-on courses in subsequent years, in which the principles and practice of hydrology and environmental hydraulics will be developed, for example ZEIT3601 (Environmental Engineering) and ZEIT4604 (Hydrology and Environmental Engineering Practice).

Course Learning Outcomes

Course Learning Outcomes	Engineers Australia - Professional Engineer (Stage 1)
CLO1 : Understand the theoretical principles of incompressible fluid flow with friction, including mass, energy and momentum conservation principles, and the occurrence and features of laminar and turbulent flow.	• PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline • PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline
CLO2 : Apply the above conservation principles, as expressed in the Navier-Stokes equations, to the analysis of general laminar flows and their reduction to simpler flow systems.	• PEE1.2 : Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline • PEE2.1 : Application of established engineering methods to complex engineering problem solving
CLO3 : Apply the principles of dimensional scaling and analysis to engineering problems of a general nature.	• PEE2.1 : Application of established engineering methods to complex engineering problem solving • PEE2.2 : Fluent application of engineering techniques, tools and resources
CLO4 : Analyse pipe flow and pipe networks to determine flow rates and pressures (heads) throughout a network with and without a pump that has its operational characteristics fully specified.	• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline • PEE1.5 : Knowledge of engineering design practice and contextual factors impacting the engineering discipline
CLO5 : Understand the handling of frictional energy losses in channel flows and analyse channel flows using these principles in conjunction with energy and momentum conservation principles.	• PEE1.2 : Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline • PEE1.5 : Knowledge of engineering design practice and contextual factors impacting the engineering discipline • PEE2.1 : Application of established engineering methods to complex engineering problem solving
CLO6 : Be able to read and investigate further into topics in hydraulic engineering as required by a practising civil engineer.	• PEE3.4 : Professional use and management of information

Course Learning Outcomes	Assessment Item
CLO1 : Understand the theoretical principles of incompressible fluid flow with friction, including mass, energy and momentum conservation principles, and the occurrence and features of laminar and turbulent flow.	• Class Quiz • Final Exam • Assignments
CLO2 : Apply the above conservation principles, as expressed in the Navier-Stokes equations, to the analysis of general laminar flows and their reduction to simpler flow systems.	• Class Quiz • Final Exam • Assignments
CLO3 : Apply the principles of dimensional scaling and analysis to engineering problems of a general nature.	• Class Quiz • Final Exam • Assignments
CLO4 : Analyse pipe flow and pipe networks to determine flow rates and pressures (heads) throughout a network with and without a pump that has its operational characteristics fully specified.	• Class Quiz • Final Exam • Assignments
CLO5 : Understand the handling of frictional energy losses in channel flows and analyse channel flows using these principles in conjunction with energy and momentum conservation principles.	• Final Exam
CLO6 : Be able to read and investigate further into topics in hydraulic engineering as required by a practising civil engineer.	• Assignments • Final Exam

Learning and Teaching Technologies

Moodle - Learning Management System

Learning and Teaching in this course

Teaching Approach

The teaching for this course will include a mixture of in-class presentation, tutorials and laboratory exercises. The course has been designed to be technically rigorous and demanding. The course content and teaching methods have been informed by course evaluations and discussions with key stakeholders in academia, industry and Defence to provide essential knowledge and skills for practicing civil engineers. Where flip-mode material is used to supplement the lectures, students are expected to keep up with the completion of the appropriate material, including on-line quizzes, prior to the start of the discussion class. The class may be divided into groups for the discussion sessions.

Learning Approach

It is expected that students will purchase the reference text and keep abreast of each topic as it

is taught in class. This will include reading the relevant section(s) of the text prior to each class (note some topics will require wider reading), and completion of all tutorials and assessment work. Students are expected be fully prepared to participate during the classes.

The Learning Management System

Moodle is the Learning Management System used at UNSW Canberra. All courses have a Moodle site which will become available to students at least one week before the start of semester. Please find all help and documentation (including Blackboard Collaborate) at the Moodle Support page.

UNSW Moodle supports the following web browsers:

» Google Chrome 50+
» Safari 10+
** Internet Explorer is not recommended

** Addons and Toolbars can affect any browser's performance.

Operating systems recommended are:

Windows 7, 10, Mac OSX Sierra, iPad IOS10

For further details about system requirements click here.

Log in to Moodle here.

If you need further assistance with Moodle:

For enrolment and login issues please contact:
IT Service Centre
Email: itservicecentre@unsw.edu.au
Phone: (02) 9385-1333
International: +61 2 9385 1333

For all other Moodle issues please contact:
External TELT Support
Email: externalteltsupport@unsw.edu.au
Phone: (02) 9385-3331

International: +61 2 938 53331

Opening hours:
Monday – Friday 7:30am – 9:30 pm
Saturday & Sunday 8:30 am – 4:30pm

Additional Course Information

Academic Integrity and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW staff and students have a responsibility to adhere to this principle of academic integrity. All students are expected to adhere to UNSW's Student Code of Conduct https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Plagiarism undermines academic integrity and is not tolerated at UNSW. It is defined as using the words or ideas of others and passing them off as your own, and can take many forms, from deliberate cheating to accidental copying from a source without acknowledgement.

For more information, please refer to the following:

https://student.unsw.edu.au/plagiarism

Referencing

In this course, students are required to reference following the APA 7 / Chicago NB referencing style. Information about referencing styles is available at: https://guides.lib.unsw.adfa.edu.au/c.php?g=472948&p=3246720

Study at UNSW Canberra

https://www.unsw.adfa.edu.au/study

Study at UNSW Canberra has lots of useful information regarding:

- Where to get help
- Administrative matters

- Getting your passwords set up

- How to log on to Moodle

- Accessing the Library and other areas.

Additional Information as required

CRICOS Provider no. 00098G
The University of New South Wales Canberra.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Class Quiz Assessment Format: Individual	30%	Start Date: Not Applicable Due Date: Week 6: 19 August - 23 August, Week 12: 14 October - 18 October
Final Exam Assessment Format: Individual	50%	Due Date: exam week
Assignments Assessment Format: Individual	20%	Start Date: Not Applicable Due Date: Not Applicable

Assessment Details

Class Quiz

Assessment Overview

Two quizzes will cover material in the four modules. For the assignments, quizzes and examination, the greater portion of marks are awarded for demonstrating an understanding of the problem posed, an understanding of the method of its solution, intelligent attempts to obtain the solution and for the correct solution. Arithmetic and similar errors attract only minor penalties.

Course Learning Outcomes

- CLO1 : Understand the theoretical principles of incompressible fluid flow with friction, including mass, energy and momentum conservation principles, and the occurrence and features of laminar and turbulent flow.

- CLO2 : Apply the above conservation principles, as expressed in the Navier-Stokes equations, to the analysis of general laminar flows and their reduction to simpler flow systems.
- CLO3 : Apply the principles of dimensional scaling and analysis to engineering problems of a general nature.
- CLO4 : Analyse pipe flow and pipe networks to determine flow rates and pressures (heads) throughout a network with and without a pump that has its operational characteristics fully specified.

Detailed Assessment Description

Each quiz carries 15 % weight

Quizzes will be held in weeks 6 and 12

Assignment submission Turnitin type

Not Applicable

Final Exam

Assessment Overview

A 3-hour final exam, which will cover material from the entire course

Course Learning Outcomes

- CLO1 : Understand the theoretical principles of incompressible fluid flow with friction, including mass, energy and momentum conservation principles, and the occurrence and features of laminar and turbulent flow.
- CLO2 : Apply the above conservation principles, as expressed in the Navier-Stokes equations, to the analysis of general laminar flows and their reduction to simpler flow systems.
- CLO3 : Apply the principles of dimensional scaling and analysis to engineering problems of a general nature.
- CLO4 : Analyse pipe flow and pipe networks to determine flow rates and pressures (heads) throughout a network with and without a pump that has its operational characteristics fully specified.
- CLO5 : Understand the handling of frictional energy losses in channel flows and analyse channel flows using these principles in conjunction with energy and momentum conservation principles.
- CLO6 : Be able to read and investigate further into topics in hydraulic engineering as required by a practising civil engineer.

Assignments

Assessment Overview

Two assignments cover will cover material of selected modules. A suitable list of textbooks available in the library is provided in the recommended reading section

Course Learning Outcomes

- CLO1 : Understand the theoretical principles of incompressible fluid flow with friction, including mass, energy and momentum conservation principles, and the occurrence and features of laminar and turbulent flow.
- CLO2 : Apply the above conservation principles, as expressed in the Navier-Stokes equations, to the analysis of general laminar flows and their reduction to simpler flow systems.
- CLO3 : Apply the principles of dimensional scaling and analysis to engineering problems of a general nature.
- CLO4 : Analyse pipe flow and pipe networks to determine flow rates and pressures (heads) throughout a network with and without a pump that has its operational characteristics fully specified.
- CLO6 : Be able to read and investigate further into topics in hydraulic engineering as required by a practising civil engineer.

Detailed Assessment Description

Each assignment carries 10 % weight,

Assignments will be held in weeks 3 and 9

Assignment submission Turnitin type

Not Applicable

General Assessment Information

All marks obtained for assessment items during the session are provisional. The final mark as published by the university following the assessment review group meeting is the only official mark. The assessment will consist of a mix of class quizzes (2), assignments (2), and a final examination. These will assist learning by requiring you to study as the course proceeds. Each of the assessment items covers a different aspect of the learning outcomes. The purpose of the quizzes is to assess your understanding of the new tools you will be introduced to in the course, and assignments will give you the opportunity to apply these tools, while the research report will give you the opportunity to extend your lifelong learning and communication capabilities. The final exam will assess both your understanding of the tools and whether you can apply them properly.

Assignments are also intended to foster discussion with the lecturer, other staff and fellow students on the nature of the assignment problems and their solution. The detailed working of the solution and the preparation of the assignment submission itself must be your own individual work. Assignments reports must be prepared in a clearly structured and sufficiently annotated way, clearly showing the development of the final results. Assignments reports that do not meet

the basic standards for such take-home assessment tasks will not be accepted. Specific guidelines for them will be distributed in class. Assignment returns should be submitted through Moodle. Students will get the feedback of Assignment 1 by the census date (11 Aug). The examination components of the assessment provide assurance that the knowledge and understanding demonstrated are your own and provide a measure of that knowledge and understanding. They also provide an extra incentive for study. They will consist of:

- The two quizzes will cover material in the four modules. For the assignments, quizzes and examination, the greater portion of marks are awarded for demonstrating an understanding of the problem posed, an understanding of the method of its solution, intelligent attempts to obtain the solution and for the correct solution. Arithmetic and similar errors attract only minor penalties.
- Two assignments cover will cover material of selected modules. A suitable list of textbooks available in the library is provided in the recommended reading section.
- A 3-hour final exam, which will cover material from the entire course.

Detailed instructions for each examination component will be issued separately.

Unless prior arrangement is made with the lecturer or a formal application for special consideration is submitted, a penalty of 5% of the total available mark for the assessment will apply for each day that an assessment item is late up to a maximum of 5 days (120 hours) after which an assessment can no longer be submitted and a grade of 0 will be applied.

For this assessment task, you may use standard editing and referencing software, but not Generative AI. You are permitted to use the full capabilities of the standard software to answer the question (e.g. you may wish to specify particular software such as Microsoft Office suite, Grammarly, etc.). If the use of generative AI such as ChatGPT is detected, it will be regarded as serious academic misconduct and subject to the standard penalties, which may include 00FL, suspension and exclusion.

Grading Basis

Standard

Requirements to pass course

To obtain a passing grade in this course, you must attain a minimum mark of 40 % in the final examination and a minimum mark of 50 % for the combined in-session components (quizzes and assignments) of the assessment and an overall mark of at least 50 %.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 15 July - 19 July	Lecture	Introduction
Week 2 : 22 July - 26 July	Lecture	Module 1: Control Volume Analysis
Week 3 : 29 July - 2 August	Lecture	Module 1: Differential Analysis
	Assessment	Assignment 1
Week 4 : 5 August - 9 August	Lecture	Module 2: Turbulence
Week 5 : 12 August - 16 August	Lecture	Module 2: Similitude and Dimensional Analysis
Week 6 : 19 August - 23 August	Lecture	Module 3: Viscous pipe flow
	Assessment	Quiz 1
Week 7 : 9 September - 13 September	Lecture	Module 3: Viscous pipe flow
Week 8 : 16 September - 20 September	Lecture	Module 3: Multiple pipe flows
Week 9 : 23 September - 27 September	Lecture	Module 3: Multiple pipe flows
	Assessment	Assignment 2
Week 10 : 30 September - 4 October	Lecture	Module 4: Open channel flows
Week 11 : 7 October - 11 October	Lecture	Module 4: Open channel flows
Week 12 : 14 October - 18 October	Lecture	Module 4: Open channel flows
	Assessment	Quiz 2
Week 13 : 21 October - 25 October	Lecture	Revision

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

The following schedule is only tentative as the pace of lecturing is adjusted continually in response to the pace of learning. Modules III and IV can also be accessed on Moodle through flip mode videos.

- Weeks 1-3: Module I: Fundamental equations for frictional fluid flow
- Weeks 4-5: Module II: Turbulence and Dimensional analysis
- Weeks 6-9: Module III: Internal flow of real fluids and pipe flows
- Weeks 10-13: Module IV: Hydraulics of open channel flow

Course Resources

Prescribed Resources

A course website will be created on Moodle. Copies of the lecture notes, assessable materials, tutorials and other resources will be distributed on Moodle. Please access Moodle regularly to check on updates.

Compulsory Texts

Gerhart, P. M., Gerhart, A. L. and Hochstein, J. I. (2016). Munson, Young, and Okiishi's Fundamentals of Fluid Mechanics, 8th edition, Wiley

Recommended Resources

The following are recommended as additional reading:

Additional reading

- Schlichting, H. and Gersten, K. (2017). Boundary layer theory, 9th ed., Springer, Berlin, Heidelberg (standard reference for boundary layer theory)
- Potter, M. C., Wiggert, D. C. and Ramadan, B. H. (2015). Mechanics of Fluids, SI edition, 5th ed., Cengage Learning, Boston (we will use some of the pipe flow material)
- Kundu, P., Cohen, I. and Dowling, D. (2015). Fluid mechanics, 6th ed., Academic Press (good overview on fluid mechanics)
- Douglas, J.F., Gasiorek, J.M. & Swaffield, J.A. (2005). Fluid mechanics, 5th. ed., Longman Scientific & Technical, Harlow, U.K. (student friendly and comprehensive presentation)
- Pope, S. B. (2000). Turbulent flow, Cambridge University Press (to date reference on turbulence)
- Webber, N.B. (1965). Fluid Mechanics for Civil Engineers, Chapman & Hall, London (includes hydraulic structures).

Open channel flow (module IV)

- Dey, S. (2014). Fluvial Hydrodynamics, Springer, Berlin, Heidelberg (includes sediment transport)
- Chanson, H. (2004). The hydraulics of open channel flow – an introduction, 2nd ed., Butterworth-Heinemann, Oxford. UK. (student friendly introduction)
- Henderson, F.M. (1966). Open channel flow, Prentice Hall, New Jersey (standard reference in open channel flow).
- Chow, V.T. (1959). Open-channel hydraulics, McGraw-Hill, New York (standard reference in open channel flow).

Engineering report writing

- Winckel, A. & Hart, B. (2002). Report Writing Style Guide for Engineering Students, 4th ed., Faculty of Engineering, University of South Australia, Adelaide

Course Evaluation and Development

One of the key priorities in the 2025 Strategy for UNSW is a drive for academic excellence in

education. One of the ways of determining how well UNSW is progressing towards this goal is by listening to our own students. Students will be asked to complete the myExperience survey towards the end of this course.

Students can also provide feedback during the semester via: direct contact with the lecturer, the “On-going Student Feedback” link in Moodle, Student-Staff Liaison Committee meetings in schools, informal feedback conducted by staff, and focus groups. Student opinions really do make a difference. Refer to the Moodle site for this course to see how the feedback from previous students has contributed to the course development.

Important note: Students are reminded that any feedback provided should be constructive and professional and that they are bound by the Student Code of Conduct Policy

https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Matthias Kramer		Room 127, Building 20	0420639264	Please drop by my office or reach out via Email: m.kramer@unsw.edu.au	No	Yes