UNSW Course Outline

CVEN4308 Structural Dynamics - 2024

Published on the 28 Aug 2024

General Course Information

Course Code : CVEN4308
Year : 2024
Term : Term 3
Teaching Period : T3
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Civil and Environmental Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Postgraduate, Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

Fundamentals of structural dynamic analysis for discrete and continuous structures; free and forced vibration of single and multiple degrees of freedom systems; normal modal analysis; transient dynamic analysis by numerical integration; response spectrum; introduction to

nonlinear dynamic analysis of structures; wind, earthquake, human-induced vibration and wave loads: definitions and effects on structures; design of structures to resist dynamic loads.

Course Aims

This course will improve students' understanding of the fundamental concepts of structural dynamics and the nature of dynamic loads. This will enable students to apply dynamic analysis to civil engineering structures, including the ability to use commercial software, and design structures to withstand dynamic actions.

This is the primary course where students learn to deal with dynamic loads. It will build upon the knowledge of structural design and will enable students to engage with a greater range of design problems.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Apply the fundamental concepts of system dynamics with specific focus and application to civil/structural engineering
CLO2 : Identify and specify various types of dynamic loading for structural analysis
CLO3 : Apply the laws of dynamics to establish simple and realistic mathematical models of engineering structures
CLO4 : Analyse the dynamic response to a dynamic load and other important parameters for structural design
CLO5 : Evaluate the dynamic susceptibility of structures and the limitations of modelling techniques
CLO6 : Apply dynamic analysis methods to practical problems in structural engineering and other disciplines
CLO7 : Demonstrate collaborative skills by working with other students in teams

Course Learning Outcomes	Assessment Item
CLO1 : Apply the fundamental concepts of system dynamics with specific focus and application to civil/ structural engineering	• Quiz 1 • Quiz 2 • Assignment • Final Exam
CLO2 : Identify and specify various types of dynamic loading for structural analysis	• Quiz 1 • Quiz 2 • Assignment • Final Exam
CLO3 : Apply the laws of dynamics to establish simple and realistic mathematical models of engineering structures	• Quiz 1 • Quiz 2 • Assignment • Final Exam
CLO4 : Analyse the dynamic response to a dynamic load and other important parameters for structural design	• Quiz 1 • Quiz 2 • Assignment • Final Exam
CLO5 : Evaluate the dynamic susceptibility of structures and the limitations of modelling techniques	• Quiz 2 • Assignment • Final Exam
CLO6 : Apply dynamic analysis methods to practical problems in structural engineering and other disciplines	• Quiz 1 • Quiz 2 • Assignment • Final Exam
CLO7 : Demonstrate collaborative skills by working with other students in teams	• Assignment

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360

Learning and Teaching in this course

This subject consists of a mixture of lectures and workshops.

Lectures will cover the theories of structural dynamics and its applications to structural engineering. Application of the theories to formulate guidelines in the analysis of practical engineering problems will be emphasized.

The workshops provide you with the opportunity to discuss the lecture material with your demonstrator and to solve the set workshop problems. In order to understand the subject matter well, it is essential to attend the workshops and solve the workshop problems by yourself.

For each hour of contact it is expected that you will put in at least 1 hour of private study. You are recommended to review the lecture and workshop material weekly.

The teaching/learning activities are summarized in the following table:

Lecture

Cover fundamental principles and derivations underlying structural dynamics and material to be learned for assessment tasks

Follow worked examples

Hear announcements on course changes

Workshops

Practice solving set problems

Identify and resolve difficulties in theory and problem-solving

Be guided by your demonstrator

Ask questions

Private Study

Review lecture material and textbook

List difficulties

Prepare for the workshop and do set problems

Reflect on class problems

Study relevant references

Download materials from Moodle

Keep up with notices and find out marks via Moodle

Join Moodle discussions of problems

Work on assignment

Prepare for quizzes

Assessments

Demonstrate your knowledge and skills

Demonstrate higher understanding and problem solving

Suggested approaches to learning in this course include:

Regular participation in lectures and workshops. Review lecture and workshop material. Follow worked examples. Reflect on class problems and quizzes.

Weekly reading and recording of your learning.

Appropriate preparation for workshop activities.

Planning your time to achieve all assessment requirements (see assessment).

Keep up with the notices via Moodle and UNSW email. It is your responsibility to check your UNSW email regularly. NOTE: Announcements made in Moodle or via emails are equally official as announcements made during lectures.

We encourage you to work with your peers. A good way to learn the material is in small study groups. Such groups work best if members have attempted the problems individually before meeting as a group. A valued and honest collaboration occurs when, for example, you "get stuck" early on in attacking an exercise and go to your classmate with a relevant question.Your classmate then can learn from your question as well as help you.

Other Professional Outcomes

The objective of this course is to enable students to gain a thorough understanding of the nature of dynamic loads and the key factors influencing the dynamic behaviour of structures. The course will provide you with an appreciation of the fundamental concepts of structural dynamics and earthquake engineering to be used in the design of structures against dynamic action. These objectives contribute to the achievement of the civil and environmental program outcomes in the following way:

By studying the theoretical background concepts of structural dynamics and their application to realistic structural problems you will engage in depth with disciplinary knowledge in structural engineering.

By applying the theoretical concepts learned to defined and open-ended class problems you will develop a capacity for analytical and critical thinking and for creative problem solving.

By working on an assignment that requires you to find information beyond what was conveyed in the classroom you will engage in independent and reflective learning.

By documenting your assignment work in a standard that would be expected in a real consultancy environment you will acquire skills for effective communication as well as collaborative and multi-disciplinary work.

The assessment strategies used in this course will assist in achieving these objectives. Assessment consists of a mix of in-class quizzes that test your understanding of the fundamental concepts and your ability to apply learned strategies to relevant problems, a major assignment, that challenges your engineering abilities and a final exam. Further details are provided in the Assessment section.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Quiz 1 Assessment Format: Individual	10%	Start Date: 23/09/2024 02:10 PM Due Date: 23/09/2024 02:55 PM
Quiz 2 Assessment Format: Individual	10%	Start Date: 04/11/2024 02:10 PM Due Date: 04/11/2024 03:10 PM
Assignment Assessment Format: Individual	20%	Start Date: Not Applicable Due Date: 15/11/2024 11:55 PM
Final Exam Assessment Format: Individual	60%	Due Date: Please refer to Moodle for more information.

Assessment Details
Quiz 1

Assessment Overview

The 45 minute quiz will cover the application of taught concepts on SDOF systems. Marks will be returned within 2 weeks.

Course Learning Outcomes

- CLO1 : Apply the fundamental concepts of system dynamics with specific focus and

application to civil/structural engineering
- CLO2 : Identify and specify various types of dynamic loading for structural analysis
- CLO3 : Apply the laws of dynamics to establish simple and realistic mathematical models of engineering structures
- CLO4 : Analyse the dynamic response to a dynamic load and other important parameters for structural design
- CLO6 : Apply dynamic analysis methods to practical problems in structural engineering and other disciplines

<u>Detailed Assessment Description</u>

The quiz will take place during the lecture and will be an invigilated, open-book assessment. Laptops, tablets, and other digital devices are not permitted.

<u>Generative AI Permission Level</u>

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.

For more information on Generative AI and permitted use please see here.

Quiz 2

<u>Assessment Overview</u>

The 1 hour quiz will cover the application of taught concepts on MDOF systems. Marks will be returned within 2 weeks.

<u>Course Learning Outcomes</u>

- CLO1 : Apply the fundamental concepts of system dynamics with specific focus and application to civil/structural engineering
- CLO2 : Identify and specify various types of dynamic loading for structural analysis
- CLO3 : Apply the laws of dynamics to establish simple and realistic mathematical models of engineering structures
- CLO4 : Analyse the dynamic response to a dynamic load and other important parameters for structural design
- CLO5 : Evaluate the dynamic susceptibility of structures and the limitations of modelling techniques
- CLO6 : Apply dynamic analysis methods to practical problems in structural engineering and other disciplines

<u>Detailed Assessment Description</u>

The quiz will take place during the lecture and will be an invigilated, open-book assessment.

Laptops, tablets, and other digital devices are not permitted.

<u>Generative AI Permission Level</u>

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.

For more information on Generative AI and permitted use please see here.

Assignment

<u>Assessment Overview</u>

The purpose of the assignment is to expose you to a realistic structural dynamics problem, which requires you to apply what you have learned. Similar to engineering practice, this will require you to find additional information by asking, reading or discussing with your classmates, to critically evaluate your model and to formulate conclusions. Here, documentation is equally important as results. It is expected that you submit a report that is similar in scope, form, and style to what you would submit to a private or public client who has commissioned you with the dynamic analysis.

The assignment will cover the application of taught concepts on SDOF and MDOF systems, and earthquake response. Marks will be returned within 2 weeks.

<u>Course Learning Outcomes</u>

- CLO1 : Apply the fundamental concepts of system dynamics with specific focus and application to civil/structural engineering
- CLO2 : Identify and specify various types of dynamic loading for structural analysis
- CLO3 : Apply the laws of dynamics to establish simple and realistic mathematical models of engineering structures
- CLO4 : Analyse the dynamic response to a dynamic load and other important parameters for structural design
- CLO5 : Evaluate the dynamic susceptibility of structures and the limitations of modelling techniques
- CLO6 : Apply dynamic analysis methods to practical problems in structural engineering and other disciplines
- CLO7 : Demonstrate collaborative skills by working with other students in teams

<u>Detailed Assessment Description</u>

The assignment will be available from Week 3 and must be submitted via Moodle by Week 10. This assessment will present you with a set of structural dynamics problems, requiring you to

apply the concepts you've learned. Both documentation and results are equally important.

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

Simple Editing Assistance

In completing this assessment, you are permitted to use standard editing and referencing functions in the software you use to complete your assessment. These functions are described below. You must not use any functions that generate or paraphrase passages of text or other media, whether based on your own work or not.

If your Convenor has concerns that your submission contains passages of AI-generated text or media, you may be asked to account for your work. If you are unable to satisfactorily demonstrate your understanding of your submission you may be referred to UNSW Conduct & Integrity Office for investigation for academic misconduct and possible penalties.

For more information on Generative AI and permitted use please see here.

Final Exam

Assessment Overview

The final exam will be held during the final exam period and will be 2 hours in length.

Course Learning Outcomes

- CLO1 : Apply the fundamental concepts of system dynamics with specific focus and application to civil/structural engineering
- CLO2 : Identify and specify various types of dynamic loading for structural analysis
- CLO3 : Apply the laws of dynamics to establish simple and realistic mathematical models of engineering structures
- CLO4 : Analyse the dynamic response to a dynamic load and other important parameters for structural design
- CLO5 : Evaluate the dynamic susceptibility of structures and the limitations of modelling techniques
- CLO6 : Apply dynamic analysis methods to practical problems in structural engineering and other disciplines

Detailed Assessment Description

The final exam will assess your understanding of all course content and your ability to apply learned strategies to relevant problems. It will be an invigilated, open-book exam. Laptops, tablets, and other digital devices are not allowed.

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.

For more information on Generative AI and permitted use please see here.

General Assessment Information

The assessment of this course will be based on two quizzes, one assignment and a final exam. The final grade will be based on the sum of the scores from each of the assessment tasks. The lecturer reserves the right to adjust the final scores by scaling.

Two in-class quizzes are scheduled for Weeks 3 and 9, respectively. They will be open book. No laptops, tablets or other digital devices will be allowed. The quizzes will be held under exam conditions. The purpose of the quizzes is to test your understanding of the fundamental concepts and your ability to apply learned strategies to relevant problems.

One assignment is to be submitted in Week 10. The purpose of the assignment is to expose you to a realistic structural dynamics problem, which requires you to apply what you have learned. Similar to engineering practice, this will require you to find additional information by asking, reading or discussing with your classmates, to critically evaluate your model and to formulate conclusions. Here, documentation is equally important as results. It is expected that you submit a report that is similar in scope, form, and style to what you would submit to a private or public client who has commissioned you with the dynamic analysis.

A mark of at least 40% in the final examination is required before the class work is included in the final mark.

Penalties

Late submissions of the assignment will be penalised at the rate of 5% of the maximum achievable mark per day after the due time and date have expired. Submissions that are more than 5 days late (unless special considerations have been granted) are not accepted and 0 marks are awarded.

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 9 September - 15 September	Topic	Introduction to Structural Dynamics Single-Degree-of-Freedom (SDOF) Systems Free Vibration of SDOF Systems (Undamped Systems)
Week 2 : 16 September - 22 September	Topic	Free Vibration of SDOF Systems (Damped Systems) Harmonic Vibration of SDOF Systems
Week 3 : 23 September - 29 September	Assessment	Quiz 1
	Topic	Harmonic Vibration of SDOF Systems (Damped Systems - continued) Response of SDOF Systems to Periodic Excitation
Week 4 : 30 September - 6 October	Topic	Response of SDOF Systems to Arbitrarily Time-Varying Excitation (Unit Impulse, Step, Ramp, Pulse) Numerical Methods for Dynamic Response Evaluation
Week 5 : 7 October - 13 October	Topic	No lecture (Public Holiday) - Workshops will go ahead.
Week 6 : 14 October - 20 October	Topic	Flexibility Week (No Lectures or Workshops)
Week 7 : 21 October - 27 October	Topic	Multi-Degree-of-Freedom (MDOF) Systems Free Vibration Analysis of MDOF Systems
Week 8 : 28 October - 3 November	Topic	Free Vibration Response of MDOF Systems Forced Vibration Response of MDOF Systems (Modal Analysis)
Week 9 : 4 November - 10 November	Assessment	Quiz 2
	Topic	Earthquake Response of Linear Systems (SDOF Systems)
Week 10 : 11 November - 17 November	Topic	Earthquake Response of Linear Systems (MDOF Systems) Introduction to Wind Loading
	Assessment	Assignment Deadline

Attendance Requirements

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

Undergraduate students must attend at least 80% of the workshop/lab in which they are enrolled for the duration of the session.

General Schedule Information

- Class timetable: https://timetable.unsw.edu.au/2024/CVEN4308.html
- Lectures: Mondays 14:00 - 17:00 (Weeks:1-4,7-10), Electrical Engineering G22 (K-G17-G22)
- Workshops: Option 1: Wednesdays 13:00 - 15:00 (Weeks:1-5,7-10), Blockhouse G13 (K-G6-G13)

    Option 2: Wednesdays 15:00 - 17:00 (Weeks:1-5,7-10), Blockhouse G13 (K-G6-G13)

- Note: No lecture in Week 5 (Public Holiday) - the workshops will go ahead. No lecture and workshops in Week 6 (Flexibility Week).

Course Resources

Prescribed Resources

Textbook (recommended):

Chopra, A. K. Dynamics of Structures, 4th ed.: Prentice-Hall 2015.

Available online from UNSW Library and in print at Main Library Level 7 (624.1762/92) and other locations.

Recommended Resources

Clough, R. W. and Penzien, J. Dynamics of Structures, 2nd ed.: McGraw-Hill 1993, Available at Main Library Level 7 (P 624.171/112 A)

Bolton, A. Structural Dynamics in Practice: A Guide for Professional Engineers, McGraw-Hill 1994, Available at Main Library Level 7 (P 624.171/212)

Rao, S. S. Mechanical Vibration, SI ed: Prentice-Hall 2011, Available at Main Library Level 7 (620.3/143 AC)

Bachmann H., Amman W.J., Vibrations in structures induced by man and machines, Zurich, Switzerland : IABSE-AIPC-IVBH, 1987, Available at Main Library Level 7 (P 624.176/55)

Humar, J. L. Dynamics of Structures, 3rd edition.: CRC Press/Balkema 2012, Available at Main Library Level 7 (624.171/194 A)

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Lecturer	Ulrike Dackermann		H20, Room 610		Please email for availability.	No	Yes

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be

awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School Contact Information

For assistance with enrolment, class registration, progression checks and other administrative matters, please see the Nucleus: Student Hub. They are located inside the Library – first right as you enter the main library entrance. You can also contact them via http://unsw.to/webforms or reserve a place in the face-to-face queue using the UniVerse app.

For course administration matters, please contact the Course Coordinator.

Questions about the this course should normally be asked during the scheduled class so that everyone can benefit from the answer and discussion.