UNSW AUSTRALIA

Course Outline

Semester 1 2016

Never Stand Still | Engineering | Mechanical and Manufacturing Engineering

MECH4305

FUNDAMENTAL & ADVANCED VIBRATION ANALYSIS

Contents

1. Staff contact details

Contact details and consultation times for course convenor

Name: Dr Nathan Kinkaid
Office location: Room 507, Ainsworth Building (J17)
Tel: (02) 9385 4180
Email: nathan.kinkaid@unsw.edu.au

Consultation about course matters will be available in person in Room 507 on Fridays from 1300 – 1500. Other queries and questions can be directed by email or to a relevant Moodle forum.

Contact details and consultation times for additional lecturers/demonstrators/lab staff

Name: Dr Danielle Moreau
Office location: Room 408E, Ainsworth Building (J17)
Tel: (02) 9385 428
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2. Course details

Credit points:

This is a 6 unit-of-credit (UoC) course, and involves 3 hours per week (h/w) of face-to-face contact.

The UNSW website states “The normal workload expectations of a student are approximately 25 hours per semester for each UoC, including class contact hours, other learning activities, preparation and time spent on all assessable work. Thus, for a full-time enrolled student, the normal workload, averaged across the 16 weeks of teaching, study and examination periods, is about 37.5 hours per week.”

This means that you should aim to spend about 9 h/w on this course. The additional time should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

There is no parallel teaching in this course.

Contact hours

	Day	**Time**	**Location**
Lectures	Wednesday	1100 - 1200	Ainsworth 202
	Thursday	1000 - 1100	Ainsworth 102
Problem Solving Classes	Wednesday	1200 - 1300	Ainsworth G01 Ainsworth 101

Summary of the course

This course is a sequel to an introductory course in Vibrations (such as MMAN2300) where you will have studied oscillatory systems under a number of simplifying assumptions – linearity, sinusoidal forcing, constant coefficients, simple boundary conditions, etc. In this course, you will examine systems that are not so nicely behaved. As such, you will be exposed to new techniques for seeing, measuring, thinking about, analysing and designing oscillatory systems.

Aims of the course

The aim of this course can be stated simply: For everyone involved (staff, students, demonstrators) to progress further towards becoming really good engineers.
Our field of endeavour will be the concepts and applications of Vibration Analysis. Additionally, we will not measure our progress as the number of equations or facts or theories that we know. Rather we will undertake to measure our degree of transformation into someone who sees, understands, can make relevant and accurate predictions, and communicates about the world around us through the lens of Vibration Analysis.

Student learning outcomes

This course is designed to address the below learning outcomes and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

After successfully completing this course, you should be able to:

Learning outcome		**EA Stage 1 Competencies**
1.	Explain and describe principles and components of Vibration Analysis and their inter-relationships formally and informally, in writing and verbally, to technical experts, peers and lay people.	1.1, 1.2, 1.3 2.2 3.2, 3.4
2.	Model, approximate, analyse and simulate vibratory systems that include general forcing, general boundary conditions, and nonlinearities using appropriate computational tools as necessary.	1.1, 1.2, 1.3 2.2
3.	Discern the relevant principles that must be applied to describe or measure the equilibrium or motion of vibratory systems and discriminate between relevant and irrelevant information in the context.	1.1, 1.2, 1.3
4.	Demonstrate an ability to communicate clearly and precisely about technical matters related to Vibration Analysis.	1.2, 1.3 2.1 3.2, 3.4

3. Teaching strategies

This course will be delivered both in the classroom and online. Full participation in the class means that you will participate fully in both arenas. That is, you will be held accountable for all content, instructions, information, etc. that is delivered either in class or online.

Online: The online forum for participation in this class is the Moodle Platform, specifically the MECH4305 course at http://moodle.telt.unsw.edu.au/. All official online interactions will take place or be linked clearly and appropriately from this site.

In class: There are two in-class activities in a typical week which we refer to as the Lecture and Problem Solving Class based on the timetable above.
Both the online and in-class segments of this course are organised on the following principles:

1. **Learning:** Student learning is the first priority - teaching and assessment are secondary concerns. Learning here is defined as gaining new ways of seeing the world, not as being filled with information. We are trying to transform you into engineers and critical thinkers in the discipline.
2. **Peer Interaction:** Learning is a social activity, and research shows that you will learn most and best when you are actively taught by your peers and, in turn, when you teach them.
3. **Authenticity:** We will have as much authenticity of engineering practice as is possible within the constraints of the course and where it does not restrain your learning.
4. **High standards:** We will have high standards for achievement in the course, and everyone (including staff) will be accountable for putting in the effort to get you to the standard.
5. **Openness:** As much of the course as possible will be conducted in the open where all participants can be aware of it and comment upon it.
6. **Process:** The focus of the course will be on processes, not outcomes. The right outcomes will be a by-product of following the correct processes.

4. Course schedule

Date	Location	Lecture Content
Week 1 2/3/2016 3/3/2016	 Rm202 Rm102	Non-sinusoidal forcing of SDOF systems, convolution, Fourier analysis
Week 2 9/3/2016 10/3/2016	 Rm202 Rm102	Euler-Bernoulli beams – free response and modes, forced vibrations, orthogonality of modes
Week 3 16/3/2016 17/3/2016	 Rm202 Rm102	Hamilton's Principle and Lagrange's Equations for continuous systems
Week 4 23/3/2016 24/3/2016	 Rm202 Rm102	Approximation and discretization methods – Rayleigh's Quotient & the Rayleigh-Ritz Method
Week 5 5/4/2016 6/4/2016	 Rm202 Rm102	Approximation Methods: Rayleigh-Ritz, Assumed Modes Method
Week 6 12/4/2016 13/4/2016	 Rm202 Rm102	Basic Concepts in Nonlinear Vibration: Equilibrium and Stability
Week 7 19/4/2016 20/4/2016	 Rm202 Rm102	Key aspects of measuring vibration: Data acquisition and transducers, Signal classification, An introduction to signal processing **Quiz 1**
Week 8 26/4/2016 27/4/2016	 Rm202 Rm102	Phase Plane Analysis
Week 9 3/5/2016 4/5/2016	 Rm202 Rm102	Perturbation Analysis of Nonlinear Systems
Week 10 10/5/2016 11/5/2016	 Rm202 Rm102	Forced Response of Quasi-Harmonic Systems
Week 11 17/5/2016 18/5/2016	 Rm202 Rm102	Subharmonic Response of Quasi-Harmonic Systems
Week 12 24/5/2016 25/5/2016	 Rm202 Rm102	 **Quiz 2** Revision

5. Assessment

As much as is practicable, assessment in the course will be used to see if students have gained new ways of seeing, not to differentiate them from each other or to sort them. This is naturally limited by University rules concerning the grading of students and students desire to understand where they stand in relation to their peers.

Further details of individual assessment tasks will be provided on Moodle, including submission procedures and the criteria by which grades will be assigned.

Assessment overview

Name	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Marks returned
Problem Set 1	TBD	10%	1,2,3,4	Lecture material from weeks 1 & 2	Thursday, 24 March, 1700	Three weeks after submission
Problem Set 2	TBD	10%	1,2,3,4	Lecture material from weeks 3 & 4	Friday, 15 April, 1700	Three weeks after submission
Problem Set 3	TBD	10%	1,2,3,4	Lecture material from weeks 5 & 6	Friday, 6 May, 1700	Three weeks after submission
Problem Set 4	TBD	10%	1,2,3,4	Lecture material from weeks 7 & 8	Friday, 20 May, 1700	Three weeks after submission
Problem Set 5	TBD	10%	1,2,3,4	Lecture material from weeks 9, 10 & 11	Friday, 3 June, 1700	Three weeks after submission
Quiz 1	1 Hour	10%	1,2,3	Lecture material from weeks 1 - 5	Thursday, 20 April, 1000 – 1100	Three weeks after submission
Quiz 2	1 Hour	10%	1,2,3	Lecture material from weeks 6 - 10	Wednesday, 25 May, 1100 - 1200	Two weeks after submission
Final exam	3 hours	30%	1, 2,3	All course content.	Exam period	Upon release of final results

Assignments

Presentation

All submissions should have a standard School cover sheet which is available from this subject's Moodle page.

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work. Presenting them clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

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Further details of individual assessment tasks will be provided on Moodle, including submission procedures and the criteria by which grades will be assigned.

Submission

Late submissions will be penalised 5 marks per calendar day (including weekends). An extension may only be granted in exceptional circumstances. Where an assessment task is worth less than 20% of the total course mark and you have a compelling reason for being unable to submit your work on time, you must seek approval for an extension from the course convenor ***before the due date***. Special consideration for assessment tasks of 20% or greater must be processed through student.unsw.edu.au/special-consideration.

It is always worth submitting late assessment tasks when possible. Completion of the work, even late, may be taken into account in cases of special consideration.

Examinations

You must be available for all quizzes and examinations. Final examinations for each course are held during the University examination periods, which are June for Semester 1 and November for Semester 2.

Provisional Examination timetables are generally published on myUNSW in May for Semester 1 and September for Semester 2

For further information on exams, please see the Exams section on the intranet.

Quizzes and examinations in this course will be open book and open note.

Calculators

You will need to provide your own calculator, of a make and model approved by UNSW, for the examinations. The list of approved calculators is shown at student.unsw.edu.au/exam-approved-calculators-and-computers

It is your responsibility to ensure that your calculator is of an approved make and model, and to obtain an "Approved" sticker for it from the School Office or the Engineering Student Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

Special consideration and supplementary assessment

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

6. Expected Resources for students

Recommended textbook (available through the UNSW bookshop):

Rao, S.S. *Mechanical Vibrations*, 5th Edition in SI Units, Pearson

Other suggested books:

Meirovitch, L. *Fundamentals of Vibrations*, 1st Edition, Waveland Press

Meirovitch, L. *Principles and Techniques of Vibrations*, 1st Edition, Prentice Hall

Timoshenko, Young, Weaver, *Vibration Problems in Engineering*, 1975, Wiley

Thomson & Dahleh, *Theory of Vibrations with Applications*, 2013, Pearson

Inman, D.J., *Engineering Vibration*, 4th Edition, Prentice Hall

Craig & Kurdila, *Fundamentals of Structural Dynamics*, 2nd Edition, Wiley

Strogatz, S.H., *Nonlinear Dynamics and Chaos*, 2nd Edition, Westview Press

Den Hartog, J.P., *Mechanical Vibration*, Dover

Ewins, D.J., *Modal Testing: Theory and Practice*, Wiley

Moodle site for MECH4305 Access via: http://moodle.telt.unsw.edu.au/

Library: *http://info.library.unsw.edu.au/web/services/services.html*

7. Course evaluation and development

Feedback on the course is gathered periodically using various means, including the Course and Teaching Evaluation and Improvement (CATEI) process, informal discussion in the final class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

In this course, recent improvements resulting from student feedback include changing the lecture format to two one-hour lectures per week instead of one two-hour lecture.

8. Academic honesty and plagiarism

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: 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.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

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) even suspension from the university. The Student Misconduct Procedures are available here: www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Further information on School policy and procedures in the event of plagiarism is available on the intranet.

9. Administrative Matters

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

- Attendance, Participation and Class Etiquette
- UNSW Email Address
- Computing Facilities
- Assessment Matters (including guidelines for assignments, exams and special consideration)
- Academic Honesty and Plagiarism
- Student Equity and Disabilities Unit
- Health and Safety
- Student Support Services

N. Kinkaid
February, 2016

Appendix A: Engineers Australia (EA) Professional Engineer Competency Standards

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving
	PE2.2 Fluent application of engineering techniques, tools and resources
	PE2.3 Application of systematic engineering synthesis and design processes
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (professional and lay domains)
	PE3.3 Creative, innovative and pro-active demeanour
	PE3.4 Professional use and management of information
	PE3.5 Orderly management of self, and professional conduct
	PE3.6 Effective team membership and team leadership