KNE462
Advanced dynamics and vibrations

Contact details

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Consultation hours: 8.30am – 4.30pm weekdays

Unit details

School: Engineering
Faculty: Science, Engineering and Technology
Unit Title: Advanced dynamics and vibrations
Unit Code: KNE462
Prerequisites/Corequisites: Prerequisite: KNE357 Dynamic and Mechatronic Systems
Campus & Mode: Hobart, Internal
Unit Weight: 12.5%
Teaching Staff: Professor M R Davis

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Unit description

The unit is directed at developing an understanding of the analysis and design of dynamic mechanical systems. Topics to be covered will be selected from: Vibration - modal analysis of multi degree of freedom systems, modal matrix, characterisation of modes by generalised mass, stiffness and damping, modes of vibration of distributed systems, including beams and plates. Noise - the propagation and generation of sound, noise control, sound and vibration measurement, testing of absorbing materials, noise sources and enclosures, noise production and mechanisms; acoustics of ducts and silencers, and human response. Mechanical systems – pneumatic & hydraulic servomechanisms, application of frequency response, transient response, feedback, transfer functions & stability criteria.

Aim

The unit introduces students to the methods underlying the design and analysis of dynamic systems and noise including human response. It emphasizes understanding principles and applying them to practical situations. The aim is to give students the necessary skills to carry out basic design and performance analysis in the areas of modal vibration, experimental modal analysis, servomechanisms, noise generation and transmission and its effect on people.

Teaching approach

Teaching will consist of lectures, tutorials and practical classes.

- A formal lecture series will be employed to deliver core concepts, theory and examples.
- Tutorials will be used to develop, reinforce and test understanding of the subject and application of MATLAB to dynamic systems.
- 5 three-hour practical sessions will allow students to explore the subject and learn through investigation. Laboratory sessions will provide hands-on experience of modal vibration analysis, modes of vibration, dynamic response, measurement of noise absorption, acoustic room response, radiation from noise sources.

Learning outcomes

Learning outcomes include the development of skills and understanding in:

1. Nature of modes of vibration for lumped parameter and distributed systems
2. Identification of modal characteristics through testing
3. Propagation and generation of acoustic noise
4. Room acoustics and sound absorbing materials
5. Response of mechanical dynamic systems
Generic attributes

Students will develop abilities in

1. Ability to analyse theoretically and experimentally system characteristics
2. Basic technical competence in vibration, noise and dynamics
3. Ability to undertake problem identification, formulation and solution
4. Working as a team member in laboratory sessions.
5. Independent learning to solve problems

Prerequisites

Assumed skills

A background in mechanics, physics and mathematics applicable in solving dynamic system problems.

Prerequisite units

KNE357 Dynamic and Mechatronic Systems

Texts, references and learning resources

Reading lists will be provided but the following are particularly relevant:

Theory of vibration, WT Thomson, Unwin and Hyman, 3rd edition 1988

Learning resources

Booklets containing the following are distributed:

Course outline notes and references to texts, laboratory notes
Tutorial problems
Past examination questions

Teaching arrangements

Lectures

Lectures are delivered 4 hours per week.
Tutorials
Tutorial problems will be worked through as part of the lecture periods, in particular during the final weeks of semester.

Laboratory sessions
There will be five 3-hour (or equivalent) laboratory sessions in the unit covering of modal vibration analysis, modes of vibration, dynamic response, measurement of noise absorption, acoustic room response, radiation from noise sources. There will also be an online remote laboratory vibration system test (or a MATLAB control assignment in the event that there are problems with the online system). It is a mandatory requirement for this subject that all students attend and report on all six practical sessions. Instructions relating to the online vibration system test will be given during semester. Individual reports should be prepared for each session and should comprise the following main elements:

- Statement of overall objectives
- Description of apparatus with diagrams of equipment and instrumentation
- Method of conduct of measurements
- Analysis of results
- Discussion of outcomes relative to objectives and conclusions.

Submission of an individual report on each practical session is a mandatory requirement.

Occupational health and safety (OH&S)
The University is committed to providing a safe and secure teaching and learning environment. In addition to specific requirements of this unit you should refer to the University’s policy at: http://www.admin.utas.edu.au/hr/ohs/pol_proc/ohs.pdf

The School of Engineering issues a document to all students outlining its OH&S policy for the School’s Laboratories and Workshops. It is a requirement that all students must have read this document prior to entering any of the School’s workshops or. Also, an online OH&S induction is available and it is a requirement that students familiarise themselves with this, take the online test and obtain a School of Engineering safety authorisation card for the current year from the School office. It is required that students attending practical sessions have a card issued for the current year. Red cards are issued for 2012. Students should be particularly aware of the dress requirements for carrying out practical work which require adequate footwear and coverage of arms and legs with no loose clothing or hair. Failure to comply with requirements will result in exclusion from the laboratory until the matter is rectified and the imposition of a mark penalty of 25% of the mark awarded for that session.
Learning expectations and strategies

Expectations

The University is committed to high standards of professional conduct in all activities, and holds its commitment and responsibilities to its students as being of paramount importance. Likewise, it holds expectations about the responsibilities students have as they pursue their studies within the special environment the University offers.

The University’s Code of Conduct for Teaching and Learning states:

Students are expected to participate actively and positively in the teaching/learning environment. They must attend classes when and as required, strive to maintain steady progress within the subject or unit framework, comply with workload expectations, and submit required work on time.

Learning strategies

If you need assistance in preparing for study please refer to your tutor or lecturer. For additional information refer to the Learning Development website: http://www.utas.edu.au/learndev/

Unit schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic (dynamics and vibration)</th>
<th>Topic (noise)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Single and multi degree of freedom vibration</td>
<td>Noise definitions</td>
</tr>
<tr>
<td>2</td>
<td>Receptance, mobility, impedance, apparent mass</td>
<td>Noise measurement</td>
</tr>
<tr>
<td>3</td>
<td>Normal modes and frequencies</td>
<td>Noise transmission: superposition</td>
</tr>
<tr>
<td>4</td>
<td>Static and dynamic coupling</td>
<td>Measurement of material absorption</td>
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<tr>
<td>5</td>
<td>Experimental modal analysis</td>
<td>Transmission through walls</td>
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<tr>
<td>6</td>
<td>Concepts of feedback, mechanisms and transfer functions, D-operator</td>
<td>Transmission along ducts</td>
</tr>
</tbody>
</table>
7 Frequency response, Nyquist, Bode diagrams Free field noise radiation
8 Open and closed loop systems Reverberant enclosures
9 Transient response. Noise source mechanisms
10 Stability Scaling of noise sources
11 Proportional and integral systems Human response to noise
12 System tuning Noise exposure measures
13 Revision/tutorial Revision/tutorial

Assessment summary

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight/Value</th>
<th>Due date</th>
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<tbody>
<tr>
<td>Laboratory (6 sessions)</td>
<td>25%</td>
<td>Two weeks after conduct of the practical session or as notified. Participation in practical sessions and submission of a complete set of reports is mandatory.</td>
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<tr>
<td>Final 3 hr exam</td>
<td>75%</td>
<td>Examination period</td>
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Tutorial exercises/activities

Tutorial exercises in class will reflect material presented in lectures and form a basis for assignments to be completed outside of classes.

Laboratory Work

Task description

Undertake five sessions of laboratory work in groups: modal vibration analysis, modes of vibration, dynamic response, measurement of noise absorption, acoustic room response, radiation from noise sources. Also, carry out individually an online frequency response test of a vibrating system.
Completion of all six sessions and submission of an individual report on each is a mandatory requirement of this subject.

**Link to learning outcomes**

Laboratory sessions serve to demonstrate principles learned in lectures and tutorials

**Report criteria/guidelines**

Reports are to be submitted within two weeks of the conduct of the related practical laboratory session. Report are graded on correctness, explanation and presentation. The report format for reports is: Explanation of the work, clear laboratory record of results, analysis, discussion and conclusions.

Weighting of laboratory components

Six laboratory reports of equal weight.

**Final exams**

One three hour paper.

**How your final result is determined**

Final mark is the aggregate of assignment & laboratory marks (max 25%) and final examination (max 75%). A pass in the unit requires an aggregate mark of 50% overall and minimum marks of 45% for the examination and coursework component.

**Requests for extensions**

Only extensions on the basis of medical reasons will be considered.

**Penalties**

Late submission of reports or failure to comply with safety requirements may incur a penalty of 25% of the mark awarded incur an immediate penalty of 25% of the mark awarded.

It is a mandatory requirement that a complete set of assignment and laboratory reports is submitted: failure to submit a complete set of reports will lead to the award of a withheld result which will ultimately become a fail if the deficiency is not rectified. A minimum of 30% is required for each report.

**Attendance**

Attendance at practical sessions is mandatory. Whilst no specific minimum attendance is required for lectures students are advised that on the basis of past outcomes they are substantially less likely to
pass the subject if they do not attend a high proportion of lectures as examinations are closely based on the course of lectures and much of the analytical detail will not be found in texts and references.

**Additional assistance**

If you are experiencing difficulties with your studies or assignments, have personal or life planning issues, disability or illness which may affect your course of study, you should raise these with your lecturer.

Student Services staff are located in Hobart, Launceston and Burnie and provide a wide range of services to assist students, they include:

- Student Counsellor
- Careers Adviser
- Disability Adviser
- Student Employment Service.

Or visit the Student Services website at: [http://student.admin.utas.edu.au/services/](http://student.admin.utas.edu.au/services/)

Should you require assistance in accessing the Library visit their website for more information at [http://www.utas.edu.au/library/](http://www.utas.edu.au/library/)

Your contact Librarian for this unit is: Mr Richard Dearden

International Services website provides information on the assistance available to international students, visit their site at: [http://www.international.utas.edu.au/index.html](http://www.international.utas.edu.au/index.html)

The Learning Development website has a wide range of resources on study skills and learning strategies, visit their site at: [http://www.utas.edu.au/learndev/](http://www.utas.edu.au/learndev/)

**Help resolving concerns about this unit**

In the first instance you should contact your lecturer. If the matter is still unresolved and you would like to know who to contact or the procedures for resolving your concern refer to the following website: [http://student.admin.utas.edu.au/services/complaints/index.html](http://student.admin.utas.edu.au/services/complaints/index.html)

The Hobart based Tasmanian University Union (TUU) or the Launceston/Burnie based Student Association (SA) may also be able to assist.

**Unit feedback**

The University of Tasmania, on a regular basis, evaluates its teaching and learning environment through the Student Evaluation of Teaching and Learning (SETL) system. The University values
feedback from students and from time to time you will be asked to complete a SETL evaluation for a unit of study. For more information on SETL go to:


Plagiarism

Please read the following statement on plagiarism. Should you require clarification please see your unit coordinator or lecturer

Plagiarism is a form of cheating. It is taking and using someone else's thoughts, writings or inventions and representing them as your own; for example, using an author’s words without putting them in quotation marks and citing the source, using an author's ideas without proper acknowledgment and citation or copying another student’s work.

In fact the intentional copying and submission of someone else's work as one's own is a serious offence tantamount to academic fraud. It is a University offence punishable by a range of penalties that may range from a fine or deduction/cancellation of marks and, in the most serious of cases, exclusion from a unit, a course, or the University. When in doubt consult your lecturer or tutor. Details of penalties that can be imposed are available in the Ordinance of Student Discipline or at: www.utas.edu.au/plagiarism