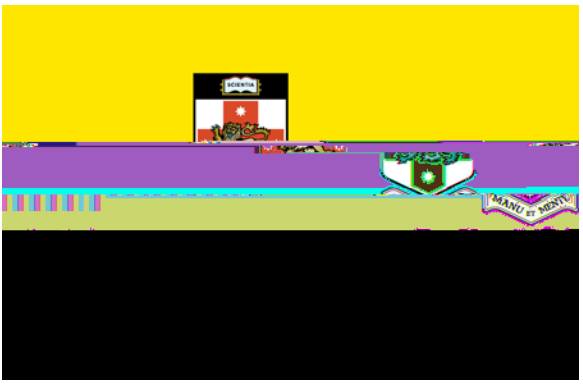

M M t E

C S O t

S st 2 2017

MECH9223

MACHINE CONDITION MONITORING

Contents

1. St t t s

Contact details and consultation times for course convenor

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Moodle:	https://moodle.telt.unsw.edu.au/login/index.php

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3. C[illegible]s

Credit Points

This is a 6 unit--

Student learning outcomes

This course is designed to address the learning outcomes below 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.	List machine condition monitoring techniques and contrast their uses and limitations.	PE1.1, PE1.2, PE1.3
2.	Employ vibration analysis techniques to diagnose faults in rotating and reciprocating machines and recommend proper actions.	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2
3.	Produce appropriate reports to communicate analysis results at a professional engineering level, including executive summary.	PE1.6, PE3.1, PE3.2, PE3.4
4.	Recall the different hardware used to measure and analyse vibration signals	PE1.2, PE1.3, PE2.2

4. T s t t s

Material in this course will be presented in Lectures, Demonstrations and Laboratory sessions.

Topics are usually first introduced through PowerPoint® presentations during the lecture time.

Demonstration sessions occur immediately afterward and are designed to investigate concepts in greater depth to ensure that you understand the application. Demonstration sessions have been devised to help you develop your theoretical understanding of the mathematical concepts and theories that you will need to learn. This will be done through several problems that will be provided during the demonstration time, and through MATLAB® examples.

5. C[illegible]

The following course schedule is an indication only, and may be adjusted slightly throughout the Semester.

Wk	Date	Lecturer	Topics covered
1	24 Jul	Phil Howlin	Overview of condition monitoring and vibration analysis maintenance practices. Condition monitoring methods: vibration analysis, oil analysis, performance analysis, thermography etc. Vibration transducers. Permanent vs intermittent monitoring. Signal classification and signals produced by machines and components in healthy and faulty condition. Vibration criteria.
2	31 Jul	Phil Howlin	Basics of mechanical vibrations. Vibration signal measurement and display. Introduction to signal processing. Frequency analysis using filters. Fourier analysis and the Fast Fourier Transform (FFT). Assignment 1 (15%) given (due Week 6 – 30 August)
3	7 Aug	Phil Howlin	Convolution and the convolution theorem. Practical FFT analysis; sampling theory, FFT pitfalls, aliasing, leakage, windowing. Scaling. Fault detection using constant percentage bandwidth (CPB) spectra on log frequency scales.
4	14 Aug	Phil Howlin	Advanced signal processing techniques; Hilbert transform, demodulation, cepstrum analysis, time-frequency analysis, cyclostationary analysis.
5	21 Aug	Phil Howlin	Order tracking to compensate for speed fluctuations. Separation of deterministic and random signals.
6	28 Aug	Phil Howlin	Diagnostics of rolling element bearings. Vibrations generated by local and extended faults. Envelope analysis by amplitude demodulation. Spectral correlation. **Assignment 1 (15%) due – 5pm Wednesday 30 August**
7	4 Sep	N/A	**Mid-Semester Exam (15%) – during lecture time** Assignment 2 (30%) given (due Week 12 – 18 October).
8	11 Sep	Dr Kana Kanapathi-pillai	Introduction to rotor dynamics. The Jeffcott rotor. More complex rotors. Critical speeds; forward/backward whirl. Unbalance; misalignment.
9	18 Sep	Dr Kana Kanapathi-pillai	Hydrodynamic bearings and their interaction with rotor dynamics. Reynolds equation and solutions.
25 Sep		Mid-semester break	
10	2 Oct	Phil Howlin	Gear diagnostics; time synchronous averaging (TSA), residual analysis, cepstrum analysis, time/frequency analysis.
11	9 Oct	Phil Howlin	Diagnostics of IC engines and other reciprocating machines; torsional vibration, time/frequency analysis.
12	16 Oct	A/Prof Zhongxiao Peng	Condition monitoring by oil analysis and wear debris analysis. **Assignment 2 (30%) due – 5pm Wednesday 18 October**
13	23 Oct	Phil Howlin	Review of course material.

6. Assessment

Assessment Overview

You will be assessed by way of two MATLAB®-based assignments and two examinations, all of which will generally involve a combination of calculations and

Assignments

Presentation

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

Submission

Assignments are due at 5pm on their due date through the TurnItIn submission ‘box’ on the course Moodle site. If 8.6(n Tw 2.6(s)-1.478 M</MCID b2(l)2.6ed)10.5(w)13.5(i)2.6(t)-6.6(a [(s)-2(ub)10.5(r

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

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.

7. Att

You are required to attend a minimum of 80% of all classes, including lectures, labs and seminars. It is possible to fail the course if your total absences equal to more than 20% of the required attendance. Please see the School intranet and the UNSW attendance page for more information.

Attendance will be noted periodically.

8. E

All material corresponding to the lectures, demonstrations and their solutions, and assignments will be provided in UNSW Moodle. Extra handouts and further useful material will be posted periodically in UNSW Moodle. You are advised to check it regularly.

All essential material for you to complete the course will be provided; the following references are mentioned in case you would like to investigate certain topics in further detail. The 'recommended text' is very useful for the course.

Recommended text

Randall, R. B., Vibration-based Condition Monitoring: Industrial, Aerospace and Automotive Applications, 1st Edition, Wiley, 2011. (Available in electronic form from the UNSW Library.)

Suggested references

Brandt, A., Noise and Vibration Analysis: Signal Analysis and Experimental Procedures, 1st Edition, Wiley, 2011.

Braun, S., Discover Signal Processing: An Interactive Guide for Engineers, 1st Edition, Wiley, 2008.

Rao, S.S., Mechanical Vibrations, 5th Edition, Prentice Hall, 2011.

Shin, K. and Hammond, J. K., Fundamentals of Signal Processing for Sound and Vibration Engineers, 1st Edition, Wiley, 2008.

Smith, D., Gear Noise and Vibration, 2nd Edition, Marcel Dekker, 2003.

Thomson, W. T., Theory of Vibration with Applications, 4th Edition, Chapman & Hall, 1993.

Other Resources

UNSW Library website: https://www.library.unsw.edu.au/
Moodle: https://moodle.telt.unsw.edu.au/login/index.php

9. C[illegible] t[illegible]

Feedback on the course is gathered periodically using various means, including the UNSW myExperience 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.

10. A[illegible]

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.

11. A[illegible]

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:

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals