MODULE DESCRIPTION FORM

ME507 MACHINERY DIAGNOSIS AND CONDITION MONITORING

Module Registrar: Dr Irina Trendafilova
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Taught To (Course): Cohorts for whom class is elective

Other Lecturers Involved: Dr Graeme West
Dr Victoria Caterson

Credit Weighting: 10 (ECTS 5)

Semester: 1 and 2

Assumed Prerequisites: 16327 Structural Mechanics; 16361 Dynamics and Control

Elective class

Academic Level: 5

Module Format and Delivery (HOURS i.e. 1 credit = 10hrs of study):

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Tutorial</th>
<th>Laboratory</th>
<th>Groupwork</th>
<th>External</th>
<th>Online</th>
<th>Project</th>
<th>Assignments</th>
<th>Private Study</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td></td>
<td></td>
<td>3</td>
<td>13</td>
<td>30</td>
<td>10</td>
<td>20</td>
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<td>100</td>
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</tbody>
</table>

Sem1: 1 lab

Group presentation in sem2

2 online assignments

Brief laboratory description:

Familiarisation with instrumentation and some analysis techniques.

Educational Aim

Condition monitoring and fault detection in structures and machinery plays an important part in the maintenance and protection of equipment, and has come to the fore since the recent advances in computer-based systems. The aim of the class is therefore to provide an understanding of Condition Monitoring (CM) and its relevance to industry. This is achieved by studying different CM and integrity assessment techniques, the instrumentation and use, and how they are applied. Particular attention is paid to vibration-based health monitoring and signal (time series) analysis.

Learning Outcomes

On completion of the module the student is expected to be able to

LO1 know and be able to explain the aim and the basics of CM;

LO2 be aware of some methods and procedures applied for general CM;

LO3 appreciate and understand the basic idea behind vibration-based structural health monitoring and vibration-based condition monitoring, know the general stages of CM;

LO4 be able to apply some basic techniques for analysis of random and periodic signals;

LO5 know the basics of Vibration of Linear Systems: time and frequency response, resonance;

LO6 be aware of some basic instrumentation used for machinery and structural vibration-based monitoring;

LO7 be aware of some basic faults in rotating machinery, their manifestation and methods for detection and recognition: low frequency, medium frequency and high frequency faults;

LO8 be able to recognise some basic faults in rotating machinery.

This is to be achieved by combining lecture material with tutorials and laboratory work.

Syllabus

The module will teach the following:

The basic idea of health monitoring and CM of structures and machines. Some basic techniques. Study of periodic and random signals, probability distribution, statistical properties, auto and cross correlation and power spectral density functions of commonly found systems, spectral analysis. Fourier transform: the basic idea of Fourier transform, interpretation and application to real signals. Response of linear systems to stationary random signals: FRFs, resonant frequencies, modes of vibration. Introduction to vibration-based monitoring. Machinery CM by vibration analysis: use and selection of measurements, analysis procedures and instruments. Typical applications to rotating machinery. Some other health monitoring techniques: acoustic emission, oil debris and temperature analysis. Applications.
**Brief description of assessment**
Laboratory exercise done in groups in semester 1. Report submitted online is worth 20% and includes some questions. Semester 2: Presentation prepared and done in groups worth 5%, Project/ Coursework is an individual assignment submitted online.

**Assessment of Learning Outcomes**

**Criteria**
For each of the Module Learning Outcomes the following criteria will be used to make judgements on student learning:

**LO1-LO4**
- These are assessed by the quality of the coursework in semester 1 and the inclusion of additional elements in it. These are discussed at the lectures and during the Lab exercise.
- An additional assignment is given to the students which is not compulsory. The first three outcomes are assessed by the completion of this assignment.
- These are also assessed by the participation of each student in the class discussions and his/her ability to answer the given questions.
- Students should demonstrate their knowledge by be able to discuss key concepts of the material during class discussion and through answering both written and verbal questions on the subject.

**LO5-LO7**
- These are assessed by the participation of each student in the class discussions and his/her ability to answer the given questions.
- They are assessed by the material included in each student’s presentation and the way the presentation is delivered. The students should be able to demonstrate their knowledge through the presentation.
- The extent to which each group completes the Lab exercise in sem.2 and the time used to complete it is also used to assess these outcomes.

The standards set for each criterion per Module Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessment.

**12 Principles of Assessment and Feedback**
(on Learning & Teaching web pages: [www.strath.ac.uk/learnteach/informationforstaff/staff/assessfeedback/12principles/](http://www.strath.ac.uk/learnteach/informationforstaff/staff/assessfeedback/12principles/))

Assessment is given in different forms
- Immediate self-directed feedback through in-class discussions and questions
- Written feedback from the Laboratory report
- Immediate self-directed feedback at Labs through discussions and through individual questions
- There will be two non-compulsory online exercises/questionnaires in both semesters which will be assessed after submission. Feedback will be provided online for each student individually.

**Assessment Method(s) Including Percentage Breakdown and Duration of Exams**

<table>
<thead>
<tr>
<th>Number</th>
<th>Month(s)</th>
<th>Duration</th>
<th><strong>Weighting</strong></th>
<th><strong>Number</strong></th>
<th><strong>Weighting</strong></th>
<th><strong>Number</strong></th>
<th><strong>Weighting</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>May/June</td>
<td>2 hrs</td>
<td>65%</td>
<td>2</td>
<td>30%</td>
<td>1</td>
<td>5%</td>
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<table>
<thead>
<tr>
<th>L/Outcomes</th>
<th>LO1-LO8</th>
<th>LO1,LO2,LO4,LO7</th>
<th>LO6-LO8</th>
</tr>
</thead>
</table>

Indicate which learning outcomes (LO1, LO2 etc) are to be assessed by exam/coursework/project as required.

**Coursework / Submissions deadlines:** The Lab report in semester 1 should be submitted two weeks after the Laboratory exercise.

**Resit Assessment Procedures:**
2hr examination in August diet.

**PLEASE NOTE:**
Students need to gain a summative mark of 50% to pass the module. This is calculated as the aggregate mark a coursework, one lab exercise, one presentation and an exam. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam.
Recommended Reading

****Purchase essential; ***Purchase recommended; **Highly recommended reading;
*Simply for reference (do NOT purchase)

****Online material including textbooks

Additional Student Feedback
(Please specify details of when additional feedback will be provided)

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<tr>
<th>Date</th>
<th>Time</th>
<th>Room No</th>
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Session: 2014/15

Approved:

Course Director Signature: [Signature]

Date of Last Modifications: 29 August 2014
Module Code: ME507
Module Title: Machinery Diagnosis and Condition Monitoring

Brief Description of Assessment:
Laboratory to be completed according to schedule in sem1. Report due 2 weeks after the Laboratory exercise. The report is submitted online and it involves some questions. Sem 2 Presentation week 10 (II sem) to be done in groups. Sem2 coursework/project is individual and it is submitted online. Exam in the May/June exam period.

Assessment Timing:-
Indicate on the table below the start/submission dates for each assignment/project and the timing of each exam/assessment(s).

<table>
<thead>
<tr>
<th>Semester One</th>
<th>WK1</th>
<th>WK2</th>
<th>WK3</th>
<th>WK4</th>
<th>WK5</th>
<th>WK6</th>
<th>WK7</th>
<th>WK8</th>
<th>WK9</th>
<th>WK10</th>
<th>WK11</th>
<th>WK12</th>
<th>Exam Period</th>
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<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
<td>Start Laboratory exercise for first two groups</td>
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<td>Start report submission for all groups</td>
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<td>End report submission for all groups</td>
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<table>
<thead>
<tr>
<th>Semester Two</th>
<th>WK1</th>
<th>WK2</th>
<th>WK3</th>
<th>WK4</th>
<th>WK5</th>
<th>WK6</th>
<th>WK7</th>
<th>WK8</th>
<th>WK9</th>
<th>WK10</th>
<th>WK11</th>
<th>WK12</th>
<th>Exam Period</th>
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<td></td>
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<td></td>
<td>Start project submission</td>
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<td></td>
<td>End project submission</td>
<td>May/June 2hour exam</td>
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