MODULE DESCRIPTION FORM

ME505 MACHINE DYNAMICS

<table>
<thead>
<tr>
<th>Module Registrar: Dr J Biggs <a href="mailto:james.biggs@strath.ac.uk">james.biggs@strath.ac.uk</a></th>
<th>Taught To (Course): Cohorts for whom class is optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Lecturers Involved:</td>
<td>Credit Weighting: 10 (ECTS 5) Semester: 1</td>
</tr>
<tr>
<td>Assumed Prerequisites: MM215 Maths (strong mathematical ability and understanding)</td>
<td>Optional class Academic Level: 5</td>
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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>18</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>100</td>
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Educational Aim

This module aims to cultivate an analytical approach to the dynamic problems which occur in conventional and modern machines from piston engine systems to autonomous system control with a view to developing good design and control practice and analytical skills. The course focusses on the dynamics and control of rotating components and machines both in 2-dimensions e.g. wind turbine dynamics and control and 3 dimensions e.g. spacecraft attitude dynamics and control. The course involves using complex numbers, linear algebra and ordinary differential equations to solve practical engineering problems.

Learning Outcomes

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

LO1 understand the fundamentals of modelling mechanical systems

LO2 understand the purpose of abstract mathematical modelling on machine design and control

LO3 understand the fundamentals of solving differential equations numerically and analytically and how this is useful for machine design and control.

LO4 understand how to develop controls for out-of-balance machines and rotating mechanisms.

Syllabus

The module will teach the following:

Introduction to machine dynamics.

Mathematical preliminaries of rotating mechanisms.

Out of balance and balancing of rotor-dynamic machines.

Out of balance and balancing of reciprocating machines.

Passive and active control of low-dimensional systems (rotations in the plane).

Passive and active control of High-dimensional machines (spatially rotating machines) such as autonomous underwater vehicles and spacecraft.

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 C1 students should be able to derive basic equations of motion for simple machine mechanisms

C2 students should be able to understand the different mathematical representations for rotating machines and the benefits of using them.

LO2 C3 students should be able to use complex numbers and manipulations to solve machine balancing problems.

C4 students should demonstrate an understanding of rigid body dynamics and control and how these relate to developing controls for modern machines.
LO3
C5 students should be able to solve simple linear differential equations with forcing terms in order to understand how to design vibration absorbers for machines.

LO4
C6 students should be able to design simple active control algorithms for machines and prove there stability.

LO7
C7 students should demonstrate a strong analytical approach to solving engineering problems related to the passive and active control of machines.

LO8
C8 students should demonstrate the ability to use numerical simulation to understand machine dynamics and control.

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/)

Formal, written feedback will be provided by the return of the coursework to students after each assignment (note: final exam scripts will not be returned to students).

Informal feedback will be provided at regular tutorial sessions primarily through verbal discussion with individuals or groups on tutorial exercises attempted in advance by students (note: to receive this feedback students should participate in these tutorials but attendance is not mandatory).

Feedback will be provided on return of each assignment and during tutorials.

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

<table>
<thead>
<tr>
<th>L/Outcomes</th>
<th>Number</th>
<th>Month(s)</th>
<th>Duration</th>
<th>Weighting</th>
<th>Number</th>
<th>Weighting</th>
<th>Number</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>LO1, LO2, LO3, LO4</td>
<td>1</td>
<td>January</td>
<td>2 hours</td>
<td>80%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LO1, LO2, LO3</td>
<td>3</td>
<td></td>
<td></td>
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Indicate which learning outcomes (LO1, LO2 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:
1 assignment with a deadline in week 8.

Resit Assessment Procedures:
2hr examination (answer 3 questions from 4) in the August diet.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of an exam.

Recommended Reading
The following books can be used as references but the course does not follow them.


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

<table>
<thead>
<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: 13/08/14
# Module Timetable

**Module Code:** ME505  
**Module Title:** Machine Dynamics

**Brief Description of Assessment:**

1 assignment which account for 20% of the final mark. The assignments will be a mixture of analytical based questions and numerical analysis undertaken using Matlab and 2 hour examination 80% of the final mark.

**Assessment Timing:**

Indicate on the table below the 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>CW</th>
<th>WK9</th>
<th>WK10</th>
<th>WK11</th>
<th>WK12</th>
<th>Exam Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester Two</td>
<td>WK1</td>
<td>WK2</td>
<td>WK3</td>
<td>WK4</td>
<td>WK5</td>
<td>WK6</td>
<td>WK7</td>
<td>WK8</td>
<td></td>
<td>WK9</td>
<td>WK10</td>
<td>WK11</td>
<td>WK12</td>
<td>Exam Period</td>
</tr>
</tbody>
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*January 2hr exam*