CLASS DESCRIPTION FORM

CL510 Advanced Structural Analysis and Design

Class Registrar: Yixiang Xu  Taught To (Course): SAE, CE, CEE, MSc in Civil Eng.

Other Lecturers Involved: Credit Weighting: 10  Semester: 1

Assumed Prerequisites: Structural mechanics classes  Compulsory/optional/elective class  Academic Level: 5

Class Format and Delivery (hours):

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Tutorial</th>
<th>Laboratory</th>
<th>Project</th>
<th>Assignments</th>
<th>Private Study</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>8</td>
<td>10</td>
<td>20</td>
<td>46</td>
<td>100</td>
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Educational Aim

To introduce the students to advanced topics in structural analysis and design of smart structures as well as mechanics of lightweight composite structures.

Learning Outcomes

On completion of the class the student is expected to be able to:

LO1 Understand the detailed mechanisms of lamina and laminate failure

LO2 Describe design processes commonly used for composite structures

LO3 Be able to use Matlab computing package to implement computational analysis which is applicable to form-findings of advanced shell or membrane structures

LO4 Be able to design basic novel structures, e.g. balloon and retractable roof.

(UK SPEC suggests no more than 4 learning outcomes per class. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the course specifications.)

Syllabus

The class will teach the following:

Part I: New structural concept and computational analysis

Introduction of Advanced Structures (Bistable, retractable, deployable, roof structures)

Geometric Foundations

Form Findings for Cable and Membrane structures (Computational Analysis)

Using Matlab

Retractable Structures

Part II: Composite Structures (Plate and shell)
**Introduction and processing**

- Introduction
- Fabrication technology

**Elastic behaviour of laminates**

- Elastic deformation of composites (stiffness bounds) and material property charts.
- On and off-axis elastic constants of laminates.
- Elastic deformation of laminates.

**Designing against failure**

- Underlying mechanisms of yield and failure for laminate. Strength of a single ply.
- Testing methods.

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**Assessment of Learning Outcomes**

**Criteria**

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

[Note: Criteria break the LO down into ‘teachable’ elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Understand the detailed mechanisms of lamina and laminate failure  
C1 Compute the material properties of composites  
C2 Set up ABD matrix for lamina  
C3 Compute the stresses within each ply and apply failure criteria

LO2 Describe design processes commonly used for composite structures  
C1 Identify and choose proper composite materials  
C2 Predict composite properties from fiber and matrix data

LO3 Be able to use Matlab computing package to implement computational analysis which is applicable to form-findings of advanced shell or membrane structures  
C1 Use Matlab to manipulate matrix and loop program  
C2 Use Matlab to solve differential equations  
C3 Perform form finding to find the solution of a required shape

LO4 Be able to design basic novel structures, e.g. balloon and retractable roof.  
C1 Use theories of deployable structures to set up governing equations for structural mechanism  
C2 Optimise the equation to yield a solution  
C3 Validate computer or theory model by experiments

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

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**12 Principles of Assessment and Feedback**

(on Learning & Teaching web pages: [www.strath.ac.uk/learnteach/teaching/staff/assessfeedback/12principles/](http://www.strath.ac.uk/learnteach/teaching/staff/assessfeedback/12principles/))

Please state briefly how these are incorporated in this class.

1. Marking criteria are outlined clearly in the assignment hand-out and multiple opportunities for questions are available, either in class or through electronic correspondence. Each marking sheet is taken directly from this handout.

2. Project work encourages interaction between peer groups and with the instructor.
3. Tutorial questions are provided to support student self-assessment and reflection.
4. Departmental policy is to carry out mid-term class assessments and provide feedback to students.

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

<table>
<thead>
<tr>
<th>L/Outcomes</th>
<th>Examinations</th>
<th>Courseworks</th>
<th>Projects</th>
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<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Duration</td>
<td>Weighting</td>
</tr>
<tr>
<td>LO1 LO2</td>
<td>1</td>
<td>45 min</td>
<td>50%</td>
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<tr>
<td>LO3 LO4</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:
- Late December 2013 - Early January 2014 TBC

### Resit Assessment Procedures:
- Exam

**PLEASE NOTE:**
Students need to gain a summative mark of 40% / 50% (please delete as appropriate) to pass the class. Students who fail the class at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam / coursework / viva (please delete as appropriate).

**Recommended Reading**

- Getting started with Matlab (Mathcad)

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

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<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Room No</th>
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<tbody>
<tr>
<td>Week 5</td>
<td>TBC</td>
<td>Classroom</td>
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Session: mid-term oral feedback.

**Approved:**

**Course Director Signature:**

**Date of Last Modifications:** 5/Aug/13

(Updated November 2010)
CLASS TIMETABLE

Class Code: CL510
Class Title: Advanced Structural Analysis and Design

Brief Description of Assessment:
One class test, one assignment and 2-3 laboratory computing sessions
Class test is set to take place at 12th week of duration 1.5 hours subject to change.
Deadline of submitting assignment is expected to be the late December or mid-end of January.

Assessment Timing:-

Indicate on the table below the Start/Submission dates for each Assignment/Project and the timing of each Exam/Class Test(s).

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<tr>
<th>Semester One</th>
<th>WK1</th>
<th>WK2</th>
<th>WK3</th>
<th>WK4</th>
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<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>Class test</td>
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<th>Semester Two</th>
<th>WK1</th>
<th>WK2</th>
<th>WK3</th>
<th>WK4</th>
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<th>WK9</th>
<th>WK10</th>
<th>WK11</th>
<th>WK12</th>
<th>Exam Period</th>
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<tbody>
<tr>
<td>Deadline for coursework</td>
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