MODULE AIM

This module introduces students to the principal stressed structural components in aircraft and more general aerospace vehicle designs. The effects of various types of loading on aerospace structures and the methods by which the resulting response characteristics may be modelled and evaluated are also covered.

MODULE LEARNING OUTCOMES

By engaging successfully with this module a student will be able to

I. Describe the general form and structural layout of typical aircraft structures

II. Apply free body diagrams and perform simple calculations relating to the loads on aircraft structures in steady and accelerated flight conditions

III. Perform simple calculations relating to stress and strain such as members under bending and torsion

IV. Demonstrate a basic understanding of the principles of fatigue and its application to aerospace structures.

INDICATIVE CONTENT

Terminology
Terms related to: flight, control, high lift devices, shape and dimensions

Form of Structures
General aircraft structures – layout for wings and fuselage
Basic load systems - shear, tension, compression, torsion, bending

Loads on Aircraft
Structural loads in steady flight, Equilibrium of loads, Free body diagrams
Supports and reactions, Internal Loads – axial load, shear force and bending moment diagrams
Design Loads – limit load, ultimate load, proof load, safety factors
Manoeuvre envelope

**Loads on Wings**
Members subject to lateral loading
Cantilever with: discrete load, discrete couple, uniformly distributed loads

**Loads in Accelerated Flight Conditions**
Load factor

**Stress Strain Relationships**
Stress and strain in tension loads, Shear stress and shear strain, Modulus of elasticity, modulus of rigidity (shear modulus), Stress and twist of members under torsion
Stresses in members under bending

**Fatigue**
Basic definitions, Mechanism of fatigue failure, Presentation of fatigue data
Fatigue damage and Miner’s Law

**Structural Dynamics**
Basic definitions and introduction to dynamic effects
Single degree of freedom lumped parameter systems - undamped, damped
Free and forced vibration - transmissibility
Introduction to acoustics

**LEARNING, TEACHING AND ASSESSMENT - STRATEGY AND METHODS**
Students will be supported in their learning, to achieve the above outcomes, in the following ways

The module will be delivered through a combination of lectures and tutorials, together with industrial visits and guest lectures invited from industries where appropriate.

Basic principles of structural design, both general and with specific application in aerospace structures, and the analytical methods used to perform sizing, strength, deformation etc. calculations will be presented and practiced.

Specific design cases will be used to reinforce the basic and applied principles.

The complete lecture notes will be available via Blackboard. There will be relevant software available on campus networks and students will be encouraged to use them freely. Further directed study will be supported by printed notes and guided reading.

The typical balance of contact time will be: Lectures/Tutorials: 50/50.
The final module mark will be determined through continuous assessment of learning outcomes (i) to (iv) through an individual portfolio of work consisting of:

1) Tutorial examples (50%)
   Assessment of learning outcomes: (i) to (iv).

2) A larger summative case study project, including a reflective review. (50%)
ASSESSMENT TASK INFORMATION

<table>
<thead>
<tr>
<th>Task No.</th>
<th>Short Description of Task</th>
<th>SI Code</th>
<th>Task Weighting %</th>
<th>Word Count or Exam Duration</th>
<th>In-module retrieval available</th>
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<tbody>
<tr>
<td>1</td>
<td>Coursework</td>
<td>CW</td>
<td>50</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Project Report</td>
<td>CW</td>
<td>50</td>
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</table>

ASSESSMENT CRITERIA

In order to pass this module, students must demonstrate evidence of:

i) Understanding of common aircraft structures and the loads which these experience in common flight modes.

ii) Understanding stress strain relationships applied to tension, bending and torsional load cases.

iii) Ability to apply these basic stress strain relationships to carry out basic analysis of key structural elements in steady state flight conditions.

iv) Understanding of the concept and mechanisms of fatigue and fatigue damage, specifically applied to aircraft structures.

v) Understanding of dynamic effects on aircraft structures.

vi) Ability to prepare written report in which results, interpretations and relevant conclusions are presented in a clear, coherent and systematic way.

Example of assessment criteria for each task

<table>
<thead>
<tr>
<th>Assessment Task</th>
<th>Pass</th>
<th>First</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1 (CW)</td>
<td>Individually demonstrate partially complete solutions to problems related to aerospace structures using standard theory and basic calculations.</td>
<td>Individually demonstrate a range of complete solutions at an advanced level to problems related to aerospace structures using standard theory and basic calculations.</td>
</tr>
<tr>
<td>Task 2 (PR)</td>
<td>Apply theoretical methods to an extended aerospace structures case study to partially solve given problems. Discuss with partial detail, justification and reflection related to the module subject.</td>
<td>Accurately apply theoretical methods to an extended aerospace structures case study to solve in full given problems. Critically discuss the case study with full detail, justification and reflection related to the module subject.</td>
</tr>
</tbody>
</table>

FEEDBACK

Students will receive feedback on their performance in the following ways:

Regular frequent formative feedback will be given by the tutors during tutorials and workshop sessions. Peer review and support will be encouraged.

Assessed work, with full feedback will be returned to the students via Sheaf reception or electronically via Blackboard.

LEARNING RESOURCES FOR THIS MODULE (INCLUDING READING LISTS)

Lecture and tutorial notes, laboratory equipped to carry out the experiments, relevant software.
SUGGESTED READING:


REVISIONS

<table>
<thead>
<tr>
<th>Date</th>
<th>Reason</th>
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<tr>
<td>Nov 2012</td>
<td>Confirmed in EDT Re/approval</td>
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**SECTION 2  MODULE INFORMATION FOR STAFF ONLY**

**MODULE DELIVERY AND ASSESSMENT MANAGEMENT INFORMATION**

**MODULE STATUS - INDICATE IF ANY CHANGES BEING MADE**

<table>
<thead>
<tr>
<th>New Module</th>
<th>Exisiting Module - No Change</th>
<th>Title Change</th>
<th>Level Change</th>
<th>Credit Change</th>
<th>Assessment Pattern Change</th>
<th>Change to Delivery Pattern</th>
<th>Date the changes (or new module) will be implemented</th>
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</thead>
<tbody>
<tr>
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<td>N</td>
<td>N</td>
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**MODULE DELIVERY PATTERN** - Give details of the start and end dates for each module. If the course has more than one intake, for example, September and January, please give details of the module start and end dates for each intake.

<table>
<thead>
<tr>
<th>Course Intake 1</th>
<th>Module Begins</th>
<th>Module Ends</th>
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<table>
<thead>
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<th>Module Begins</th>
<th>Module Ends</th>
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<tr>
<td></td>
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<td>30/06/2016</td>
</tr>
</tbody>
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**Is timetabled contact time required for this module?**

| Y |

**Are any staff teaching on this module non-SHU employees?**

| N |

**If yes, please give details of the employer institution(s) below**

**What proportion of the module is taught by these non-SHU staff, expressed as a percentage?**

**MODULE ASSESSMENT INFORMATION**

Indicate how the module will be marked

<table>
<thead>
<tr>
<th>Overall PERCENTAGE Mark of 40%</th>
<th>Overall PASS / FAIL Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y / N</td>
<td>Y / N</td>
</tr>
</tbody>
</table>

*Choose one only – module cannot include both percentage mark and pass/fail graded tasks*

**SUB-TASKS**

Will any sub-tasks (activities) be used as part of the assessment strategy for this module?

| N |

If sub-tasks / activities are to be used this must be approved within the Faculty prior to approval. Sub-task / activity marks will be recorded locally and extenuating circumstances, extensions, referrals and deferrals will not apply to sub-tasks / activities.

**FINAL TASK**

According to the Assessment Information shown in the Module Descriptor, which task will be the LAST TASK to be taken or handed-in? (Give task number as shown in the Assessment Information Grid in Section 1 of the Descriptor)

<table>
<thead>
<tr>
<th>Task No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
</tr>
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</table>

**NON-STANDARD ASSESSMENT PATTERNS**

MARK ‘X’ IN BOX IF MODULE ASSESSMENT PATTERN IS NON STANDARD, eg MODEL B, ALL TASKS MUST BE PASSED AT 40%.

**NB:** Non-standard assessment patterns are subject to faculty agreement and approval by Registry Services - see guidance notes.