SPACECRAFT STRUCTURES AND MECHANISMS - 2024/5

Module code: EEEM049

Module Overview

Module purpose: Spacecraft can range from small unmanned microsatellites through to large complex manned craft such as the international space station. Structure is the physical platform that supports and integrates sub-systems and payloads. As such, it is of fundamental importance for any spacecraft. Through a series of lectures and exercises, this module gives the students an understanding of the issues that must be addressed in the design and analysis of spacecraft structures and mechanisms.

Module provider

Computer Science and Electronic Eng

Module Leader

VIQUERAT Andrew (Mech Eng Sci)

Number of Credits: 15

ECTS Credits: 7.5

Framework: FHEQ Level 7

Module cap (Maximum number of students): N/A

Overall student workload

Independent Learning Hours: 98

Lecture Hours: 22

Tutorial Hours: 11

Guided Learning: 10

Captured Content: 9

Module Availability

Semester 2

Prerequisites / Co-requisites

None.

Module content

Indicative content includes the following.

- Overview of the module
- Launch and operational environment
- Vibration response
- Typical structural component
- Typical spacecraft structural layouts
- Typical spacecraft mechanisms
- Overview of structural analysis techniques for spacecraft structures, FEM
- Overview of materials typically used in spacecraft structures
- Structural thermal response

Assessment pattern

Assessment type	Unit of assessment	Weighting
Examination	OPEN BOOK EXAMINATION - 2 HOURS	100

Alternative Assessment

N/A

Assessment Strategy

The **assessment strategy** for this module is designed to provide students with the opportunity to demonstrate knowledge and application of the module content as described above.

The **summative assessment** for this module consists of the following:

- examination to be completed in person.

This will contain a selection of questions designed to assess the breadth and depth of knowledge that the students have gained by studying the module. The examination also verifies the assimilation of appropriate terminology, and the capability to apply specific structural design methodologies.

Formative assessment and feedback

For the module, students will receive formative assessment and feedback in the following ways.

- During live sessions, by question-and-answer sessions.
- During tutorials/tutorial classes, students are given exercises which they try to solve independently
- By means of unassessed tutorial problem sheets (with answers/model solutions), similar to homework and the students are given the solutions at a later date.
- During meetings with the lecturer or at the end of face-to-face sessions, the lecturer is available for one-to one Q&A with the students to clarify any doubt they may have regarding to the material that was presented during the lectures.
- There will be opportunities for formative assessment during other learning activities such as discussion forums.

Module aims

- To provide an overview of the issues that need to be addressed in the design of spacecraft structures and mechanisms.
- To provide students with an appreciation and understanding of the development of the whole spacecraft structural design process.
- To provide the student with the ability to apply this knowledge to practical applications.

Learning outcomes

		Attributes Developed	
Ref			
001	Having successfully completed the module, the student will be able to demonstrate knowledge and understanding of the development of the spacecraft structural design, starting from the definition of the structural requirements to the final structural test campaign. The students will also gain a good understanding of the basic principles of spacecraft mechanisms design.	CPT	M5
002	Having successfully completed the module, the student will be able to understand the mechanical design requirements quoted in launchers user manuals.	KC	M1, M2
003	Calculate preliminary loads on the spacecraft.	KCT	M3
004	Select appropriately the materials and structural parameters to meet basic requirements.	KC	M13
005	Perform a preliminary structural design/analysis of some spacecraft elements.	KC	M6

Ref		Attributes Developed	
006	Analyse data from experimental testing and compare them with theoretical predictions.	KC	M2

Attributes Developed

C - Cognitive/analytical

K - Subject knowledge

T - Transferable skills

P - Professional/Practical skills

Methods of Teaching / Learning

The learning and teaching strategy is designed to achieve the following aims

- To provide students with an overview of issues that need to be addressed in the design of spacecraft structures and mechanisms, giving them an appreciation and understanding of the development of the whole spacecraft structural design process.
- To provide the student knowledge and skills which are relevant for a future employment in industry or other institutions.

Learning and teaching methods include the following:

- Teaching is primarily by face-to-face lecture sessions and tutorials. Learning takes place through lectures, tutorials, and exercises. Some of the example problems come from real industrial applications.
- The students are invited to participate to the face-to-face lecture sessions raising questions, and at the end of these lectures the lecturer is available for one-to one Q&A with the students to clarify any doubt they may have regarding to the material presented during lectures.
- Pre-recorded Panopto video material providing supplementary material to the in-person sessions.

Indicated Lecture Hours (which may also include seminars, tutorials, workshops and other contact time) are approximate and may include in-class tests where one or more of these are an assessment on the module. In-class tests are scheduled/organised separately to taught content and will be published on to student personal timetables, where they apply to taken modules, as soon as they are finalised by central administration. This will usually be after the initial publication of the teaching timetable for the relevant semester.

Reading list

https://readinglists.surrey.ac.uk
Upon accessing the reading list, please search for the module using the module code: EEEM049

Other information

This module is designed to allow students to develop knowledge, skills and capabilities in the areas of Digital Capabilities, Employability, Global and Cultural Capabilities and Sustainability.

Digital Capabilities: Throughout this module students learn to navigate and utilise the Virtual Learning Environment @ Surrey (SurreyLearn) and other digital resources and online videos (e.g., YouTube) to aid their learning and undertake research. For example, the lecture provided by the European Space Agency specifically for this module is available on YouTube. Students are also encouraged to use current media such as Teams and Zoom, and cloud/file sharing for communication and team working.

Employability: Throughout this module, students will be taught by, and exposed to, a variety of internal and external invited speakers, exposing them to the variety of technical issues that professionals have in their workplace. The tasks and assessments undertaken across the module are specifically chosen to equip students with knowledge and skills that are key to the role of modern spacecraft structure engineers. Key to this, students will develop the ability to critically appraise evidence and the appropriate application of this knowledge in the design of future spacecraft structures and mechanisms, and by advancing research or creating new enterprises.

Global and Cultural Capabilities: the programme is taught in an interactive and collaborative way, in a cohort that commonly represents a wealth of nationalities and backgrounds. Students are encouraged to engage with, and learn from, diverse perspectives through interaction and teamwork.

Sustainability: Students will be supported to address sustainability considerations in problem-solving activities. The effectiveness of innovative material solutions to sustainable issues will be inherent in the design of future composite spacecraft structures.

This module is run in the second semester of the fourth (final) year for various MES and EEE programmes, and it is related to other space modules such as EEE3040 (Space System Design) and EEEM057 (Space Environment and Protection).

Programmes this module appears in

Programme	Semester	Classification	Qualifying conditions
Advanced Mechanical Engineering MSc	2	Optional	A weighted aggregate mark of 50% is required to pass the module
Aerospace Engineering MEng	2	Optional	A weighted aggregate mark of 50% is required to pass the module
Space Engineering MSc	2	Optional	A weighted aggregate mark of 50% is required to pass the module