STUDENT AND ACADEMIC SERVICES

MODULE SPECIFICATION

Part 1: Information			
Module Title	Space Systems Design		
Module Code	UFMFCV-15-M	Level	Level 7
For implementation from	2023-24		
UWE Credit Rating	15	ECTS Credit Rating	7.5
Faculty	Faculty of Environment & Technology	Field	
Department	FET Dept of Engineering Design & Mathematics		
Module Type:	Standard		
Pre-requisites	Space Engineering 2022-23, Spaceflight 2019-20		
Excluded Combinations	None		
Co-requisites	None		
Module Entry Requirements	None		
PSRB Requirements	None		

Part 2: Description

Overview: The module provides the principles and methods of space systems engineering. The objective is to architect a heterogeneous and complex space system at the preliminary design level. The content will encompass broad aspects of design and performance analysis through payload and bus subsystem behaviours, interactions and emergent properties.

A space system is a unified whole of integrated payload and platform subsystems. The system performs tasks that the subsystems alone cannot. The subsystems have origins in multiple technologies and energy domains (electrical, electronic, electromagnetic, information, optical, mechanical, nuclear and thermal). The subsystems contend for common resources. The system design begins with the analysis and trading the requirements to develop a conceptual design and a functional architecture. This is followed by apportioning the required sub-functions, performance requirements and technical budgets in a cordial way that no single subsystem surmounts or starves any other. Once each subsystem is allocated resources, a design and analysis process suiting the particular technology or energy domain of the subsystem is followed.

In this module, a high-level space system will be defined and designed, and the payload and bus subsystems will be developed to sufficient detail. The subsystems will be integrated and validated through several engineering analyses to ensure the overall spacecraft meets the mission objectives and system requirements.

Educational Aims: Apply the industry practice of systems engineering to the design of space systems. Develop a space system by allocating top-level functions, requirements and performance budgets to the subsystems. Integrate and validate system architecture. Use analytical and numerical techniques for system analysis. The module broadens the scope of the aerospace discipline to the space regime. The practice is favoured by the Royal Aeronautical Society.

Outline Syllabus: Spacecraft systems engineering.

NASA and ESA lifecycle engineering methodologies, processes and standards.

Technology readiness levels (TRLs).

Management of electrical, electronic, electromechanical (EEE) and commercial off the shelf (COTS) parts, procurement and parts reliability.

Model philosophy.

Conceptual design.

Mission and system requirements.

System architecture.

Functional analysis and functional tree.

Product tree and configuration management.

Preliminary design.

Analysis of system budgets and margins:

mass, area, volume,

CoG, envelope (mechanical loads),

pointing accuracy, field of view,

thermal margin,

radiation dose budget,

link budget,

reliability margin

cost.

Interfaces:

ground segment,

electrical, bi-level, data bus,

mechanical,

deployer and launch vehicle.

Allocation of requirements, functions and system technical budgets.

Payload design.

Bus design:

On-board computer (OBC),

Electric power system (EPS),

Attitude and orbit control system (AOCS), sensors and actuators,

Communications,

Propulsion and pyrotechnics,

Structure, thermal and mechanisms.

Assembly, integration & test (AIT).

Verification & validation (V&V).

Qualification.

Teaching and Learning Methods: The module delivery is designed to support students to engineer a space system at the preliminary design level.

The space systems engineering process, standards and design methods will be applied to the development of payload and bus subsystems of a spacecraft. To motivate and make clear the connection between theory and practice, the students will apply design and simulation techniques on different aspects of the system design. The material will then be explored in-depth and discussed in small groups in tutorials to develop a full-scale space vehicle system and its subsystems which will be analysed for technical feasibility, performance and space worthiness.

Part 3: Assessment

The assessment strategy is designed to allow students to follow the standard space systems engineering design process as part of a space team.

The space system will be developed during the module with a methodological approach supported by the weekly delivery of material. The students will work in groups in the tutorial and simulation-based workshops to conceptually design the space system. The student will then synthesise and refine the systems architecture by allocating resources, performing necessary technical analysis, and proving the design suitability.

Component A will be a controlled condition 2-hour open source examination (open book exam in a computer lab) to assess specific and independent learning.

Component B assesses a broader understanding of multidisciplinary space systems engineering in a team setting. The Component has two elements. Element 1 will be a 3500-word group report that documents the design detail of the space systems. Element 2 will be a half-hour group presentation and a demonstration of the mission viability.

The group marks will be moderated using a peer review process as set out in the Departmental Group Work Policy.

The resit assessment will follow the same format as above but with the report (1500 words) and the demonstration both being individual tasks.

First Sit Components	**Final Assessment**	**Element weighting**	**Description**
Examination - Component A	✓	50 %	examination (2 hours)
Report - Component B		50 %	written report (3500 words)

Resit Components	Final Assessment	Element weighting	Description
Examination - Component A	✓	50 %	examination (2 hours)
Report - Component B		50 %	written report (1500 words)

Part 4: Teaching and Learning Methods	
Learning Outcomes	On successful completion of this module students will achieve the following learning outcomes:

Module Learning Outcomes	Reference
Develop concepts and architectures for complex systems which outline user, operational and commercial requirements at mission level	MO1
Critically evaluate the performance of the system design against mission requirements.	MO2
Define the design of each subsystem at an appropriate level of detail and Integrate subsystems into an overarching design.	MO3
Assess the compatibility of system interfaces and resources within a complex system with multiple subsystems.	MO4
Apply the systems design cycle to Verify and Validate (V&V) the design against appropriately defined criteria, iterating the design process to achieve improvements as required. (EA2, EA4m)	MO5

Contact Hours

Independent Study Hours:	
Independent study/self-guided study	114
Total Independent Study Hours:	114
Hours to be allocated	150
Allocated Hours	114

Reading List

The reading list for this module can be accessed via the following link:

https://rl.talis.com/3/uwe/lists/7CCB85CC-03B8-46F1-85FC-75FEE9DDD579.html?lang=en-US&login=1

Part 5: Contributes Towards
This module contributes towards the following programmes of study: Aerospace Engineering [Sep][FT][Frenchay][4yrs] MEng 2020-21 Aerospace Engineering with Pilot Studies [Sep][FT][Frenchay][4yrs] MEng 2020-21