

Robust Engineering Systems Analysis and Failure Mode Avoidance

Module Code:	MAE7020-B
Academic Year:	2018-19
Credit Rating:	20
School:	Department of Mechanical and Energy Systems Engineering
Subject Area:	Mechanical and Automotive Engineering
FHEQ Level:	FHEQ Level 7 (Masters)
Module Leader:	Professor Felician Campean

Additional Tutors:

Pre-requisites:

Co-requisites:

Contact Hours

Type	Hours
Lectures	32
Tutorials	8
Directed Study	160

Availability Periods

Occurrence	Location/Period
BDA	University of Bradford / Semester 1 (Sep - Jan)
BDB	University of Bradford / Semester 1 (Sep - Jan)
BDA	University of Bradford / Semester 2 (Feb - May)
BDA	University of Bradford / Semester 3 (June - Oct)

Module Aims

This module aims to provide the advanced knowledge base underpinning a disciplined holistic approach to robust Engineering systems analysis and design, which employs a systematic methodology and process based on systems engineering and Failure Mode

Avoidance (FMA) tools and practices to ensure that all failure modes are discovered, and countermeasures developed and implemented in a timely and efficient manner early in the product creation process.

Outline Syllabus

FMA Foundation: Function Analysis in Systems Engineering

Overview of Engineering Systems Analysis and the FMA paradigm

Function analysis tools - Boundary Diagram, Interface Analysis, System State Diagram, Function Tree

Systems engineering methods and tools: Stakeholder mapping; Use Case analysis; Feature function analysis.

FMA Management tools: Failure Mode Investigation through FMEA and FTA

Function Failure Modes and Effects Analysis (FMEA)

Function Fault Tree Analysis (F-FTA)

FMA Demonstration: Robust Design Verification

Noise Factors Analysis through P-Diagram

Noise Factor Management Strategy through Robustness Checklist.

Robust Design Verification Process - development and management through Robustness

Demonstration Matrix and Design Verification Plan.

FMA Process Integration and Management.

Module Learning Outcomes

On successful completion of this module, students will be able to...

- 1
 - 1a. Demonstrate a critical understanding of the structured function based approach for managing interfaces in Systems Engineering Design;
 - 1b. Demonstrate a critical understanding of the concept of robustness in Engineering design.
- 2
 - 2a. Demonstrate mastery of the skills required to apply FMA Systems Engineering Tools for function analysis, failure mode and root cause analysis;
 - 2b. Ability to conduct Noise Factor Management analysis and develop and implement countermeasures to failure;
 - 2c. Plan and conduct robust design verification;
 - 2d. Management of the information flow in the FMA process.
- 3
 - 3a. Demonstrate FMA analytical and problem solving skills;
 - 3b. Communicate efficiently in a design team and contribute to teamwork facilitation.

Learning, Teaching and Assessment Strategy

This module will be delivered in a short course style, through a combination of formal presentations and hands-on case-studies. The learning materials (both lecture notes and case study) use a coherent problem based approach, introducing 'Failure Mode Avoidance' concepts and tools aligned with a range of Engineering scenarios. The hands-on case-studies aim to reinforce the concepts, principles and theories explored in the presentations, and develop the necessary skills for the application of the relevant FMA tools.

Assessment is via an individual report covering the application of the ESA&FMA methodology and tools to a specific Engineering problem in the workplace (typically part of a Six Sigma Black Belt project). Expected length of the report is up to 4,000 words, including

self-reflection of learning gain. The workplace based project will typically be part of Six Sigma Black Belt project or a Product Development project, and engineers will benefit from coaching and facilitation in the workplace from a technical expert (Master Black-Belt). At least one gateway review / clinic will be organised to support students with their coursework and provide feedback on their progress.

Mode of Assessment

Type	Method	Description	Length	Weighting	Final Assess'
Summative	Presentation	Presentations (team and individual)		20%	No
Summative	Coursework	Portfolio: Individual report on an engineering design case study based on the application of the ESA & Failure Mode Avoidance tools	0-4000 words	80%	Yes

Legacy Code (if applicable)

Reading List

To view Reading List, please go to [rebus:list](#).