

Module Name:	Titanium Alloys for Aerospace Applications
Module Code:	EGTM94
Presenter(s):	Professor John Evans/Dr David Rugg (Rolls-Royce plc) and Dr Roger Thomas (Timet UK)
Credit Rating:	10
Venue:	College of Engineering, Swansea University

Synopsis:

Titanium alloys are viewed as the archetypical aerospace materials. Developed extensively during the 1950s, they offered significant weight saving opportunities to aero-engine designers who had previously relied on relatively dense steels for the critical static and rotating components within the fan and compressor stages of the gas turbine. This module will review their historical development, current processing techniques (spanning ore extraction, sponge production, melting, casting and forming) and service applications. Failure investigations relating to open literature case studies will be discussed.

Intended Outcomes:

On completion of the module the students will gain an in-depth appreciation of:

- The types of titanium alloy, their processing routes and heat treatments
- The role of microstructure and texture in the optimisation of mechanical properties
- Associated machining, joining and surface treatment technologies
- Failure modes and their identification
- Design criteria

Module Aims:

On completion of the module the student will have gained an appreciation of the engineering benefits of titanium alloys to the aero-engine and airframe industries plus the associated economic issues surrounding their processing and service application. The future use of titanium alloys in these industries will be placed into context against competing material systems such as nickel based superalloys and organic matrix composites.

Syllabus:

Course Structure:

Day 1

- Historical context of titanium and its alloys.
- Fundamental crystallography
- Alloying techniques
- Extraction and working
- Heat treatment and microstructures
- Alloy processing
- Manufacturing techniques

Day 2

- Mechanical Properties
- Dwell fatigue and macrozones
- CF34 811 fan blade case study
- Welding/LFW/surface treatment
- Aeroengine design and applications

Day 3

- Plant tour, Timet Waunarlwydd
- Industrial applications
- Characterisation - NDT / EBSD/optical

- Microstructure and Failure analysis

Assessment:

5,000 word assignment to be submitted within three weeks, after the course presentation