
Module Leader
Dr E Shwageraus [1]

Lecturers
Dr N Read [2]

Timing and Structure
Lent Term. 16 lectures, 4 examples papers, 2 examples classes in support of coursework. Assessment: 100% coursework

Prerequisites
4M16

Aims
The aims of the course are to:

• provide an understanding of advanced systems, why they are being pursued, what their advantages are and their difficulties in becoming commercially viable designs.

Content
Further aims:

• What are the factors that are driving the development of advanced systems?
• Overview of fast reactor development & Generation IV reactor systems, including accelerator driven sub-critical reactors;
• Introduce the principles of fusion energy physics and the current status of research;
• Explain how the principles of fusion energy are to be applied for the design of future fusion energy systems;
• Re-cycle fuel studies, including reprocessing and re-fabrication;
• Status, issues and what would be needed to bring advanced reactor systems to a commercial standard with safety and economics as good as current Generation III+ designs

Fission Systems
• Design objectives, drivers & alternatives (2L)
• Advanced thermal systems – example high temperature gas-cooled reactor (2L)
• Fast spectrum reactor systems – including external lecturer A Judd (4L)
• Transmutation and advanced fuel cycles (2L)

Fusion Systems
Introduction & Physics of Fusion Systems - CCFE (2L)
Fusion reactions: cross-sections and reactivity
Magnetic and inertial approaches to fusion
Equilibrium, transport, instabilities and power balance

Physics & Materials - CCFE (2L)
- Heating systems and current drive
- Layout of a fusion power plant
- Fusion reactor components and materials requirements

Performance Safety and Design - CCFE (2L)
- Safety of a fusion reactor
- Radiological hazards and waste products
- Fusion in the market and timescale to commercial fusion plant
- Designing a fusion power plant

Examples papers
- Thermal Reactor Systems (High Temperature Gas-cooled Reactors)
- Fast Reactors
- Fusion: Plasma Physics and Reactor Engineering

Coursework

Coursework #1
Group project (3-4 students) researching into a particular advanced reactor design.
This part will be assessed by a group presentation to the rest of the class.
The presentations will be scheduled at a convenient time outside the normal lectures schedule.

Learning objective:
- Research in depth one of the advanced reactor systems
- Become familiar with a broad range of advanced systems, their strengths and weaknesses

Coursework #2
Fast reactor transient analysis using provided computer models.
This part of the coursework will be preceded by an examples class, where these models will be introduced and demonstrated.

Learning objective:
- Understand fundamentals of fast reactor transient behaviour and safety

Coursework #3
Problem set on advanced fission reactors, plasma physics and fusion technology.

**Learning objective:**

- Understand fundamentals of fusion power systems physics and engineering

**Booklists**

Please refer to the Booklist for Part IIB Courses for references to this module, this can be found on the associated Moodle course.

**Examination Guidelines**

Please refer to [Form & conduct of the examinations](http://teaching.eng.cam.ac.uk/content/form-conduct-examinations) [3].

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**Links**

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