

# Engineering Tripos Part IIB, 4I11: Advanced Fission and Fusion System, 2023-24

## Module Leader

[Dr N Read](#) [1]

## Timing and Structure

Lent Term. 16 lectures, 1 group presentation session. 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
- 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
- Advanced thermal systems – example high temperature gas-cooled reactor
- Fast spectrum reactor systems – including external lecturer A Judd
- Transmutation and advanced fuel cycles

### Fusion Systems

Introduction & Physics of Fusion Systems - CCFE

- Fusion reactions: cross-sections and reactivity
- Magnetic and inertial approaches to fusion
- Equilibrium, transport, instabilities and power balance

Physics & Materials - CCFE

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- Heating systems and current drive
- Layout of a fusion power plant
- Fusion reactor components and materials requirements

Performance Safety and Design - CCFE

- 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

## 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 analysis using provided computer models.

These models will be introduced during the preceding lecture.

Learning objective:

- Understand fundamentals of fast reactor behaviour

### 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](#) [2].

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### **Links**

[1] <mailto:nr438@cam.ac.uk>

[2] <https://teaching26-27.eng.cam.ac.uk/content/form-conduct-examinations>