Engineering Tripos Part IIB, 4M16: Nuclear Power Engineering (shared with IIA), 2018-19

Module Leader

Dr G Parks [1]

Lecturers

Dr G T Parks, Dr E Shwageraus and Mr R L Skelton

Timing and Structure

Lent term. 12 lectures + 2 examples classes + 2 laboratory demonstrations. Assessment: 100% exam

Aims

The aims of the course are to:

- give the student an introduction to and appreciation of nuclear power engineering and the UK nuclear industry

Objectives

As specific objectives, by the end of the course students should be able to:

- appreciate the nature of neutron-nucleus interactions
- classify ionising radiation by physical nature and health hazard
- conduct safely a simple experiment involving radiation
- understand the principles of radiation detection and shielding
- understand the principles of operation of UK nuclear reactors
- apply elementary models of neutron behaviour in reactors
- compute simple power distributions in reactors
- compute simple temperature distributions in reactors and appreciate their consequences
- appreciate the significance of delayed neutrons and xenon-135 to the control and operation of reactors
- appreciate the advantages and disadvantages of on-load and off-load refuelling
- perform simple calculations to predict the refuelling requirements of reactors
- explain the operation of enrichment plant
- appreciate the problems of radioactive waste management
- appreciate the range of activities of the UK nuclear industry

Content

This module aims to give the student an introduction to and appreciation of nuclear power engineering and the UK nuclear industry, particularly the technology used in the production of electricity in nuclear power stations, the preparation and subsequent treatment of the fuel and its by-products, and the detection of ionising radiation and the protection of workers within the nuclear industry and the general public from it.

Basic Principles and Health Physics (2L, Dr E Shwageraus)

- Principles of nuclear reactions;
- Radioactivity and the effects of ionising radiation;
- Introduction to health physics and shielding.

Reactor Physics (3L, Dr G T Parks)

- The fission chain process;
- Interactions of neutrons with matter;
- Models for neutron distributions in space and energy.

Reactor Design & Operation (4L, Dr G T Parks)

- Simple reactor design;
- Heat transfer and temperature distributions in commercial reactors;
- Time dependent aspects of reactor operations; delayed neutrons and xenon poisoning;
- In-core and out-of-core fuel cycles.

Fuel Processing (3L, Mr R L Skelton)

- Enrichment and reprocessing;
- The containment and disposal of radioactive wastes.

LABORATORY DEMONSTRATIONS

Demonstration of the use of Geiger-Muller and scintillation counters for detecting ionising radiation (1 hour in-lecture time).

Demonstration of the detection and shielding of fast and thermal neutrons using a 37 GBq Americium-Beryllium source (1 hour in-lecture time).

Booklists

Please see the Booklist for Group M Courses [2] for references for this module.

Examination Guidelines

Please refer to Form & conduct of the examinations [3].

UK-SPEC

This syllabus contributes to the following areas of the UK-SPEC [4] standard:

Toggle display of UK-SPEC areas.

GT1

Develop transferable skills that will be of value in a wide range of situations. These are exemplified by the Qualifications and Curriculum Authority Higher Level Key Skills and include problem solving, communication, and working with others, as well as the effective use of general IT facilities and information retrieval skills. They also include planning self-learning and improving performance, as the foundation for lifelong learning/CPD.

IA1

Apply appropriate quantitative science and engineering tools to the analysis of problems.

IA2

Demonstrate creative and innovative ability in the synthesis of solutions and in formulating designs.

KU1

Demonstrate knowledge and understanding of essential facts, concepts, theories and principles of their engineering discipline, and its underpinning science and mathematics.

KU2

Have an appreciation of the wider multidisciplinary engineering context and its underlying principles.

S1

The ability to make general evaluations of commercial risks through some understanding of the basis of such risks.

S4

Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues.

E1

Ability to use fundamental knowledge to investigate new and emerging technologies.

E2

Ability to extract data pertinent to an unfamiliar problem, and apply its solution using computer based engineering tools when appropriate.

E3

Ability to apply mathematical and computer based models for solving problems in engineering, and the ability to assess the limitations of particular cases.

P1

A thorough understanding of current practice and its limitations and some appreciation of likely new developments.

P3

Understanding of contexts in which engineering knowledge can be applied (e.g. operations and management, technology, development, etc).

US1

A comprehensive understanding of the scientific principles of own specialisation and related disciplines.

US3

An understanding of concepts from a range of areas including some outside engineering, and the ability to apply them effectively in engineering projects.

Last modified: 30/05/2018 11:46

Source URL (modified on 30-05-18): https://teaching23-24.eng.cam.ac.uk/content/engineering-tripos-part-iib-4m16-nuclear-power-engineering-shared-iia-2018-19

Links
[1] mailto:gtp10@cam.ac.uk
[2] https://www.vle.cam.ac.uk/mod/book/view.php?id=364101&chapterid=56261
[3] https://teaching23-24.eng.cam.ac.uk/content/form-conduct-examinations
[4] https://teaching23-24.eng.cam.ac.uk/content/uk-spec