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

The UK Standard for Professional Engineering Competence (UK-SPEC) [4] describes the requirements that have to be met in order to become a Chartered Engineer, and gives examples of ways of doing this.

UK-SPEC is published by the Engineering Council on behalf of the UK engineering profession. The standard has been developed, and is regularly updated, by panels representing professional engineering institutions, employers and engineering educators. Of particular relevance here is the 'Accreditation of Higher Education Programmes' (AHEP) document [5] which sets out the standard for degree accreditation.

The Output Standards Matrices [6] indicate where each of the Output Criteria as specified in the AHEP 3rd edition document is addressed within the Engineering and Manufacturing Engineering Triposes.

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