MODULE DESCRIPTION FORM

ME926 NUCLEAR POWER SYSTEMS

Module Registrar: Dr Paul Tuohy
paul.tuohy@strath.ac.uk

Taught To (Course): MSc Power Plant Engineering/Power Plant Technologies

Other Lecturers Involved: Credit Weighting: 10
Assumed Prerequisites: BEng level in Mechanical/Chemical Engineering Optional class
Academic Level: 5

Module Format and Delivery (HOURS i.e. 1 credit = 10hrs of study):

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Tutorial</th>
<th>Laboratory</th>
<th>Project</th>
<th>Assignments</th>
<th>Private Study</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>10</td>
<td>-</td>
<td>-</td>
<td>20</td>
<td>50</td>
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Educational Aim

This module aims to provide core knowledge of nuclear power plant engineering and to develop a critical awareness of the nuclear basics, reactor basics, reactor operation and design, waste disposal and key issues relating to health and safety.

Learning Outcomes

On completion of the module the student is expected to be able to

LO1 Understand atomic physics terminology, nuclear particles and interaction processes with material.

LO2 Identify and discuss the purpose of key components of nuclear power plant for a variety of different configurations.

LO3 Understand the basic nuclear principles underlying power reactor technology and be able to carry out basic calculations in relation to the design and operation of the plant.

LO4 Have a critical understanding of nuclear plant health, safety and environmental issues.

Syllabus

The module will teach the following:

Prelude - history of nuclear power and typical power plant configuration.

Part 1 Nuclear fundamentals
(i) Fundamentals of nuclear physics
(ii) Interaction of radiation with matter
(iii) Radiation protection and shielding

Part 2 Nuclear Reactor Engineering
(i) Neutron diffusion and moderation
(ii) Reactor core theory.
(iii) Heat generation and core thermal characteristics
(iv) Nuclear reactor designs
(v) Reactor operational characteristics

Part 3
(i) Radiation and health
(ii) Plant safety and accidents
(iii) Uranium resources and fuel processing
(iv) Waste and storage
Assessment of Learning Outcomes

Criteria

For each of the Module Learning Outcomes the following criteria will be used to make judgements on student learning:

LO1 To understand atomic physics terminology, nuclear particles and interaction processes with material

C1 The ability to describe and explain radioactive decay processes from a nuclear physics perspective.
C2 The ability to explain the consequences of nuclear radiation and its interaction with matter.
C3 The ability to explain the effect on biological tissue of radiation and understand current safety limits
C4 The ability to carry out basic decay rate, half-life and abundance calculations.

LO2 Identify and discuss the purpose of key components of nuclear power plant systems for a variety of different configurations.

C1 The ability to describe the main components of a nuclear reactor power plant and explain their role.
C2 The ability to identify different designs of nuclear power plant including thermal and fast reactors and explain their differences with engineering or nuclear physics reasoning.
C3 The ability to describe plant operating and shut-down conditions for thermal reactors.
C4 The ability to describe and discuss the main issues associated with the nuclear fuel cycle, reprocessing and waste storage.

LO3 To understand the basic nuclear principles underlying power reactor technology and be able to carry out basic calculations in relation to the design and operation of the plant

C1 The ability to understand the mechanisms of neutron diffusion and moderation.
C2 The ability to understand and solve simple problems in homogeneous reactor theory.
C3 The ability to understand and apply simple models for the operation and shut down of reactors.
C4 The ability to understand and calculate the thermal aspects of core heat generation and cooling.

LO4 To have a critical understanding of nuclear plant health, safety and environmental issues

C1 The ability to describe the general impact of radiation on health, the background environmental radiation levels, health effects of radiation exposure and the relationship between reactor fission products and potential health impacts.
C2 The ability to identify the failure modes associated with historical nuclear accidents, the health and environmental impacts of those accidents, and lessons learned for application in future.
C3 The ability to describe the nuclear waste disposal process and current issues.

The standards set for each criterion per Module Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessment.

12 Principles of Assessment and Feedback
(on Learning & Teaching web pages: www.strath.ac.uk/learnteach/teaching/staff/assessfeedback/12principles/)

The class has been implemented as a distance learning module. The students are enrolled to a class blog which allows questions to be asked, facilitates peer discussions, and provides a vehicle for tutor feedbacks. The class content includes a number of video lectures which end with a tutorial question, the students are asked to attempt the question before looking at the video tutorial answers, if the student has questions they are encouraged to use the blog, the tutorials in this format are intended to provide the main formative feedback mechanism.

Assessment Method(s) Including Percentage Breakdown and Duration of Exams

<table>
<thead>
<tr>
<th>Examinations</th>
<th>Courseworks</th>
<th>Projects</th>
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<tbody>
<tr>
<td>Number</td>
<td>Duration</td>
<td>Weighting</td>
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<tr>
<td>L01,L02,L03,L04</td>
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<td>100%</td>
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Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.
**Coursework / Submissions deadlines:**
End of semester.

**Resit Assessment Procedures:**
2hr examination in August Diet

**PLEASE NOTE:**
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam.

**Recommended Reading**


**Additional Student Feedback**

(Please specify details of when additional feedback will be provided)

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<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Room No</th>
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<tbody>
<tr>
<td>By arrangement</td>
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Session: 2014/15

**Approved:**

Course Director Signature: P Strachan

Date of Last Modifications: 28 August 2014
**MODULE TIMETABLE**

<table>
<thead>
<tr>
<th>Module Code:</th>
<th>ME926</th>
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<tbody>
<tr>
<td>Module Title:</td>
<td>Nuclear Power Plant Systems</td>
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**Brief Description of Assessment:**

Coursework to be handed in through Myplace before end of semester

**Assessment Timing:**

Indicate on the table below the Start/Submission dates for each Assignment/Project and the timing of each Exam/Class Test(s).

<table>
<thead>
<tr>
<th>Semester One</th>
<th>WK1</th>
<th>WK2</th>
<th>WK3</th>
<th>WK4</th>
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<th>WK6</th>
<th>WK7</th>
<th>WK8</th>
<th>WK9</th>
<th>WK10</th>
<th>WK11</th>
<th>WK12</th>
<th>Exam Period</th>
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<table>
<thead>
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<th>WK9</th>
<th>WK10</th>
<th>WK11</th>
<th>WK12</th>
<th>Exam Period</th>
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