Module Leader
Prof A Al-Tabbaa

Lecturers
Prof A Al-Tabbaa and Prof G Madabhushi

Lab Leader
Prof A Al-Tabbaa

Timing and Structure
Michaelmas term. 14 lectures + 1 examples classes + 1 invited lecture + coursework. Assessment: 75% exam/25% coursework.

Aims
The aims of the course are to:

- provide an in-depth look at aspects of contaminated land and waste containment including sources of contamination, characterisation of waste, assessment, containment, remediation and sustainable regeneration.

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

- develop an appreciation of current and future problems and legislations related to contaminated land and waste containment;
- develop good understand of contaminated land remediation options and selection decisions.
- develop an understanding of decision support tools for contaminated land management.
- identify potentially hazardous chemicals and sources of contamination.
- appreciate the crucial stages in dealing with and managing contaminated land.
- assess the risk of pollution hazards from buried wastes.
- appreciate the legal, technical and health constraints on the design of waste repositories.
- discuss the design of appropriate containment facilities.

Content
The module starts with an overview of contaminated land and waste containment and a review of contaminants in the ground and methods of groundwater analysis. This is followed by lectures on disposal of waste in the ground to develop an understanding of the safe design of landfill sites for disposal of waste materials. Finally the module looks at contaminated land remediation, management and aspects of sustainable regeneration.
Introduction to contaminated land and waste containment (1L, Prof A Al-Tabbaa)

- Introduction and overview of contaminated land remediation and waste and its containment;
- Introduction to relevant legislation

Disposal of waste in the ground (5L, Prof G Madabhushi; 1 example class)

- Characterisation of waste materials;
- Estimation of landfill size, cost of waste disposal, Landfill Tax
- Design of barriers: grout curtain, slurry wall, geomembranes;
- Constructed facilities: design of landfill and hazardous waste repositories

Contaminants and analysis in soil and water (2L, Dr R J Lynch)

- Contamination in the environment, introduction of inorganic and organic contaminants, and their analysis;
- Demonstration of pollutant analysis in soils and water

Contaminated land remediation and regeneration (6L, Prof A Al-Tabbaa, 1L Guest Speaker)

- Land contamination and remediation, sources and solutions including case studies;
- Sustainable remediation of contaminated land;
- Decision support tools including cost-benefit analysis, life cycle assessment and multi-criteria analysis;
- Sustainable brownfield land management and regeneration

SITE VISIT

We may visit a landfill site near Cambridge in one of the afternoons.

Coursework

Cost-benefit analysis of remediation techniques at a contaminated site.

<table>
<thead>
<tr>
<th>Coursework</th>
<th>Format</th>
<th>Due date &amp; marks</th>
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<tbody>
<tr>
<td>Qualitative appraisal for the remediation of a contaminated site</td>
<td>Individual Report anonymously marked</td>
<td>by 4pm on Wednesday 21 March 2018 [15/60]</td>
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The coursework will involve carrying a qualitative appraisal, using the Environment Agency ‘Cost-benefit analysis for remediation of land contamination’ document, comparing six remediation techniques on a real contaminated site. Extracts from the site investigation report will be provided and the site is to be redeveloped for industrial use.

Learning objectives:

- Develop a good understand of contaminated land remediation selection decisions
- Develop an appreciation of the factors influencing such decisions
- Develop an appreciation of impact of sensitivity analyses on the decision outcome
- Develop a good practice for writing a professional report
Booklists

Please see the Booklist for Group D 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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Links
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