Engineering Tripos Part IIB, 4D9: Offshore Geotechnical Engineering, 2019-20

Module Leader
Dr C Abadie [1]

Lecturers
Dr C Abadie, Dr S Stanier & Dr D Liang [2]

Timing and Structure
Lent term. 14 Lectures + 2 examples classes. Assessment: 100% exam

Prerequisites
3D2 assumed

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

- Introduce the geology and geotechnical properties of the seabed in renewable energy and hydrocarbon producing regions;
- Develop awareness of the geohazards prevalent in the offshore environment;
- Introduce offshore site investigation techniques and methods of sediment characterisation;
- Introduce the design of geotechnical offshore infrastructure including pipelines, shallow foundations, piles and anchors, for both renewable energy and hydrocarbon producing facilities;
- Develop an awareness of the potential impact of scour on subsea infrastructure.

Content
The offshore environment (2 hours: sas229)

- A historical perspective on energy production in the offshore environment
- Continental drift and plate tectonics
- Extent and topography of the Continental margins
- Sediment characteristics, distribution and origins
- Offshore geohazards

Offshore site investigation (2 hours: sas229)

- Purpose and techniques
- Geophysical and geotechnical surveys
- In-situ tests: cone penetrometer, full-flow penetrometers and vane shear
- Sampling methods
- Simple shear testing: strain and pore pressure accumulation
- Model testing

Pipelines (2 hours: sas229)
• Pipeline systems and terminology
• Routing and hazard avoidance
• Pipeline installation
• Hydrodynamic stability and thermal expansion management
• On-bottom pipelines: embedment, axial and lateral resistance
• Buried pipelines: uplift resistance

**Shallow foundations (2 hours: cna24)**

• Types and applications
• Ultimate limit state: bearing capacity and failure envelope approaches
• Installation of embedded shallow foundations
• Serviceability limit state: immediate and consolidation settlements
• Removal of shallow foundations

**Piles (2 hours: cna24)**

• Types and applications
• North Sea examples: offshore renewables and hydrocarbon producing platforms
• Axial response:
  o Capacity and stiffness
  o Behaviour in clay / sand / rock
  o Linear elastic pile stiffness solutions
  o Numerical analysis using the load transfer method
• Lateral response:
  o Limiting lateral resistance and design charts
  o Typical P-y curves
  o PISA
  o Design for cyclic loading

**Anchors (2 hours: cna24)**

• Type of buoyant facilities and mooring configurations
• Types of anchor:
  o Surface / gravity anchors
  o Embedded anchors: piles, caissons and drag anchors
• Design principles for:
  o Anchor chain response
  o Drag anchors
  o Suction caissons
• Next generation anchors

**Scour (2 hours: dl359)**

• Scour processes: sediment transport and scour hole development
• Scour hole measurement techniques
• Predicting scour around: pipelines and pile foundations
• Scour remediation techniques

**Booklists**

Please see the [Booklist for Group D Courses][3] for references for this module.

**Examination Guidelines**

Please refer to [Form & conduct of the examinations][4].
UK-SPEC

The [UK Standard for Professional Engineering Competence (UK-SPEC)](http://www.engc.org.uk/ukspec.aspx) 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](http://www.engc.org.uk/standards-guidance/standards/accreditation-of-higher-education-programmes-ahep/) which sets out the standard for degree accreditation.

The [Output Standards Matrices](http://teaching.eng.cam.ac.uk/content/output-standards-matrices) 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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