

## **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: oshore renewables and hydrocarbon producing platforms
- Axial response:
  - Capacity and stiffness
  - Behaviour in clay / sand / rock
  - Linear elastic pile stiness solutions
  - Numerical analysis using the load transfer method
- Lateral response:
  - Limiting lateral resistance and design charts
  - Typical P-y curves
  - PISA
  - Design for cyclic loading

#### **Anchors (2 hours: cna24)**

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

This syllabus contributes to the following areas of the [UK-SPEC](#) [5] standard:

[Toggle display of UK-SPEC areas.](#)

## General Learning Outcomes

Graduates with the exemplifying qualifications, irrespective of registration category or qualification level, must satisfy the following criteria:

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## Links

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[2] <mailto:cna24@cam.ac.uk>, [sas229@cam.ac.uk](mailto:sas229@cam.ac.uk), [dl359@cam.ac.uk](mailto:dl359@cam.ac.uk)

[3] <https://www.vle.cam.ac.uk/mod/book/view.php?id=364101&chapterid=52181>

[4] <https://teaching23-24.eng.cam.ac.uk/content/form-conduct-examinations>

[5] <https://teaching23-24.eng.cam.ac.uk/content/uk-spec>