Engineering Tripos Part IB, 2P8: Civil and Structural Engineering, 2024-25

Course Leader

Dr J Hambleton [1]

Lecturers

Dr J Hambleton, Dr S Selvakumaran, Prof A McRobie [2]

Timing and Structure

Weeks 1-4 Easter Term. 16 lectures / design workshops, 4 classes/week

Prerequisites

Engineering Part I

Aims

The aims of the course are to:

- Act as a shop window for the techniques and technologies of civil engineering seen as a practical and scientific discipline.
- Create interest in the design, construction and maintenance of the built environment, using floating offshore wind turbines as an example.
- Provide illustrations from real life schemes, and in combining theory in context with real life examples, highlight the role of the professional.
- Introduce the topics of structural materials (with more detailed introduction to structural concrete), structural stability, geotechnical engineering, and using data for smart infrastructure and construction.

Objectives

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

- Introduce students to the range of disciplines within civil engineering;
- Develop awareness of the integrated civil engineering projects that they might work on as professional engineers;
- Learn to use Part I theory in simple integrated design applications;
- Recognise limitations with Part I theory; and
- Develop an awareness of potential courses of study that will address these limitation in Part II.

Content

The course focuses on a Civil Engineering mega-project - in this case the design of Floating Offshore Wind Turbines (FOWT). This will illustrate how the knowledge you have gained in Part I knowledge might be used immediately. Their enormous scale makes FOWTs a very exciting prospect for making a major contribution to tackllng the world's energy demand in a sustainable manner.

The course will also highlight a wide spectrum of Division D Part II module offerings that will provide extensions to

specialist knowledge in specifc areas.

There will be four sub-topics, and these will be covered by lectures in the first half of the course.

- Concrete Design

- Hydrostatic Stability

- Geotechnical Engineering (Ground anchor design)

- Smart Infrastructure & Construction (Systems thinking and Digital Twins)

The second half of the course will be informal workshop sessions with the lecturers, where students can undertake their own research into these issues and prepare coursework for submission.

Students should attend all lectures but only need to submit coursework on TWO of the four topics.

Integrated Civil Engineering Introduction

The course will begin with an introductory lecture, explaining how the course works. It will also give a background to the wider topic of Floating Offshore Wind Turbines (FOWTs). This will be given by Ari Liddell, an alumna of the department, who now works on the design of FOWTs and associated green energy infrastructure in the Celtic Sea.

Structural Materials (2L + 2 Design Workshops)

- **Lectures**: overview of structural aspects related to FOWT design (steel for turbine, and an introduction to concrete for base design); development of simple analysis techniques from Part I material, highlighting limitations and scope for knowledge extension in Part II through the design of reinforced concrete sections;

- **Design classes**: two hours of interactive design classes to help students work through producing a design for the FOWT base.

Hydrostatic Stability (2L + 2 Design Workshops)

- **Lectures**: an introduction to ship stability and the buoyancy considerations related to FOWT design, extending basic stability from Part I to how a FOWT floats and how it can be moved safely into place;

- **Design classes**: two hours of interactive design classes to help students work through to determine the stabilty of various shapes, to better understand the design for the FOWT main section.

Geotechnical Engineering (2L + 2 Design Workshops)

- **Lectures**: overview of geotechnical aspects related to FOWT design (seabed); development of simple analysis techniques from Part I material, highlighting limitations and scope for knowledge extension in Part II;

- **Design classes**: two hours of interactive design classes to help students work through producing a design for the FOWT cables and anchor to the seabed.

Smart Infrastructure and Construction (2L + 2 Design Workshops)

- **Lectures**: overview of sensing and data aspects related to FOWT design (Big Data, smart sensing, data-driven approaches and systems thinking, digital twins); developing an understanding of how we can derive value from data, rather than simply collecting it.

- **Design classes**: two hours of interactive design classes talking with an industry guest speaker to work out why they want to measure followed by a design exercise and the option to analyse real data collected from a FOWT.

Examples papers

Example papers will not be issued as part of this course, and **there will be no examination**. Students will work through design workshops and hand in their completed assignments for assessment over the 4-week period.

Coursework

There is no examination for this course. Assessment is via coursework submitted in the duration of the course.

Coursework exercises will be delivered during the design workshops, where students will have time and support in working on their designs. There will be 4 possible exercises, one for each lecture topic:

1. Structural Materials
2. Hydrostatic Stability
3. Geotechnical Engineering
4. Smart Infrastructure and Construction

Students are asked to submit **two** coursework assignments on Moodle (and are encouraged to come to the design classes and try out each of the activities!).

Booklists

Please refer to the Booklist for Part IB Courses for references to this module, this can be found on the associated Moodle course.

Examination Guidelines

Please refer to Form & conduct of the examinations [3].

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