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CE7J06: J6 – Wave and Hydro Energy [5 credits]

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Module organisation

Department of Civil, Structural and Environmental Engineering

Module description, aims and contribution to programme

The aims of the module are:

1. To foster problem solving and critical thinking skills by requiring students to apply the theory learnt on wave, tidal and hydro energy to real life projects and engage in discussions with other experts.
2. To enable students to communicate well in engineering contexts in relation to ocean energy, both when discussing about projects, plans and problems, and when writing, reporting and communicating about these.
3. To achieve a pro-active engagement in wave, tidal and hydro energy problems.
4. To enable students to identify, formulate, analyse and solve engineering problems by applying the theory of ocean energy both analytically and computationally.
5. To solve real world engineering problems by carrying out analysis using real data such as those available from tank tests or sea trials.
6. To solve real world engineering problems by applying the theory and employing software packages WecSim, Nemoh and DynaMOOC.

Learning outcomes

Upon successful completion of the module, students should be able to:

1. Carry out assessment of wave energy, applying wave equations and wave theory.
2. Carry out simplified analysis using linear wave theory.
3. Carry out nonlinear wave analysis.
4. Analyse oscillating body systems.
5. Analyse fixed and floating wave energy devices.
6. Analyse mooring systems.
7. Explain tidal power – tidal theory and prediction; barrage generation; in-flow turbines.
8. Explain hydro-power – basic equations; types of turbines; flow data and pump storage.
9. Carry out the basic design of hydro power, wave energy and tidal power systems.
10. Calculate resource and potential outputs for particular ocean energy, tidal and hydro systems.

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11. Articulate the social and environmental aspect of hydro, wave and tidal power systems.
12. Describe legislative and economic drivers in these renewable technology industries.

Module content

To introduce students about the theory, technology and engineering associated with wave, hydro-power, tidal and ocean energy. The topics covered are:

- Introduction to wave energy resource
- Hydrodynamics – Theoretical and numerical, model testing
- Controls
- Oscillating water column – Fixed, Floating
- Oscillating body systems – single, multiple, pitching, many body
- Overtopping devices
- Power equipment
- Moorings
- Ocean tides
- Theory and dynamics of tides
- Tidal power plants
- Introduction to hydropower
- Principles of hydropower, Turbines, Hydraulic rams pumps

Teaching strategies

- Lectures
- Tutorials
- Labs

Assessment

The assessment of this module is made of the following components:

- Written examination (worth 80%)
- Coursework and project work during semester (worth 20%)

Required textbook

Ocean wave energy conversion (1981) McCormick, Wiley, New York.

Power from sea waves (1995) Ross, OUP, Oxford.

Wave energy conversion (2003) Brooke, Elsevier, Amsterdam.

Wave and Tidal Power (2011) Gerdes, Greenhaven Press, Detroit.

Costal & Offshore Engineering (2011) Reid, Chadwick and Flemming.

Hydropower Water Power (2013) Atkins & Escudier

Further information

<https://www.tcd.ie/Engineering/>