University of Dundee

CE50034 Marine Renewable Energy and Design *MODULE GUIDE and SYLLABUS*

Module Information	**CE50034 Marine Renewable Energy and Design** **Semesters 1 and 2, 2019-2020 Academic Year**

Module Leader	Masoud Hayatdavoodi, Ph.D. School of Science and Engineering	*Office:* Fulton Building, J10 *Website:* `https://sites.dundee.ac.uk/masoud/`
Module Instructors (Academic)	Masoud Hayatdavoodi, Ph.D. Alan Cuthbertson, Ph.D. Anirban Guha, Ph.D.	*E-mail:* MHayatdavoodi@dundee.ac.uk *E-mail:* a.j.s.cuthbertson@dundee.ac.uk *E-mail:* AGuha001@dundee.ac.uk

Semester 1 Class Schedule

- **Lectures:**
  Weeks 1-11, Monday, 12:00PM - 01:00PM at Dalhousie 2F14
  Weeks 1-11, Wednesday, 01:00PM - 02:00PM at Dalhousie 1G06
- **Tutorials:** Weeks 3-11, Friday, 10:00AM - 11:00AM at Dalhousie 1G06

Semester 2 Class Schedule

- **Lectures:**
  Weeks 15-20, Monday, 11:00AM - 12:00PM at Dalhousie 2G13
  Weeks 15-25, Wednesday, 01:00PM - 02:00PM at Fulton H2
- **Tutorials:** Weeks 15-25, Friday, 11:00AM - 12:00AM at Fulton H2

Office Hours (Module Leader)

Wednesday: 12:00PM-01:00PM
Thursday: 12:00PM-01:00PM
And by appointments.

Grading

Written Assignments (about four over the year)	40%
Practical exams (Reports and Presentations)	60%

Grading Scale

A $\geq 70\%$
B $\geq 60\%$
C $\geq 50\%$
D $\geq 40\%$
F $< 40\%$

For more information see:
`https://www.dundee.ac.uk/governance/policies/policy-taught-provision/`

REFERENCES

Textbooks

- Ehrlich, R., and Geller, H. A. (2017), Renewable energy: a first course, CRC Press, pp. 464, ISBN: 978-1439861158.
- Boyle, G. (2004), Renewable Energy, Oxford University Press, pp. 456, ISBN: 978-0199261789.
- McCormick, M. E. (2013), Ocean wave energy conversion, Courier Corporation, pp. 256, ISBN: 978-0486462455.
- Gipe, P. (2004), Wind Power, James & James, pp. 496, ISBN: 978-1902916545.
- Yang, Z. and Coppng, A. (2017), Marine Renewable Energy, Springer International Publishing, pp XIV+387, ISBN: 978-3319535340.
- Masters, G. M. (2013), Renewable and efficient electric power systems, John Wiley & Sons, pp. 654, ISBN: 978-1118633496.
- Tester, J. W., Drake, E. M., Driscoll, M. J., Golay, M. W., & Peters, W. A. (2012), Sustainable energy: choosing among options, MIT press, pp. 1056, ISBN: 978-0262017473.
- Sorensen, B. (2004). Renewable Energy: Its Physics, Engineering, Use, Environmental Impacts, Economy, and Planning Aspects. Elsevier Academic Press, pp. 976, ISBN: 978-0123750259.
- Brin, A. (1981), Energy and the Oceans, Ann Arbor Science Publishing Inc/ The butterworth Group, pp. 133, ISBN: 978-0250421510.
- Dhanak, M. R. and Xiros, N. I. (Eds.), (2016). Springer Handbook of Ocean Engineering, Springer, 1345 pp., ISBN 978-3-319-16649-0.
  `http://www.springer.com/gb/book/9783319166483`.
  (Available to UoD students free of charge through the library links.)
- Newman, John N. (1977), Marine Hydrodynamics, The MIT Press, 432 pp., ISBN: 978-0262140263.
- Chakrabarti, S.K. (2003), Hydrodynamics of Offshore Structures, WIT Press / Computational Mechanics, 464 pp., ISBN: 978-0905451664.
- Sarpkaya, Turgut and Isaacson, Michael (1981), Mechanics of Wave Forces on Offshore Structures, Van Nostrand Reinhold Company; First edition, 651 pp., ISBN: 978-0442254025.

Journals and Conferences

- Renewable Energy, Elsevier
  `https://www.journals.elsevier.com/renewable-energy`.
- Journal of Ocean Engineering and Marine Energy, Springer
  `https://link.springer.com/journal/40722`.

- Journal of Renewable and Sustainable Energy, AIP
  https://aip.scitation.org/journal/rse.
- Wind Energy, John Wiley & Sons Ltd
  https://onlinelibrary.wiley.com/journal/10991824.
- Renewable & Sustainable Energy Reviews, Elsevier
  https://www.journals.elsevier.com/renewable-and-sustainable-energy-reviews.
- Renewables: Wind, Water, and Solar, Springer
  https://link.springer.com/journal/40807.
- Journal of Renewable Energy, Hindawi
  https://www.hindawi.com/journals/jre/.
- International Journal of Renewable Energy Research
  https://www.ijrer.org/ijrer/index.php/ijrer.
- International Offshore Wind Technical Conference (IOWTC), ASME
  https://event.asme.org/IOWTC.
- European Wave and Tidal Energy Conference (EWTEC),
  https://ewtec.org/
- International Conference on Ocean, Offshore and Arctic Engineering (OMAE), ASME, ,
  https://event.asme.org/OMAE
- Marine Energy Technology Symposium (METS),
  http://marineenergytechnologysymposium.org/

Module Communications

Module-related material, along with class communications, are held on *My Dundee* portal and communicated through Emails. Students are expected to check their emails and to use the module webpage regularly. All required material should be downloaded from My Dundee and stored locally; access to the module page will not be extended beyond the current academic year.

Module Aims

The aim of this module is to enable individuals to explain, classify and investigate various types of marine renewable energy resources and analyse the key energy converters; to describe the fundamental and applied aspects of physical oceanography, buoyancy and stability of floating bodies and marine structures; and to participate in a major design experience of marine renewable energy systems, incorporating realistic constraints that include technical, economic, environmental, ethical, social, and liability considerations; emphasis is placed on teamwork.

INTENDED LEARNING OUTCOMES

On completion of this module students should be able to:

- clearly understand and explain the principles of physical and dynamics processes associated with surface and deep ocean circulation,
- demonstrate a comprehensive understanding of buoyancy and stability of floating bodies, dynamics of marine structures, and mooring lines,
- critically assess various types of marine renewable energy, key energy converters, their characteristics, advantages and limitations,
- concisely analyse the interaction of wind, waves and current with marine renewable energy systems,
- perform a comprehensive engineering design of marine renewable energy systems, incorporating realistic constraints that include technical, economic, environmental, ethical, social, and liability considerations,
- develop and apply the necessary skills to complete a comprehensive design project while working in a team with other members,
- develop effective team-work and self-learning skills.

PREREQUISITES

CE40006 Environmental Hydraulics or equivalent background.

ATTENDANCE POLICES

The module content will be primarily discussed in class. Some (and NOT all) module material will be made available online through *My Dundee* portal. It is assumed that students will attend all lectures and tutorials, and take notes of the material written on the board and discussed in class.

EXAMINATION:

The examination of this module includes coursework, project report and project presentations. Exact day and time, and deadlines of the module assessments will be communicated in class.

Semester 1
Tentative
Schedule

Monday	Wednesday	Friday
Sep 16th **1** Module Introduction	18th **2** Phys. Oceanography	20th **3**
23rd **4** Phys. Oceanography	25th **5** Phys. Oceanography	27th **6**
30th **7** Wind & Applications	Oct 2nd **8** Wind & Applications	4th **9** Wind Energy External Speaker
7th **10** Wind & Applications	9th **11** Wind & Applications	11th **12** Wind Energy Tutorial
14th **13** Wave & Applications	16th **14** Wave & Applications	18th **15** Wave Energy External Speaker
21st **16** Wave & Applications	23rd **17** Wave & Applications	25th **18** Wave Energy Tutorial
28th **19** OTEC	30th **20** OTEC	Nov 1st **21** OTEC
4th **22** Design & Analysis	6th **23** Design & Analysis	8th **24** Projects Allocation
11th **25** Buoyancy & Stability	13th **26** Buoyancy & Stability	15th **27** Project Management External Speaker
18th **28** Buoyancy & Stability	20th **29** Buoyancy & Stability	22nd **30** Project Review
25th **31** Buoyancy & Stability	27th **32** Buoyancy & Stability	29th **33** Project Presentations

Semester 2
Tentative
Schedule

Monday	Wednesday	Friday
Jan 20th **1** Tide Energy & Application	22nd **2** Tide Energy & Application	24th **3** Hybrid ORE & Farms
27th **4** Tide Energy & Application	29th **5** Tide Energy & Application	31st **6** Tide Energy External Speaker
Feb 3rd **7** Tide Energy & Application	5th **8** Project Review	7th **9** Decommissioning
10th **10** Project Review	12th **11** Project Review	14th **12** PTO & Control
17th **13** Project Review	19th **14** Project Review	21st **15** Structural Integrity
24th **16** Project Review	26th **17** Project Review	28th **18** Project Presentations
Mar 2nd **19**	4th **20** Project Review	6th **21** Major Accidents
9th **22**	11th **23** Project Review	13th **24** Environmental Impact
16th **25**	18th **26** Project Review	20th **27** Risk Management
23rd **28**	25th **29** Project Review	27th **30** Ethics; Health & Safety
30th **31**	Apr 1st **32** Project Presentations	3rd **33** Project Submission