ENVIRONMENTAL AERODYNAMICS AND WIND POWER - 2024/5

Module code: ENGM299

Module Overview

This module offers an introduction to industrial aerodynamics and wind engineering, covering applications of aerodynamics to areas beyond the classical aerospace ones. Particular focus is given to the main characteristics of natural winds, concentrating on four aspects:

- Meteorology and the atmospheric boundary layer
- Wind power aerodynamics
- Pollutant dispersion in the atmosphere
- Building aerodynamics

The above applications are designed to introduce students to wider applications of aerodynamics not covered elsewhere in the aerospace and mechanical engineering programmes.

Module provider

Mechanical Engineering Sciences

Module Leader

CARPENTIERI Matteo (Mech Eng Sci)

Number of Credits: 15

ECTS Credits: 7.5

Framework: FHEQ Level 7

Module cap (Maximum number of students): N/A

Overall student workload

Workshop Hours: 11

Independent Learning Hours: 74

Lecture Hours: 22

Tutorial Hours: 10

Guided Learning: 11

Captured Content: 22

Module Availability

Semester 2

Prerequisites / Co-requisites

On Sustainable Energy MSc and Sustainable Energy with Industrial Practice MSc programmes: -A good knowledge of the fundamentals of fluid mechanics at undergraduate level is strongly recommended. Students without a degree in Aerospace, Mechanical, Civil, Chemical or Environmental Engineering (or equivalent) are advised to speak with the module co-ordinator before selecting the module.

Module content

Basic meteorology - the development and structure of the atmospheric boundary layer;

Description of flow patterns around basic structural shapes and terrain features;

Wind turbine aerodynamics and modelling;

Wind farms and wind farm economy;

Wind loading on buildings, structures and component elements;

Environmental effects of flow around buildings;

Dispersion in and above the atmospheric boundary layer;

Dispersion models, their strengths and weaknesses.

Assessment pattern

Assessment type	Unit of assessment	Weighting
Oral exam or presentation	Group presentation	50
Examination	Exam (2 hrs)	50

Alternative Assessment

Individual coursework will subsitute the group presentation in the Late Summer Assessment

Assessment Strategy

The assessment strategy is designed to provide students with the opportunity to demonstrate understanding of scientific principles, the ability to adapt and apply those principles to specific calculations and the ability to describe aspects of environmental aerodynamic phenomena and wind turbine design. The coursework will involve the analysis of a case study and a final presentation in small groups.

Summative assessment

Group presentation (LO 1,3,4,5)

Examination (LO 1-6)

Formative assessment and feedback

Formative verbal assessment is given in tutorials and workshops.
Written feedback is given on the coursework assessment/presentation.

Module aims

- To provide students with a general understanding of:
  the physics of atmospheric flow;
- the aerodynamics of wind turbines and wind farms;
- the physics of dispersion in the atmosphere and awareness of the methods available for its prediction;
- the general wind effects associated with buildings and terrain, including basic flow patterns and pedestrian comfort.

Learning outcomes

		Attributes Developed	
Ref			
001	Understand, analyse and use meteorological and related data describing wind and turbulence conditions in the atmosphere near the ground	KC	M1,M2
002	Understand and apply methodologies to carry out wind loading design of basic shapes of buildings and structures	K	M1,M5
003	Recognise structural arrangements or layouts of building groups which may present problems due to wind effects and how these may be rectified	KC	M2

Ref		Attributes Developed	
004	Appreciate the advantages and limitations of wind tunnel testing for obtaining wind loads on complex structures and concentration level downwind of sources	KC	M1,M2
005	Understand the main issues affecting the dispersion of emissions from a wide variety of source types, conduct analyses of ground level concentrations	K	M1,M2,M3,M6
006	Understand the basic aerodynamic design of wind turbines	K	M1,M2,M5

Attributes Developed

C - Cognitive/analytical

K - Subject knowledge

T - Transferable skills

P - Professional/Practical skills

Methods of Teaching / Learning

The learning and teaching strategy is designed to introduce the basic principles of industrial aerodynamics with worked examples. This is delivered principally through lectures and tutorial classes. Practice is covered through case studies and an assessment solving basics test cases.

The learning and teaching methods include:

- Lectures: theory and examples
- Workshops and seminars: group projects will be assigned, developed and discussed, and seminars given from industrial and research perspectives
- Tutorials: preparation for final exam

Indicated Lecture Hours (which may also include seminars, tutorials, workshops and other contact time) are approximate and may include in-class tests where one or more of these are an assessment on the module. In-class tests are scheduled/organised separately to taught content and will be published on to student personal timetables, where they apply to taken modules, as soon as they are finalised by central administration. This will usually be after the initial publication of the teaching timetable for the relevant semester.

Reading list

https://readinglists.surrey.ac.uk
Upon accessing the reading list, please search for the module using the module code: ENGM299

Other information

The School of Mechanical Engineering Sciences is committed to developing graduates with strengths in Employability, Digital Capabilities, Global and Cultural Capabilities, Sustainability and Resourcefulness and Resilience. This module is designed to allow students to develop knowledge, skills and capabilities in the following areas;

Employability: This module provides students with knowledge about applications of aerodynamics beyond vehicle design. The module builds on this to develop the student's understanding of multidisciplinary aspects of building and wind farm design, including metheorological and microclimate aspects. Students will work in small groups to develop a practical project of their choice, deepening their understanding on a specific topic within the module's remit. Students will become familiar with open discussion methods and supportive collaborative environments.

Digital capabilities: Students will use digital platforms as tools to develop their project of choice. This might range from tools to design wind farms to meteorological and pollutant dispersion modelling, for example. This is conducted as part of the group project activities, aided by the weekly workshops and seminars, which then feed into the class discussions

Global and Cultural Capabilities: Students will work in groups to develop their project of choice. This will require students to engage effectively with people from different backgrounds in ways that respect the interests of cultural groups. Peer assessment of the presentations encourages students to value and recognize perspectives from different cultural backgrounds.

Sustainability: All the learning outcomes of this module are strongly linked with sustainability. These include aspects related to air quality and pollutants in the atmosphere, weather and climate aspects, effects of building on the atmospheric environment, development and assessment of wind farms to generate power as well as their effects on the surrounding environment.

Resourcefulness and resilience: Through participation in the group project work and weekly workshops, students will actively engage in group working which will emphasise the importance of team cohesion, respect, empathy and build trust with other learners. Students will provide peer feedback for presentations, therefore building their confidence, through taking ownership of identifying strengths.

Programmes this module appears in

Programme	Semester	Classification	Qualifying conditions
Advanced Mechanical Engineering MSc	2	Optional	A weighted aggregate mark of 50% is required to pass the module
Aerospace Engineering MEng	2	Optional	A weighted aggregate mark of 50% is required to pass the module
Mechanical Engineering MEng	2	Optional	A weighted aggregate mark of 50% is required to pass the module
Sustainable Energy MSc	2	Optional	A weighted aggregate mark of 50% is required to pass the module
Sustainable Energy with Industrial Practice MSc	2	Optional	A weighted aggregate mark of 50% is required to pass the module