CEE 9695 - Wind-Excited and Aeroelastic Response of Structures

Course Outline

This course covers a broad range of Wind Engineering topics with special concern to Wind-Excited and Aeroelastic Response of Structures. The general aims are for the student to become able to:

- Recognize structures sensitive to wind-induced vibrations and aeroelastic phenomena.
- Analyse the dynamic response of structures to wind-excitation.
- Evaluate the critical velocity ranges in which structures are prone to motion-induced actions and aeroelastic instabilities.
- Recognize the need to carry out integrated analyses involving analytical, numerical, laboratory and full-scale evaluations.
- Recognize the engineering tools that make new and existing structures safe and suitable under wind loading.

Prerequisites:
It is expected that students have basic knowledge of structural dynamics. In addition, it is suggested that students have preliminary elementary knowledge of probability. Students totally missing of such background are invited to contact the instructor prior to registering to the course. Simple lecture notes will be made available to them, well in advance of the course, to provide such elementary knowledge. In any case, the first lectures of the course will be dedicated to provide the fundamental concepts of this matter.

Corequisites:
None.

Antirequisites:
None.

Contact Hours:
Three lecture hours per week
July 17, 2017- August 10, 2017
Monday- Friday; 1:00pm-3:00pm

Instructor:
Giovanni Solari, PhD
Professor of Structural Engineering and Wind Engineering at the University of Genoa (UNIGE) Prof. Giovanni Solari, DICCA, UNIGE, Room XXX, Ext. XXXX, email: giovanni.solari@unige.it
Administrative Assistant: Room XXX, Ext. XXXX, email: XXXX
Textbook:
Lecture notes, other useful reference material and data for assignments will be made available at the course website.

Other References:
• J. Holmes (2001). Wind loading on structures, Spon Press, NY.

Laboratory:
None

Specific Learning Objectives:

Part I:  FUNDAMENTALS
1. Probability
   1.1 Probability theory
   1.2 Random processes
   1.3 Couple of random processes
   1.4 Vector of random processes
   1.5 Monte Carlo simulation
2. Dynamics
   2.1 Introductory elements
   2.2 Single-Degree-Of-Freedom systems
   2.3 Multi-Degree-Of-Freedom systems
   2.4 Random dynamics
   2.5 Maximum response
3. Wind
   3.1 Atmospheric circulation
   3.2 Mean wind velocity
   3.3 Turbulent fluctuations
   3.4 Wind statistics
4. Aerodynamics
   4.1 Wind loading
   4.2 Tools

Part II:  STRUCTURAL ANALYSIS
5. Wind-excited response
   5.1 Alongwind response
   5.2 3-D response of slender structures
   5.3 3-D response of buildings
   5.4 Thunderstorm loading and response
6. Aeroelasticity
   6.1 Vortex shedding
   6.2 Alongwind interaction
   6.3 Crosswind galloping
   6.4 Torsional instabilities
   6.5 Reynolds crisis
   6.6 3-D coupled aeroelasticity
   6.7 Flutter
7. Miscellanea

7.1 Construction phase
7.2 Non-structural elements

During the course lectures basic concepts and analytical formulations will be exposed, numerical simulations, model experiments and full-scale tests will be illustrated, academic exercises will be developed; problems related to real structures will be shown and discussed.

Complimentary Optional Seminars

• Wind monitoring and forecast for the safe management of port areas
• Buffeting analysis of the Messina Straits Bridge by Double Modal Transformation
• The role of wind engineering in the evolution of tall buildings
• Wind-induced fatigue damage of structures

Course Project:
At the beginning of the course students will be divided in groups of 2-3 persons each. Each group will be involved in the analysis of a real structure. The project will be evaluated based on the submitted final report.

Evaluation:
The final course mark will be determined as follows:

Final examination*  50%
Course project   50%
Total              100%

*Students must pass the final examination to pass this course.

Final Examination:
The final examination will be OPEN BOOK.

Units:
SI units will be used in lectures, assignments and examinations.

Use of English:
In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests and examinations for the improper use of English. Additionally, poorly written work with the exception of final examinations may be returned without grading. If re-submission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Scholastic Offences:
Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_grad.pdf.

Attendance:
Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.
Conduct:
Students are expected to arrive at lecture on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others. Please turn off your cell phone before coming to a class, tutorial or examination.

Sickness and Other Problems:
Students should immediately consult with the instructor regarding any problem that could affect their performance in the course. Where appropriate, the problems should be documented (see attached). The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

Notice:
Students are responsible for regularly checking their e-mail and the course web site.

Consultation:
Office hours will be arranged for students to see the instructor. Other individual consultation can be arranged by appointment with the instructor. Students are encouraged to discuss problems with the instructor.