

Western University
Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 9619 – DYNAMICS OF SOILS AND FOUNDATIONS
COURSE OUTLINE 2021-2022

DESCRIPTION

This course develops understanding of the concepts, theories and procedures of design of foundations subjected to dynamic loads. The students will learn to calculate the stiffness and damping constants of different types of foundations. They will also learn to calculate the response of these foundations under the effect of different types of dynamic loading

PREREQUISITES

This course is intended for graduate students enrolled in civil and environmental engineering. It is expected that students will have basic understanding of soil mechanics and geotechnical engineering obtained by taking suitable courses at either the undergraduate or graduate level. Students without a suitable background in soil mechanics should discuss this with the instructor prior to registering for the course.

TOPICS

Topic #	Description	Learning Activities	Tentative timeline
1a	Introduction		
a) Introduction	Design objectives, design procedure, basic notions, mathematical models, DOFs, types of dynamic loads, foundations types, excitation forces of machines.	<ul style="list-style-type: none"> One lecture (In-Person) 	Week 1
1b	Dynamic Soil Properties		
b) Investigation of Dynamic Soil Properties	Wave propagation, field measurement methods, laboratory measurement methods, empirical correlations, cyclic behaviour of soils.	<ul style="list-style-type: none"> Two lectures (In-Person) 	Week 2-3
2	Stiffness and damping of Shallow Foundations		
a)	Definition of stiffness, damping and inertia, circular shallow foundation	<ul style="list-style-type: none"> Two lectures (In-Person) 	Weeks 4-5
b)	non-circular foundation, embedded footings, impedance functions of a layer on half-space.3.3.1 Constitutive models		

3	Stiffness and Damping of Pile Foundations		
a)	Pile applications, mathematical models for pile analysis, stiffness and damping of piles	<ul style="list-style-type: none"> Two Lectures (In-Person) 	Weeks 6-7
b)	Pile groups, interaction factors, impedance functions of pile groups, pile batter		
4	Dynamic Response of Foundations to Harmonic Loading		
a)	Response of rigid foundations in 1 DOF, effects of vibration	<ul style="list-style-type: none"> Two lectures (In-Person) 	Weeks 8-9
b)	Response of rigid foundations in 2 DOF and 6 DOF, response of structures on flexible foundations		
5	Dynamic Response of Foundations to Transient Loading		
a)	Types of hammers and hammer foundations, design criteria, mathematical models, impact forces	<ul style="list-style-type: none"> Two lectures (In-Person) 	Weeks 10-11
b)	Response of one and two mass foundations, numerical modelling.		
6	Vibration Damage and Remedial Measures		
	Damage and disturbance, problem assessment and evaluation, remedial principles, examples from different industries, sources of error.	<ul style="list-style-type: none"> One lecture (In-person) 	Week 12

SPECIFIC LEARNING OUTCOMES

Degree Level Expectation	Weight	Assessment Tools	Outcomes
Depth and breadth of knowledge	15%	<ul style="list-style-type: none"> Assignments Project 	<ul style="list-style-type: none"> Understanding of advanced concepts and theories Awareness of important current problems in the field of study Understanding of computational and/or empirical methodologies to solve related problems
Research & scholarship	20%	<ul style="list-style-type: none"> Assignments Project 	<ul style="list-style-type: none"> Ability to conduct critical evaluation of current advancements in the field of specialization

			<ul style="list-style-type: none"> Ability to conduct coherent and thorough analyses of complex problems using established techniques/principles and judgment
Application of knowledge	30%	<ul style="list-style-type: none"> Assignments Project 	<ul style="list-style-type: none"> Ability to apply knowledge in a rational way to analyze a particular problem Ability to use coherent approach to design a particular engineering system using existing design tools
Professional capacity / autonomy	10%	<ul style="list-style-type: none"> Project 	<ul style="list-style-type: none"> Awareness of academic integrity Ability to implement established procedures and practices in the coursework Defends own ideas and conclusions Integrates reflection into his/her learning process
Communication skills	15%	<ul style="list-style-type: none"> Project 	<ul style="list-style-type: none"> Ability to communicate (oral and/or written) ideas, issues, results and conclusions clearly and effectively
Awareness of limits of knowledge	10%	<ul style="list-style-type: none"> Project 	<ul style="list-style-type: none"> Awareness of the need of assumptions in complex scientific analyses and their consequences Understanding of the difference between theoretical and empirical approaches Ability to acknowledge analytical limitation due to complexity of practical problems

ASSESSMENTS

Assessment Type	Material Covered	Tentative Due Date	Weight
Homework Assignments (Five)	Topic 1-5		40%
Multiple Choice Quizzes (two)	Topics 1-5		10%
Participation	Attendance in class		10%
Project: Design project/critical review of some technical papers will be assigned	Topics 1-5		40%

Activities in which collaboration is permitted:

- Analysis/calculations of assignments and project

Activities in which students must work alone (collaboration is not permitted):

- Writing reports of assignments and projects

CONTACT INFORMATION

Course instructor: Prof. M. Hesham El Naggar, P.Eng.

Email address: naggar@uwo.ca

Contact policy:

- Contact instructor via email (above) or through messages in OWL
- Weekly Office hours (TBD) are held via Zoom
- A general FAQ section on the 'forums' section of OWL will be used for students to pose course-related questions so that all have the same information.

REQUIRED TEXTBOOK: None

OPTIONAL COURSE READINGS: Any relevant books and scientific papers

COURSE CONTENT: The lecture notes are copyrighted to the instructor and legally protected. Do not post these lecture notes on any other website or online forums. The recording of the lectures of the course without the permission from the instructor is prohibited. The illegal posting and sharing of the copyrighted course content could be subjected to legal actions.

CHEATING, PLAGIARISM/ACADEMIC OFFENCES

Academic integrity is an essential component of learning activities. Students must have a clear understanding of the course activities in which they are expected to work alone (and what working alone implies) and the activities in which they can collaborate or seek help; see information above under “Assessments” and ask instructor for clarification if needed. Any unauthorized forms of help-seeking or collaboration will be considered an academic offense. University policy states that cheating is an academic offence. If you are caught cheating, there will be no second warning. Students must write their essays and assignments in their own words. Whenever students take an idea or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence. Academic offences are taken seriously and attended by academic penalties which may include expulsion from the program. Students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence (see Western's scholastic discipline regulations for graduate students).

SYNCHRONOUS LEARNING ACTIVITIES: Students are expected to participate in in-person learning activities as outlined in the course syllabus and/or described by the instructor. If you have issues that will impede your ability to participate in in-person activities, please discuss with the course instructor at the beginning of the course.

CONDUCT: Students are expected to follow proper etiquette during in-person classes to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in the learning activities and/or is not following the rules and responsibilities associated with physical distancing, will be reported to the Associate Dean (Graduate) (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Associate Dean (Graduate), the student could be debarred from completing the assessment activities in the course as appropriate.

HEALTH/WELLNESS: As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several health and wellness related services (remotely accessible) to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. Information regarding health- and wellness-related services available to students may be found at <http://www.health.uwo.ca/>. Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Campus mental health resources may be found at

http://www.health.uwo.ca/mental_health/resources.html
<https://www.uwo.ca/health/psych/index.html>

SICKNESS: Students should immediately consult with the Instructor (for a particular course) or Associate Chair (Graduate) (for a range of courses) if they have problems that could affect their performance. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal. Obtaining appropriate documentation (e.g., a note from the doctor) is valuable when asking for accommodation due to illness.

ACCESSIBILITY: Please contact the course instructor if you require material in an alternate format or other arrangements to make this course more accessible to you. You may contact Accessible Edu.:661-2111x 82147. or http://academicsupport.uwo.ca/accessible_education/index.html, for any specific question regarding an accommodation.