

Western University  
Faculty of Engineering  
*Department of Civil and Environmental Engineering*

**CEE 9619 – DYNAMICS OF SOILS AND FOUNDATIONS**

**COURSE OUTLINE 2023-2024**

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**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.

**ENROLLMENT RESTRICTIONS**

This course is restricted 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.

**INSTRUCTOR CONTACT INFORMATION**

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

Email address: naggar@uwo.ca

Lecture hours: 3 hours lecture per week – TBD

Office hours: weekly Office hours (TBD) are held via Zoom

**COURSE FORMAT**

This course will be delivered **in-person**.

**TOPICS**

<b>Topic #</b>	<b>Description</b>	<b>Learning Activities</b>	<b>Tentative timeline</b>
1	<b>Introduction</b>		
a) Introduction	Design objectives, design procedure, basic notions, mathematical models, DOFs, types of dynamic loads, foundation types, excitation forces of machines.	<ul style="list-style-type: none"><li>• One lecture (In-Person)</li></ul>	Week 1 Monday Jan. 8 <sup>th</sup>
b) Dynamic Soil Properties	Wave propagation, field measurement methods, laboratory measurement methods, empirical correlations, cyclic behaviour of soils.	<ul style="list-style-type: none"><li>• Two lectures (In-Person)</li></ul>	Weeks 2-3 Mondays Jan. 15 <sup>th</sup> and 22 <sup>th</sup>
2	<b>Stiffness and damping of Shallow Foundations</b>		

a)	Definition of stiffness, damping and inertia, circular shallow foundation	<ul style="list-style-type: none"> <li>Two lectures (In-Person)</li> </ul>	Weeks 4-5 Mondays Jan. 29 <sup>th</sup> and Feb. 5 <sup>th</sup>
b)	non-circular foundation, embedded footings, impedance functions of a layer on half-space.		
3	<b>Stiffness and damping of Pile Foundations</b>		
a)	Pile applications, mathematical models for pile analysis, stiffness and damping of piles	<ul style="list-style-type: none"> <li>One lecture (In-Person)</li> </ul>	Week 6 Monday Feb. 12 <sup>th</sup>
	<b>Reading Week (No Classes)</b>		Week 7 Monday Feb. 19 <sup>st</sup>
b)	<b>Pile groups, interaction factors, impedance functions of pile groups, pile batter</b>	One lecture	Week 8 Monday Mar. 4 <sup>th</sup>
4	<b>Dynamic Response of Foundations to Harmonic Loading</b>		
a)	Response of rigid foundations in 1 DOF, effects of vibration	<ul style="list-style-type: none"> <li>Two lectures (In-Person)</li> </ul>	Weeks 9-10 Mondays Mar. 11 <sup>th</sup> and 18 <sup>th</sup>
b)	Response of rigid foundations in 2 DOF and 6 DOF, response of structures on flexible foundations		
5	<b>Dynamic Response of Foundations to Transient Loading</b>		
a)	Types of hammers and hammer foundations, design criteria, mathematical models, impact forces	<ul style="list-style-type: none"> <li>Two lectures (In-Person)</li> </ul>	Weeks 11-12 Mondays Mar. 25 <sup>st</sup> and April 1 <sup>st</sup>
b)	Response of one and two mass foundations, numerical modelling.		

## SPECIFIC LEARNING OUTCOMES

<b>Degree Level Expectation</b>	<b>Weight</b>	<b>Assessment Tools</b>	<b>Outcomes</b>
<b>Depth and breadth of knowledge</b>	15%	<ul style="list-style-type: none"> <li>• Assignments</li> <li>• Project</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding of advanced concepts and theories</li> <li>• Awareness of important current problems in the field of study</li> <li>• Understanding of computational and/or empirical methodologies to solve related problems</li> </ul>
<b>Research &amp; scholarship</b>	20%	<ul style="list-style-type: none"> <li>• Assignments</li> <li>• Project</li> </ul>	<ul style="list-style-type: none"> <li>• Ability to conduct critical evaluation of current advancements in the field of specialization</li> <li>• Ability to conduct coherent and thorough analyses of complex problems using established techniques/principles and judgment</li> </ul>
<b>Application of knowledge</b>	30%	<ul style="list-style-type: none"> <li>• Assignments</li> <li>• Project</li> </ul>	<ul style="list-style-type: none"> <li>• Ability to apply knowledge in a rational way to analyze a particular problem</li> <li>• Ability to use coherent approach to design a particular engineering system using existing design tools</li> </ul>
<b>Professional capacity / autonomy</b>	10%	<ul style="list-style-type: none"> <li>• Project</li> </ul>	<ul style="list-style-type: none"> <li>• Awareness of academic integrity</li> <li>• Ability to implement established procedures and practices in the coursework</li> <li>• Defends own ideas and conclusions</li> <li>• Integrates reflection into his/her learning process</li> </ul>
<b>Communication skills</b>	15%	<ul style="list-style-type: none"> <li>• Project</li> </ul>	<ul style="list-style-type: none"> <li>• Ability to communicate (oral and/or written) ideas, issues, results and conclusions clearly and effectively</li> </ul>
<b>Awareness of limits of knowledge</b>	10%	<ul style="list-style-type: none"> <li>• Project</li> </ul>	<ul style="list-style-type: none"> <li>• Awareness of the need of assumptions in complex scientific analyses and their consequences</li> <li>• Understanding of the difference between theoretical and empirical approaches</li> <li>• Ability to acknowledge analytical limitation due to complexity of practical problems</li> </ul>

## ASSESSMENTS

Assessment Type	Material Covered	Tentative Due Date	Weight
Homework Assignments (five)	Topics 1- 5		40%
Multiple Choice Quizzes (two)	Topics 1- 5		10%
Participation	Participation in class activities		0%
<b>Project:</b> Design project/critical review of some technical papers will be assigned	Topics 1- 5		50%

### 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

## REQUIRED TEXTBOOK

None

## OPTIONAL COURSE READINGS

Any relevant books and scientific papers

## COURSE CONTENT

The lecture notes are copyrighted to Prof. M. Hesham El Naggari 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 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 at the following website: [https://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/scholastic\\_discipline\\_grad.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf)

All required papers may be subject to submission for textual similarity review to the commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

## **CONDUCT**

Students are expected to follow proper etiquette to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in course activities and/or is not following the rules and responsibilities associated with the course activities, 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 SERVICES**

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 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. Faculty of Engineering has a Student Wellness Counsellor. Information on how to schedule an appointment with the counsellor is available at: <https://www.eng.uwo.ca/undergraduate/academic-support-and-accommodations/Student-Wellness-Counselling.html>

Students who are in emotional/mental distress should refer to Mental Health@Western: <http://www.uwo.ca/uwocom/mentalhealth/> for a complete list of options about how to obtain help.

## **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.

Students who are not able to meet certain academic responsibilities due to medical, compassionate or other legitimate reason(s), could request for academic consideration. The Graduate Academic Accommodation Policy and Procedure details are available at:

<https://www.eng.uwo.ca/graduate/current-students/academic-support-and-accommodations/index.html>

### **ACCESSIBLE EDUCATION WESTERN (AEW)**

Western is committed to achieving barrier-free accessibility for all its members, including graduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective graduate program. Graduate students with disabilities (for example, chronic illnesses, mental health conditions, mobility impairments) are strongly encouraged to register with Accessible Education Western (AEW): [http://academicsupport.uwo.ca/accessible\\_education/index.html](http://academicsupport.uwo.ca/accessible_education/index.html)

AEW is a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both AEW and their graduate programs (normally their Graduate Chair and/or Course instructor) to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction.