Western University
Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 9619 – DYNAMICS OF SOILS AND FOUNDATIONS

COURSE OUTLINE 2022-2023

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 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.

INSTRUCTOR CONTACT INFORMATION

Course instructor: Dr. Safwat Ramadan, P.Eng.
Email address: sramada6@uwo.ca
Office: TBD
Lecture hours: 3 hours lecture per week – Mondays 4:30 pm – 7:30 pm
Office hours: weekly Office hours (TBD) are held via Zoom

COURSE FORMAT

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

TOPICS

Topic #	**Description**	**Learning Activities**	**Tentative timeline**
1	**Introduction**		
a) Introduction	Design objectives, design procedure, basic notions, mathematical models, DOFs, types of dynamic loads, foundation types, excitation forces of machines.	• One lecture (In-Person)	Week 1 Monday Sept. 12th
b) Dynamic Soil Properties	Wave propagation, field measurement methods, laboratory measurement methods, empirical correlations, cyclic behaviour of soils.	• Two lectures (In-Person)	Weeks 2-3 Mondays Sept. 19th and 26th

2	**Stiffness and damping of Shallow Foundations**		
a) b)	Definition of stiffness, damping and inertia, circular shallow foundation non-circular foundation, embedded footings, impedance functions of a layer on half-space.	• Two lectures (In-Person)	Weeks 4-5 Mondays Oct. 3rd and 10th
3	**Stiffness and damping of Pile Foundations**		
a) b)	Pile applications, mathematical models for pile analysis, stiffness and damping of piles Pile groups, interaction factors, impedance functions of pile groups, pile batter	• Two lectures (In-Person)	Weeks 6-7 Mondays Oct. 17th and 24th
	Reading Week (No Classes)		Week 8 Monday Oct. 31st
4	**Dynamic Response of Foundations to Harmonic Loading**		
a) b)	Response of rigid foundations in 1 DOF, effects of vibration Response of rigid foundations in 2 DOF and 6 DOF, response of structures on flexible foundations	• Two lectures (In-Person)	Weeks 9-10 Mondays Nov. 7th and 14th
5	**Dynamic Response of Foundations to Transient Loading**		
a) b)	Types of hammers and hammer foundations, design criteria, mathematical models, impact forces Response of one and two mass foundations, numerical modelling.	• Two lectures (In-Person)	Weeks 11-12 Mondays Nov. 21st and 28th

6	**Vibration Damage and Remedial Measures**		
	Damage and disturbance, problem assessment and evaluation, remedial principles, examples from different industries, sources of error.	• One lecture (In-Person)	Week 13 Monday Dec. 5th

SPECIFC LEARNING OUTCOMES

Degree Level Expectation	Weight	Assessment Tools	Outcomes
Depth and breadth of knowledge	15%	• Assignments • Project	• 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%	• Assignments • Project	• Ability to conduct critical evaluation of current advancements in the field of specialization • Ability to conduct coherent and thorough analyses of complex problems using established techniques/principles and judgment
Application of knowledge	30%	• Assignments • Project	• 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%	• Project	• 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%	• Project	• Ability to communicate (oral and/or written) ideas, issues, results and conclusions clearly and effectively
Awareness of limits of knowledge	10%	• Project	• 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)	Topics 1- 5		40%
Multiple Choice Quizzes (two)	Topics 1- 5		10%
Participation	Participation in class activities		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

REQUIRED TEXTBOOK

None

OPTIONAL COURSE READINGS

Any relevant books and scientific papers

COURSE CONTENT

The lecture notes are copyrighted to Prof. M. Hesham El Naggar 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

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. To schedule an appointment with the counsellor, contact Kristen Edwards (khunt29@uwo.ca) via confidential email and you will be contacted by our intake office within 48 hours to schedule an appointment.

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

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.