Spring 2021

CE 641-102: Engineering Properties of Soil

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NJIT New Jersey's Science & Technology University

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

CE 641 Course Title Spring 2021

Course Description: An in-depth study of physical and mechanical properties of soils. Topics include clay mineralogy, shear behavior and compressibility of fine and coarse grained soil; and in-situ measuring techniques such as vane shear, core penetration and pressure meter. Laboratory work includes consolidation test and triaxial test, with emphasis on analysis, interpretation and application of data to design problems.
Co-requisite or Pre-requisite: approved undergraduate course in soil mechanics within last five years.

Canvas: CE641102

Instructor: Dr. Jay N. Meegoda, Ph. D, PE, FASCE
Office: 221 Colton Hall
Office Hours: F: 4:00 to 6:00 PM and any other time by email request
Email: meegoda@njit.edu

Suggested Text: Mitchell and Soga, *Fundamentals of Soil Behavior*, latest edition, Wiley ISBN: 9780471463027
Holtz, Kovacs, and Sheahan, *introduction to geotechnical engineering*, latest edition, Pearson, ISBN: 9780132496346

Course Sections: 102

Week	Topic	Mitchell and Soga Book Chapter
1	Soil Formation and Soil Mineralogy	2 and 3
2	Soil Composition and Soil Fabric	4 and 5
3	Granular Interactions	7 and 8
4-6	Soil-Water-Chemical Interactions	6
7	Soil Compaction and Filed Applications	Notes
8	Midterm Examination	
9-10	Conduction Phenomenon and Field Applications	9
11-12	Volume Change Behavior and Field Applications	10
13-14	Shear Strength/Deformation and Field Applications	11
15	Final Exam	

Grading Policy: Grading: Homework = 25%, Term Paper = 25%, Mid-term = 25%, Final = 25%

Grading Scale:

A: 100-90
B+: 89-85
B: 84-80
C+: 79-75
C: 74-70
D: 69-60
F: Below 60

Attendance Policy: Students are required to attend all classes. If there is a conflict they should inform the instructor prior to the class.

Withdrawals: In order to ensure consistency and fairness in application of the NJIT policy on withdrawals, student requests for withdrawals after the deadline will not be permitted unless extenuating circumstances (e.g., major family emergency or substantial medical difficulty) are documented. The course Professors and the Dean of Students are the principal points of contact for students considering withdrawals.

NJIT Honor Code: The NJIT Honor Code will be upheld; any violations will be brought to the immediate attention of the Dean of Students. The Honor Code can be found at (http://www5.njit.edu/doss/policies/honorcode/index.php).

Assignment Policy:

- Carefully review the notes and example problems in your textbook.
- Homework is due at the beginning of the class following the start of a new topic. Late homework carries 50% penalty.
- You are encouraged to ask questions about homework problems before or after the class, and discuss with classmates outside of class, post to emails for classmates to comment and my response, but homework problems should not be done together.
- The midterm and final composed of in class multiple choice questions and take home exam
- Please select one publication from the following for your term paper. You need to select your topic (first come first serve before January 29). Then you need to download the paper and also related publications and select five other publications and send to me for approval by February 26. On March 26 you need to develop an outline and a draft abstract. Draft paper is due on April 30 and final paper on May 7. Your paper should be professional quality with a minimum of five pages of single space lines with a list of supporting references. In you term paper you are supposed to critique the original paper.
  1. Gao, S., **Meegoda, J. N.** and Hu, L., Microscopic Investigation of Air Sparging - Dynamic Two-phase Flow," Transport in Porous Media, Volume 96, Issue 1 (2013), Page 173-192
  2. Pasha, Y. A., Aflaki E., Hu L., and **Meegoda J. N.,** "Effect of Soil Fabric on Transport of a LNAPL through Unsaturated Fine Grained Soils: A Centrifugal Model Study," Soil and Sediment Contamination an International Journal, Vol. 22# 1, pp. 223-240, 2013
  3. Gao, S., **Meegoda, J. N.** and Hu, L., "Two Methods for Pore-Network of Porous Media". International Journal for Numerical and Analytical Methods in Geomechanics, Volume 36, Issue 18, 25 December 2012, Pages 1954-1970
  4. Gao, S., **Meegoda, J. N.** and Hu, L., "Microscopic Modeling of Air Migration during Air Sparging," Journal of Hazardous, Toxic, and Radioactive Waste Management, Vol. 15#2, pp. 70-79, 2011
  5. **Meegoda, J. N.,** and Ratnaweera, P., "Prediction of Effective Porosity of Contaminated Soils using Electrical Properties," Geotechnical Testing Journal, Vol. 31 #4, pp. 344-357, 2008.
  6. Kamolpornwijit, W., **Meegoda, J. N**., and Hu, Z., "Characterization of Chromite Ore Processing Residue," Journal of Hazardous, Toxic, and Radioactive Waste Management, Vol. 11#4, pp 234-239, 2007
  7. **Meegoda, J. N.,** and Tantemsapya, N., "Microscopic Modeling of Colloidal Silica Stabilized Granular Contaminated Soils," Journal of Materials in Civil Engineering, Vol. 19 #1, pp 91-98, 2007
  8. Ratnaweera, P., and **Meegoda, J. N.,** "Shear Strength and Stress-Strain Behavior of Contaminated Soils," Geotechnical Testing Journal, Volume 29 #2, pp. 141-148, 2006.
  9. **Meegoda, J. N.,** Chen, B., Gunasekera, S. D. and Pederson, P., "Compaction Characteristics of Contaminated Soils-Reuse as a Road Base Material" Recycled Materials in Geotechnical Applications, Geotechnical Special Publication # 79, pp. 195-209, 1998.
  10. Ratnaweera, P., and **Meegoda, J. N**., "Treatment of Oil Contaminated Soils for Identification and Classification", Geotechnical Testing Journal, Vol. 18#1 pp. 41-49, 1995.
  11. Ratnaweera, P. and **Meegoda, J. N.,** Compressibility of Contaminated Clay Soils", Geotechnical Testing Journal, Vol. 17#1, March pp. 101-112, 1994.
  12. **Meegoda, N. J.,** and Rajapakse, R. A. "Long-term and Short-term Hydraulic Conductivities of Contaminated Clays", Environmental Engineering Journal, Vol. 119#4, pp. 725-743, 1993.
  13. **Meegoda, N. J.,** and Gunasekera, S. D., "A Method to Measure the Effective Porosity of Clays", Geotechnical Testing Journal, Vol. 15#4, pp. 340-351, 1992.
  14. **Meegoda, N. J.,** King, Ian P., and Arulanandan, K. "An Expression for Permeability of Anisotropic Granular Media," International Journal for Numerical and Analytical Methods in Geomechanics, Vol. 13#6, pp 575-598, 1989
  15. **Meegoda, N. J.,** Arulanandan, K., "Electrical Method of Predicting In- situ Stress State of Normally Consolidated Soils," Use of In-situ Tests in Geotechnical Engineering, Geotech. Special Publication #6, pp. 794-808, 1986
  16. Shan, H. Y., and **Meegoda J. N.,** "Construction Use of Abandoned Soils," Journal of Hazardous Materials, Vol. 56#1-3, pp. 133-145, 1998
  17. **Meegoda, J. N.** and Martin, L., In-Situ Specific Surface Area of Clays, , Geotechnical and Geological Engineering, https://doi.org/10.1007/s10706-018-0623-7
  18. **Meegoda, J. N.,** Hewage, S. A, and Batagoda, J. H., "Application of the Diffused Double Layer Theory to Nanobubbles," Journal of Langmuir, https://doi.org/10.1021/acs.langmuir.9b01443
  19. Du, J., Hu, L., **Meegoda, J. N.,** and Zhang, G., "Shale Softening: Observations, Phenomenological Behavior, and Mechanisms" Applied Clay Science 161 (2018) 290–300
  20. Pasha, Y. A., Aflaki E., Hu L., and **Meegoda J. N.**, "Effect of Soil Fabric on Transport of a LNAPL through Unsaturated Fine Grained Soils: A Centrifugal Model Study," Soil and Sediment Contamination an International Journal,, Vol. 22# 1, pp. 223-240, 2013.
  21. Du, J., Whittle, A. J., Hu, L., Divoux, T., and **Meegoda, J. N.**, (2021), "Characterization of Meso-Scale Mechanical Properties of Longmaxi Shale Using Grid-Micro-indentation Experiments," Journal of Rock Mechanics and Geotechnical Engineering, V13 #3, June 2021.
  22. Hewage, S. A, Kewalramani, J. A., and **Meegoda, J. N.,** (2021), "Stability of Nanobubbles in Different Salts Solutions," Journal of Colloids and Surfaces A: Physicochemical and Engineering Aspects, https://doi.org/10. 1016/ j. colsurfa. 2020. 125669
  23. **Meegoda, J. N.,** Hewage, S. A, and Batagoda, J. H., (2019), "Application of the Diffused Double Layer Theory to Nanobubbles," Journal of Langmuir, https://doi.org/10.1021/acs.langmuir.9b01443.
  24. Martin, L. and Meegoda, J. N., (2021) Introduction to Anion Exchange Membranes and Their Use in Electro-Osmotic Consolidation, Environmental Geotechnics, Published Online: August 21, 2020 https://doi.org/10.1680/jenge.20.00006

25. Zhang, Z, Celia, M. A.,Bandilla, K. W., Hu, L., and **Meegoda, J. N., (**2020), "A Pore-Network Simulation Model of Dynamic CO_2 Migration in Organic-Rich Shale Formations," Transport in Porous Media, https://doi.org/10.1007/s11242-020-01434-9

Syllabus Information: The dates and topics of the syllabus are subject to change; however, students will be consulted with and must agree to any modifications or deviations from the syllabus throughout the course of the semester.

Email Policy: The instructor will be communicating with you via your NJIT email

Items Required for this Course: Weekly homework and term paper.

Dress Policy: None

Outcomes Course Matrix –

Strategies, Actions and Assignments	ABET Student Outcomes (1-7)	Program Educational Objectives	Assessment Measures
Student Learning Outcome 1: Select appropriate laboratory and field methods for determining mechanical properties of coarse grained and fine grained soils interacting with the environment.			
Class presentation, class discussions, Homework	1,2,3,4,5,6,7	1,2	HW, Term Paper and Exams
Student Learning Outcome 2: Estimation or measurement of such based on laboratory and field tests and use of such in geotechnical designs.			
Class presentation, class discussions, Homework	1,2,3,4,5,6,7	1,2	HW, Term Paper and Exams
Student Learning Outcome 3: Interpretation of laboratory or field tests.			
Class presentation, class discussions, Homework	1,2,3,4,5,6,7	1,2	HW, Term Paper and Exams

CEE Mission, Program Educational Objectives and Student Outcomes

The mission of the Department of Civil and Environmental Engineering is:

- to educate a diverse student body to be employed in the engineering profession
- to encourage research and scholarship among our faculty and students
- to promote service to the engineering profession and society

Our Program Educational Objectives are reflected in the achievements of our recent alumni:

Engineering Practice: Alumni will successfully engage in the practice of civil engineering within industry, government, and private practice, working toward safe, practical, sustainable solutions in a wide array of technical specialties including construction, environmental, geotechnical, structural, transportation, and water resources.

Professional Growth: Alumni will advance their technical and interpersonal skills through professional growth and development activities such a graduate study in engineering, research and development, professional registration and continuing education; some graduates will transition into other professional fields such as business and law through further education.

Service: Alumni will perform service to society and the engineering profession through membership and participation in professional societies, government, educational institutions, civic organizations, charitable giving and other humanitarian endeavors.

Our Student Outcomes are what students are expected to know and be able to do by the time of their graduation:

1. an ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies