CEE 648 – 102: **Flow through Soils**
(3 credits)

Lectures Thursday 6:00pm – 8:50pm, CKB 114
Instructor Jay N. Meegoda Office Hours: Thursday 4-6
Colton 221 Any day by request
Meegoda@NJIT.edu, 973-596-2464

Prerequisite CE 341 taken over the last five years.

Required Textbook

Seepage, Drainage and Flow Nets by H. R. Cedergren, Wiley

Other Recommended Texts & Reading

Soil Physics by Jury, Gardner and Gardner Wiley

Course Description: Explains the fundamentals of fluid flow through saturated and unsaturated soils and the use of computer programs for the solution of boundary value fluid flow problems in soils. The first two-thirds of the course is devoted to flow through saturated soils. The topics are mathematical description of flow through soils, solutions for steady state and transient state fluid flow and geotechnical applications. The last one-third is devoted to flow through unsaturated soils. Topics include steady state of transient state fluid flow and a presentation of how these concepts are applied to geo-environmental problems.

Course Objectives (General)

By the end of this course, the student will be able to provide designs for any geotechnical or geo-environmental problem involving fluid flow.

Course Outline

Weeks	Content
1	Introduction to Flow through Soils/Darcy's Law
1-2	Hydraulic heads and Pore Water Pressures
2	Hydraulic Conductivity and Scale Issues Prediction/Estimation of Hydraulic conductivity
3-4	Saturated Flow - Theory for Steady Flow and Transient Flow La Place Equation and Boundary conditions
5-6	Geotechnical/Geo-environmental Applications Flow Nets- Seepage through Dams and Foundations
7	Mid- term Exam
8-10	Geotechnical/Geo-environmental Applications Filter design, Piping and Boiling in Earth dams Excavation, De-watering, Percolation test and On-site disposal of storm water
11	Fluid Statics of Air-Water Systems Two Phase Hydraulic Conductivity Relationships
12	Unsaturated Flow Steady-state Infiltration to a fixed water-table Uniform soils, Layered soils
13	Unsaturated Transient Flow Empirical formulae, Green-Ampt approach, Boltzmann transformation, Constant flux vs. constant potential solutions, Applications to layered soils and Macro-pore flow models
14	Geo-environmental Applications Landfills, and Infiltrometers, estimation of hydraulic conductivities
15	Final Exam

POLICIES & PROCEDURES

Academic Integrity: It is expected that NJIT's University Code on Academic Integrity will be followed in all matters related to this course. Refer to NJIT's Dean of Students website to become familiar with the Code on Academic Integrity and how to avoid Code violations.

https://www.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf

Communication: Via email

Lectures/Class: Attendance of all classes and class participation are mandatory

Handouts: Handouts will be emailed before each class.

Homework: There will be weekly individual homework assignments

Homework Format: Submitted homework assignments should be typed and all graphs should be drawn using MS excel.

Late Homework: Homework will be due on the date specified in the assignment and no late homework accepted.

Homework Solutions: Once homework from all students is collected they will be graded and returned within two weeks.

Exams: All exams are open book and open notes.

Calculation of Course Grade: A weighted average grade will be calculated as follows:

Homework	25%
Midterm	25%
Project	25%
Final Exam	25%

The minimum requirements for final letter grades are as follows:

A = 90%, B+ = 85%, B = 75%, C+ = 65%, C = 60%, D = 55%, F < 50%

Instructor Commitment: You can expect the Instructor to be courteous, punctual, organized, and prepared for lecture and other class activities; to answer questions clearly; to be available during office hours or to notify you beforehand if office hours are moved; to provide a suitable guest lecturer or pre-recorded lecture when they are traveling or unavailable; and to grade uniformly and consistently.

Students with Documented Disabilities: NJIT is committed to providing students with documented disabilities equal access to programs and activities. If you have, or believe that you may have, a physical, medical, psychological, or learning disability that may require accommodations, please contact the Coordinator of Student Disability Services located in the Center for Counseling and Psychological Services, in Campbell Hall, Room 205, (973) 596-3414. Further information on disability services related to the self-identification, documentation and accommodation processes can be found on the webpage at: (http://www.njit.edu/counseling/services/disabilities.php)

Course Schedule:

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Course Objectives Matrix - CEE 648 – 102

Strategies and Actions	Course Student Learning Outcomes	ABET Student Outcomes (a-k)	Program Educational Objectives	Assessment Methods/Metrics
Course Objective 1: Ability to perform geotechnical designs involving water flow				
Lectures and worked problems during the class	Students will learn and apply analytical methods incorporating concepts of flow through soils in geotechnical designs involving water flow.	a and b	1 and 2	Homework, exams and projects reports.
Course Objective 2: Ability to perform geo-environmental designs involving fluid flow				
Lectures and worked problems during the class	Students will learn and apply analytical methods incorporating concepts of flow through soils in geo-environmental designs involving fluid flow.	a and b	1 and 2	Homework, exams and projects reports.

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:

1. Engineering Practice: Alumni will successfully engage in the practice of civil engineering within industry, government, and private practice, working toward safe, practical, resilient, sustainable solutions in a wide array of technical specialties including construction, environmental, geotechnical, structural, transportation, and water resources.
2. 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.
3. 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