CE 662 – FALL 2023 SYLLABUS

NJIT CIVIL AND ENVIRONMENTAL ENGINEERING

NJIT New Jersey Institute of Technology

CE 702 (CE 662) – Energy from Underground Resources **Fall 2023**
Section: 101

Instructor: Prof. Oladoyin Kolawole, Ph.D.
Colton RM 233
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Office Hours: Tuesdays 2:00-5:00pm
(In person or via WebEx)
https://njit.webex.com/meet/ok62

Room: **TIER 106** Day and Time: **Tuesdays 6:00 - 8:50 pm**

Prerequisite: CE 342, or CE 341, or CE 320/ME 304, or CHEM 125, or EVSC 325. Restriction: None or permission of instructor.

Required Textbook

There is no required textbook for this course. A very detailed lecture notes/materials will be provided to the students.

Other Recommended Texts & Reading

- Wendell H. Wiser. "Energy Resources". Springer New York, NY, 2000. ISBN: 978-0-387-98744-6. https://doi.org/10.1007/978-1-4612-1226-3.
- Ibrahim Dincer and Murat Ozturk. "Geothermal energy systems". Elsevier eBooks, 2021. ISBN: 978-0-12-820775-8. https://doi.org/10.1016/C2019-0-01786-4.
- Surampalli, R.Y., et al. "Carbon Capture and Storage: Physical, Chemical, and Biological Methods". Edited by Rao Y. Surampalli, TianC. Zhang, et al. American Society of Civil Engineers, 2015. ISBN (print): 9780784413678; ISBN (PDF): 978-0-78-447891-2. https://doi.org/10.1061/9780784413678.
- Alessio Ferrari and Lyesse Laloui. "Energy Geotechnics". Springer Nature Switzerland AG, 2019. ISBN978-3-030-07622-1. https://doi.org/10.1007/978-3-319-99670-7.2.

Course Description *(from NJIT's course catalog)*

This course will provide students with fundamental and applied engineering knowledge critical for identifying, designing, and harnessing various economically valuable materials from deep underground to provide society with renewable and non-renewable energy. This course covers essential energy engineering concepts and technologies related to advancing the current and emerging underground energy resources such as oil and gas, metallic and non-metallic minerals, coal, tar sands, deep underground water, carbon transport and geo-sequestration, and hydrogen geological storage. This course will also explore the governing mechanisms controlling the transfer of fluid and mass at varying deep underground temperature and pressure conditions for safe and efficient extraction and utilization of these energy resources. Case study applications are included to show students how to apply the learned energy techniques in various engineering and science practices.

Course Objectives (General)

By the end of this course, students will be able to:

- Identify and understand the various underground energy resources.
- Understand various engineering techniques to extract energy from deep underground.

- Design efficient underground energy infrastructures.
- Apply various engineering principles to advance the extraction, transport and utilization of various underground energy resources.
- Understand the impact of Underground Energy Extraction & Storage on Environment & Sustainability.

Course Schedule:

Week(s)	Topic(s)
1	Introduction to Underground Resources Energy Geotechnics Renewable vs. Non-Renewable Underground Resources
2	Underground Drilling and Extraction Techniques & Technologies Underground Wellbore Assembly Underground Wellbore Tools (e.g., casing, drill pipe, drill bits, tubing) Underground Wellbore Cementing Process
3	Underground Mining: Extraction and Utilization of Metallic & Non-Metallic Minerals Underground Extraction of Critical Minerals Energy From Coal Energy From Oil Sands Merits & Demerits of Energy from Minerals, Coal, & Oil Sands
4	Nuclear Energy Fuel (Uranium) Underground Nuclear Energy Materials Storage & Disposal Merits & Demerits of Underground Nuclear Energy & Disposal Energy From Fossil Fuels (Oil & Gas) – Fundamentals & Engineering Concepts Energy From Fossil Fuels – Underground Reservoir Characterization
5	Energy from Fossil Fuels – Potential Resources in United States Energy From Fossil Fuels – Extraction, & Utilization Merits & Demerits of Energy from Fossil Fuels (Oil & Gas)
6	Exam 1
7	Geothermal Energy – Introduction & Characterization Geothermal Energy – Geothermal Reservoirs & Systems, & Underground Heat Flow Geothermal Energy – Enhanced Geothermal Systems (EGS) Geothermal Energy – Potential of Resources in United States & worldwide Underground Thermal Energy Storage (UTES) Underground Thermal Energy Storage (UTES) Types & Applications Geothermal Energy Piles (GEPs) Merits & Demerits of Geothermal Energy & Underground Thermal Energy Storage
8	Carbon Capture, Transport, & Underground Storage Concepts Current And Emerging Technologies for Carbon Capture, Transport, & Underground Storage Carbon Transport – Pipelines, Ships, Truck, & Rail. Geologic Carbon Sequestration Modeling and Uncertainty Analysis of Transport & Geological Carbon Sequestration Direct air capture (DAC) for Carbon Sequestration BECCS Biomass Carbon Sequestration Bio-Sequestration of Carbon Dioxide Enhanced Soil Carbon Trapping Enhanced Carbon Sequestration in Oceans (Ocean CO_2 Sequestration) Merits & Demerits of Carbon Capture, Transport, & Underground Storage
9	Methane Gas Hydrates Underground Hydrogen Production for Energy Hydrogen Storage & Utilization for Energy Merits & Demerits of Underground Hydrogen Production & Storage
10	No Class
11	Underground Energy Transport Infrastructure & Systems Impact of Underground Energy Resources Extraction & Storage on Environment & Sustainability Greenhouse Gases & Their Effect on Climate Change
12	Exam 2
13	Underground Thermal Energy Storage – Industry Perspective Underground Energy Extraction & Storage Infrastructure & Systems - Industry Perspective Safe Underground Energy Transport & Storage Infrastructure & Systems - Industry Perspective
14	Final project Report and Presentation
15	Final project Report and Presentation

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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.

POLICIES & PROCEDURES

Academic Integrity:
Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at:
http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. **Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university**. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu

Communication: All communications by the instructor will be during the class and via NJIT e-mail. It is your responsibility to check your NJIT e-mail regularly. Expect an e-mail response/reply from the instructor only on Monday - Friday between 9am - 5pm.

Lectures/Class: Some weekly lectures will start with quizzes. During the class, the instructor can often ask you to work on a problem or brainstorm ideas with the people next to you and you will be called on to provide one or more of your answers. The goal of this in-class work and discussion is to get you started on a problem (not necessarily to finish) and improve how you think about the problem which will then be discussed. Lectures will NOT be recorded for subsequent access to students; therefore, students have the burden of making up for missed lectures. Please be respectful to the course instructor and your classmates. You should always bring a pencil and calculator with you to class. Please put your cell phones on silent or turned off during class.

Lecture Notes: Copies of the notes used in class will be posted on Canvas throughout the semester before lecture. It is highly recommended that you download or print out or have access to the set of lecture notes to follow along during lecture.

Attendance: Attendance at all lecture/class periods is compulsory, regardless of location or modality. A student is permitted a maximum of two (2) unexcused absences throughout the semester. If a student is absent for more than two (2) classes for the entire semester without a DOS-approved excused absence, the student will receive a final grade of "**F**."

Homework: All homework should be presented in an organized manner and submitted online on canvas in pdf format using recommended HW submission template provided. Laboratory and homework assignments must be handed in or submitted before the beginning of the class. Assignments must be typed, however, hand sketches (as necessary) may be submitted. If plots or calculations are required, either use hand calculations of the problem in your submitted HW solution or you can use Excel program and attach the solution excel files along with pdf homework submissions. Begin each problem on a new page and number all pages; collate all homework pages together and have your name written clearly on the front page. It is your responsibility to make sure you understand how to solve the problems by attending office hours with the instructor/TA and/or asking questions in class. As with many conceptual problems, multiple solutions may be possible. This means that all rational solutions to the assignments may be considered for acceptance. Homework will be due at the beginning of class on the date it is due. Late Homework will NOT be accepted after the due date. The homework should be turned in as instructed before 6 pm.

Exams: There will be two exams held during class time and no final exam. All exams in this course will be in-person and may be delivered in the form of an oral exam. No electronic devices (such as

laptops/cellphones/tablets/smart watches, etc.) are allowed during quizzes/exams. No recording devices shall be allowed during class or examinations.

Term Project and Presentation: There will be a term project/assignment for this course that must be carried out individually. This term project is made up of two parts: (1) term project paper/report, and (2) term project presentation. Necessary background information and knowledge, in addition to the expectations and format of the term project will be provided during class lectures throughout the semester.

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

Homework	10% (Total 100 points)
Term Paper Report & Presentation	25% (Total 250 points)
Class Participation	15% (Total 150 points)
Exam 1	25% (Total 250 points)
Exam 2	25% (Total 250 points)
Total:	**100% (Total 1000 points)**

The final letter grades are computed as follows:

A = > 90.0%, B+ = 85.0% - 89.9%, B = 80.0% - 84.9%, C+ = 75.0% - 79.9%, C = 70.0% - 74.9%, F = < 69.9%

Grades are not curved in computing the final grade. It is theoretically possible for everyone in the class to get an A (or an F). Your performance depends only on how you do and how much you learn, not on how everyone else in the class does.

Changes to the exam dates if any will be notified in advance.

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, fairly, 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).

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, 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.

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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