



California State University, Fullerton
College of Engineering and Computer Science
Department of Civil and Environmental Engineering
EGCE 481 Remediation of Contaminated Soil and Groundwater
Summer Semester 2018

Instructor: Sudarshan Kurwadkar Ph.D., PE

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Class Meetings: Online

Units: 3 units

Skype: sudarshan.kurwadkar

Course Description

Site assessment, green technologies, design for soil remediation systems and design for groundwater remediation systems.

Prerequisites

EGCE 441 or equivalent, or enrollment in M.S. Environmental Engineering program

During the semester, the department will verify the prerequisite requirement. The students, who have taken the prerequisite course at another school, must submit the appropriate documentation to the department office. Otherwise, their name will be automatically deleted from the class roll at any time during the semester.

Textbook

1. "Hazardous Waste Management (2nd ed.)" by Michael D. LaGrega, Phillip L. Buckingham, Jeffrey C. Evans (2010), Waveland Inc. ISBN-9781577666936
2. "Site Characterization for Subsurface Remediation" by EPA (1991), EPA/625/4-91/026

References

1. "Practical Design Calculations for Groundwater and Soil Remediation" by J. Kuo, CRC Press, Taylor and Francis Group, 2nd edition (2014)
2. "Transport and Fate of Contaminants in Subsurface" by EPA (1989), EPA/625/4-89/019.
3. "How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites" by EPA (2004)

Course Content and Objectives

This course covers site assessment, green technologies, design for soil remediation system, and design for groundwater remediation systems. Students will learn:

- Practical design calculations for remedial investigation activities
- Common practices in soil and groundwater monitoring and sampling
- Migration of contaminants in soil and groundwater
- Design of common soil remediation systems
- Design of common groundwater remediation systems
- Development of remedial alternatives and analysis

Program Educational Objectives (PEOs) for this course

A. Technical Strength: Graduates will be successful in multi-disciplinary engineering practice and being well integrated into the workforce.



California State University, Fullerton
College of Engineering and Computer Science
Department of Civil and Environmental Engineering
EGCE 481 Remediation of Contaminated Soil and Groundwater
Summer Semester 2018

Program Student Outcome (SOs) for this course

- a. An ability to apply knowledge of mathematics, science and engineering
- c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
- h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context.
- j. Knowledge of contemporary issues.

Drop Policy

Please consult the Summer 2018 Schedule regarding the University regulations and the deadlines for dropping this course. Note that the department stamp and/or the Department chair's signature is required in addition to instructor's signature.

Office Hours (Summer 2018)

Tuesdays 11:00 AM – 1:00 PM, Skype Hours (sudarshan.kurwadkar). Prior scheduling of meeting via Phone/e-mail inquiries is encouraged. (Tel: 657-253-3734; e-mail: skurwadkar@fullerton.edu) (By appointment only)

Online Availability of Instructor

The instructor will monitor course emails at least twice a week during the specified office hours. Every effort will be made to respond to emails within 24 hours during the week, but this is not guaranteed. The instructor will also be available on Skype during office hours or by appointment. Skype availability may not always be immediate, depending upon the presence of other students in the office. During real-time course assignments such as chat rooms, the instructor will answer immediately. Alternatively, the instructor may be reached by phone.

Response Time

The instructor will monitor course emails at least twice a week during the specified office hours. Every effort will be made to respond to emails within 48 hours (except weekends). The instructor will also be available on Skype during office hours or by appointment. Skype availability may not always be immediate, depending upon the presence of other students in the office. During real-time course assignments such as chat rooms, the instructor will answer immediately. Alternatively, the instructor may be reached by phone.

Course Communication

All course announcements and individual email are sent through Titanium, which only uses CSUF email accounts. Therefore, you **MUST** check your CSUF email on a regular basis (several times a week) for the duration of the course.

Required Technical Competencies and Equipment

All course materials will be distributed using the CSUF TITANium system. Students will additionally be expected to submit assignments and participate in class discussion periods using



California State University, Fullerton
College of Engineering and Computer Science
Department of Civil and Environmental Engineering
EGCE 481 Remediation of Contaminated Soil and Groundwater
Summer Semester 2018

TITANium. To use TITANium and student portal, students will need access to a computer, an Internet connection capable of handling large file downloads, and a data transmission rate for real-time discussions and viewing web-cast materials. Submission of hand-written problem sets will require the use of a scanner. The details of minimum technical specifications, internet connection/access, and computer skills and competencies are shown below:

1. Minimum Technical Specifications

To fully participate in this course, you will need to have and successfully operate a computer system that meets the following minimum technical specifications:

Computer Requirements

Operating System: Windows 7 or higher, Macintosh OS X

Processor: 2.0 GHz or higher preferred. **Memory:** 3 GB of RAM or higher.

Plug-ins: Adobe Reader, Flash Player, Quicktime, Java, Windows Media Player

Browser: Chrome or Firefox (Safari for Mac)

Monitor: 15" monitor with 800 x 600 resolution capability or higher.

Network Connection: Cable, DSL, or another high speed network highly recommended.

Software: Microsoft Office 2007 or Open Office, PowerPoint 2010 Viewer

E-mail Account: Must be able to send/receive attachments.

2. Internet Connection/Access: Students are required to have a dependable and reliable connection to the Internet. The speed and reliability of your connection can and will directly influence your online learning experience and your ability to complete exams, online exercises, and assignments. A Cable, DSL, or other high-speed network is highly recommended.

3. Computer Skills and Competencies

Students who enroll in online courses and/or programs must have the requisite knowledge to use the computer, navigate the internet, and use TITANium. It is not the instructor's responsibility to teach students how to use the computer, navigate the internet, send and/or receive emails or how to use the TITANium system.

Online Participation

Student on-line participation (e.g., blog postings) is expected.

Planned Assignments

There will be homework assignments throughout the semester. Homework assignments will be calculation/design type problems relevant to class discussion. Assignments must be submitted electronically through TITANium by midnight of the day they are due. Unless specifically indicated by the instructor, assignments should be submitted in a standard readable format (PDF preferred). Assignments must also be submitted in a single file. Calculations or diagrams completed by hand may be scanned and submitted as a PDF, jpeg, or png. Ensure that scanned documents are readable, particularly if using the greenish engineering paper. Missed assignments will be rewarded zero points. Excused late assignments will be accepted, provided the student



California State University, Fullerton
College of Engineering and Computer Science
Department of Civil and Environmental Engineering
EGCE 481 Remediation of Contaminated Soil and Groundwater
Summer Semester 2018

has communicated with the instructor ahead of time. Late homework will receive penalty ranging from 10 to 50 % depending on how late the submission is.

In the event of technical problems, students may submit hard copies of assignments by hand delivering or faxing their work to the Civil and Environmental Engineering office in E-100 (657-278-3016). Assignments must be labeled with the course number and instructor's name. Students who submit or fax assignments to the office must notify the instructor ahead of time.

Examinations

Examinations will be offered on-campus on a Saturday for those near enough to drive in. Those students who do not live nearby to drive, they will have to arrange to take the exams at an approved testing center. The final examination will be comprehensive. Anyone missing a scheduled examination must notify the instructor or the department office in advance except for *bona fide* emergencies. A written letter must follow absence from a medical doctor or another appropriate official. For excused absences, no make-up examinations will be given, and the score of the other examination may be just extended, at the discretion of the instructor. Unexcused absences will count as a zero score obtained. Cheating and use of unfair means during the examination will result in automatic 'F' grade in the class.

Grading Policy

Assignments will be evaluated and assigned a grade to provide you with feedback on the quality of your efforts. Assignments will be distributed throughout the semester as roughly indicated by the Course Schedule. The final grade for the course will be calculated as follows:

▪ Homework sets	15%
▪ Midterm examination	40%
▪ Final examination	45%

The "+/-" grading will be used, and final grades will be computed according to the following scale:

Tentative Letter Grade

Note that this is *tentative* grading guideline.

A+ (4.0): 97 – 100	C+ (2.3): 77 – 79
A (4.0): 93 – 96	C (2.0): 73 – 76
A- (3.7): 90 – 92	C- (1.7): 70 – 72
B+ (3.3): 87 – 89	D+ (1.3): 67 – 69
B (3.0): 83 – 86	D (1.0): 63 – 66
B- (2.7): 80 – 82	D- (0.7): 60 – 62
	F (0.0): 0 – 59

On-campus Meeting Requirements

There is no mandatory meeting requirement. However, the option exists for those students within driving distance to take the Midterm and Final exams on campus. Those students who do



California State University, Fullerton
College of Engineering and Computer Science
Department of Civil and Environmental Engineering
EGCE 481 Remediation of Contaminated Soil and Groundwater
Summer Semester 2018

not attempt the exams on campus will be required to take it at the approved testing centers and at their own expense.

Technical Support

In case of technical problems, students may contact the CSUF Help Desk at 657-278-7722.

Students with Special Needs

Please inform the instructor during the first week of classes about any disability or special needs that you may have that may require specific arrangements related to attending class sessions, carrying out class assignments, or writing papers or examinations. According to California State University policy, students with disabilities must document their disabilities at the Disability Support Services (DSS) Office in order to be accommodated in their courses. Additional information can be found at the DSS website, by calling 657-278-3112 or email dsservices@fullerton.edu

Academic Dishonesty Policy

Academic dishonesty includes such things as cheating, inventing false information or citations, plagiarism, and helping someone else commit an act of academic dishonesty. It usually involves an attempt by students to show possession of a level of knowledge or skill, which they, in fact, do not possess. Cheating is defined as the act of obtaining or attempting to obtain credit for work by the use of any dishonest, deceptive, fraudulent, or unauthorized means. Plagiarism is defined as the act of taking the work of another and offering it as one's own without giving credit to that source. Instructors who believe that an act of academic dishonesty has occurred (1) are obligated to discuss the matter with the student(s) involved; (2) should possess reasonable evidence such as documents or personal observation; and (3) may take whatever action (subject to student appeal) they deem appropriate, ranging from an oral reprimand to an F in the course. Additional information on this policy is available from University Policy Statement 300.02 http://www.fullerton.edu/senate/publications_policies_resolutions/ups/UPS%20300/UPS%20300.021.pdf

It is expected that all work submitted for this course, as well as any other at Cal State Fullerton, will be your own unless properly attributed to another author. All work should be original for this class and specific to the assignment. Unless an assignment is specifically designated a team project, all assignments are expected to be completed individually. If you have any questions, please contact the instructor.

Students who violate university standards of academic integrity are subject to disciplinary sanctions, including failure in the course and suspension from the university. Since dishonesty in any form harms you, other students, and the university, policies on academic integrity are strictly enforced. Safeguards, such as verification the identity of students during online participation and the exams shall be taken at a proctored place, will be taken to ensure the authenticity of student work.



California State University, Fullerton
College of Engineering and Computer Science
Department of Civil and Environmental Engineering
EGCE 481 Remediation of Contaminated Soil and Groundwater
Summer Semester 2018

Academic Integrity Statement

As stated in the CSUF Catalog "**Plagiarism** is defined as the act of taking the specific substance of another and offering it as one's own without giving credit to the source. When sources are used, acknowledgment of the original author or source must be made following standard scholarly practice."

We expect that you will familiarize yourself with the academic integrity guidelines in the current *Catalog* and *Student Handbook*.

Appropriate Online Behavior

In all of their online interactions with the course instructor and their student colleagues, students in this course are expected to exhibit appropriate online behavior. Such guidelines have been famously compiled as "netiquette" by Virginia Shea (<http://www.albion.com/netiquette>). In summary:

- Do not write something online that would be considered rude or offensive in person;
- Abide by civil and criminal laws (paying for shareware; eschewing piracy);
- Make sure that the content you post is appropriate to the tone and purpose of the domain;
- Respect others' time and bandwidth by being succinct and taking care not to post accidentally;
- Use formal language that is appropriate to a classroom setting;
- Share what you know with others when it is helpful;
- Do not perpetuate extended "flaming";
- Respect the privacy of others;
- Do not abuse your expert knowledge;
- Be forgiving of others' mistakes.

You are encouraged to read more about netiquette at <http://www.albion.com/netiquette>

Emergency Preparedness

To be able to respond effectively in an emergency, be sure to note (a) fire alarm pull station locations, (b) evacuation map including the class's outside meeting area, (c) emergency procedures for fire, medical emergency, hazardous materials release, earthquake and dangerous situations, and (d) location of nearest emergency phone. Any person with special needs is encouraged to speak with the instructor privately. All campus personnel are required to participate in all campus-wide drills. More emergency preparedness information can be found at the [Classroom Preparedness website](http://prepare.fullerton.edu/campuspreparedness/ClassroomPreparedness.php).

<http://prepare.fullerton.edu/campuspreparedness/ClassroomPreparedness.php>

The emergency procedures (c above) that you need to follow in our class are detailed in the classroom guide at the end of this syllabus.

If an emergency disrupts normal campus operations or causes the University to close for a prolonged period (more than three days), students are expected to complete the course assignments listed on the syllabus as soon as it is reasonably possible to do so.



California State University, Fullerton
College of Engineering and Computer Science
Department of Civil and Environmental Engineering
EGCE 481 Remediation of Contaminated Soil and Groundwater
Summer Semester 2018

Library Support

The Library offers various resources and services to assist students receiving online instruction. Students can download a PDF copy here

http://www.library.fullerton.edu/_resources/pdf_word/guidelines-online-instruction-30aug12.pdf

Library guidelines can be accessed through the web link:

<http://www.library.fullerton.edu/about/guidelines/online-instruction-guidelines.php>

Final Exams Schedule

Student can access the final examination schedule by visiting the web link

<http://records.fullerton.edu/registration/finalexaminations.php>

University Learning Center

The goal of the University Learning Center is to provide all CSUF students with academic support in an inviting and contemporary environment. The staff of the University Learning Center will assist students with their academic assignments, general study skills, and computer user needs. The ULC staff work with all students from diverse backgrounds in most undergraduate general education courses including those in science and math; humanities and social sciences; as well as other subjects. They offer one-to-one peer tutoring, online writing review, and many more services. More information can be found on the [University Learning Center website](#).

Writing Center

The Writing Center offers 30-minute; one-on-one peer tutoring sessions and workshops, aimed at assisting with all written assignments and student writing concerns. Writing Center services are available to students from all disciplines. Registration and appointment schedules are available at the [Writing Center Appointment Scheduling System](#). Walk-in appointments are also available on a first come, first served basis, to students who have registered online. More information can be found at the [Writing Center webpage](#). The Writing Center is located on the first floor of the [Pollack Library](#) their phone number is (657) 278-3650.

EGCE 481 Remediation of Contaminated Soil and Groundwater (Summer 2018)

Sudarshan Kurwadkar, Ph.D., P.E., BCEE

<i>Date</i>	<i>Topics</i>
1. 05/29/18	General overview of the Course Environmental remediation market General discussion on groundwater contaminants, types, sources, generation, magnitude and management, and treatment Environmental ethics Environmental Legislation RCRA, CERCLA, and others (HSWA, CAA, etc.)
2. 6/05/18	Characterization of Vadose Zone Review of concepts Hydraulic head, Hydraulic gradient, and hydraulic conductivity Characterization of Groundwater Movement Darcy's velocity, seepage velocity, permeameters
3. 06/12/18	Homogeneity and Heterogeneity of sub-surface environment Isotropy and anisotropy Measurement of hydraulic conductivity: <ul style="list-style-type: none">• Empirical• Laboratory• Field
4. 06/19/18	Sampling of Soil & Groundwater Soil borings and vadose zone sampling Well hydraulics: Groundwater monitoring wells and sampling Physicochemical make-up of sub-surface environment Soil gas survey Groundwater contaminant of concern Properties of common groundwater contaminants Introduction to mass concentration relationship
5. 06/26/18	Mass Concentration Relationship Determine Extent of Contamination Extent of contamination – Capillary fringe Mass and volume of free product Solve problems related to mass and volume of groundwater contaminants
6. 07/03/18	Remedial Investigation Activities Common Remedial Investigation (RI) activities Types of groundwater monitoring and sampling Location and sampling frequency Vadose zone sampling Groundwater sampling

EGCE 481 Remediation of Contaminated Soil and Groundwater (Summer 2018)

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<i>Date</i>	<i>Topics</i>
07/07/18	<i>First Mid-Term Examination (1:0 PM - 2:50 PM)</i>
7. 07/10/18	Soil Remediation Statistical approach: Sampling excavated soil stockpile Partitioning behavior of soil contaminants in different phases Equilibrium between free product and vapor phase Liquid-vapor equilibrium
8. 07/17/18	Fate and Transport of Contaminants Solid-liquid equilibrium Retardation factor Relative mobility of contaminants Travel velocity of dissolved plume
9. 07/24/18	Physicochemical Treatment Processes I Soil Vapor Extraction System design Radius of influence Mechanisms Related to Contaminant Transport Advection, dispersion, diffusion, Bio-concentration factors Overview of transport model
10. 7/31/2018	Physicochemical Treatment Processes II - Air Stripping Air stripping and steam stripping System design Air Sparging Advanced Oxidation Processes
08/04/18	<i>Final Exam (1:0 PM - 2:50 PM)</i>