

2015-2016 LONG SIGNATURE SHEET

Proposal Number: CEE 20150324

Proposal Title: Establishment of Permanent Course #s for CEE Graduate Courses

Originating Department: Civil & Environmental Engineering (CEE)



UNC CHARLOTTE

TYPE OF PROPOSAL: UNDERGRADUATE _____ GRADUATE X UNDERGRADUATE & GRADUATE _____
 (Separate proposals sent to UCCC and Grad. Council)

DATE RECEIVED	DATE CONSIDERED	DATE FORWARDED	ACTION	SIGNATURES
			Approved	<u>DEPARTMENT CHAIR</u> John Daniels
			Approved	<u>COLLEGE CURRICULUM COMMITTEE CHAIR</u>
			Approved	<u>COLLEGE FACULTY CHAIR (if applicable)</u>
	4/29/15		Approved	<u>COLLEGE DEAN</u> Robert E. Johnson
			Approved	<u>GENERAL EDUCATION</u> (if applicable, for General Education courses)
			Approved	<u>UNDERGRADUATE COURSE & CURRICULUM COMMITTEE CHAIR</u> (for undergraduate courses only)
5-5-15	9-1-15	10-14-15	Approved	<u>GRADUATE COUNCIL CHAIR</u> (for graduate courses only) Alan R. Freitag Dennis Livesay
				<u>FACULTY GOVERNANCE ASSISTANT</u> (Faculty Council approval on Consent Calendar)
				<u>FACULTY EXECUTIVE COMMITTEE</u> (if decision is appealed)



UNC CHARLOTTE

LONG FORM COURSE AND CURRICULUM PROPOSAL

To: Graduate Committee

From: Department of Civil & Environmental Engineering (CEE)

Date: March 24, 2015; Revised October 13, 2015

Re: Proposal for New Graduate Courses (Permanent Numbers)

A. PROPOSAL SUMMARY.

SUMMARY.

The CEE Department proposes to add the following courses to its graduate curriculum leading to the MSCE and MSE degrees.

CEGR 5147 Stormwater Management
CEGR 5242 Wastewater Treatment Plant Design
CEGR 5247 Sustainability
CEGR 6222 Experimental Structural Mechanics and Nondestructive Evaluation
CEGR 6166 Urban Transportation Networks: Operations & Optimization

The aforementioned courses have been taught at least once as “topics” courses (CEGR 5090 or CEGR 6090). Copies of syllabus for each course listed above are shown in Appendix A (in the same order).

The proposed courses have been well-received by students and well-regarded by the faculty. Verbal feedback received from practitioners (both public and private sector) who hired our students indicated that the concepts and topics learned from these courses would have our students be well-prepared to better solve real-world engineering problems.

A review by the CEE Curriculum Committee resulted in a strong recommendation that these courses be offered as permanent electives in the graduate curriculum, and the CEE faculty agreed. Therefore, permanent course number and permanent catalog description are requested for the aforementioned courses.

The course numbers were identified maintaining consistency with CEE past practices and recommended guidelines.

In addition to including descriptions of the proposed courses in the Graduate Catalog, appropriate information was also added to the recommended courses listed in the catalog. Based on discussions amongst faculty of respective concentrations, some other changes (addition or deletion) are proposed to the core courses listing. These changes to the CEE portion of the Graduate Catalog are highlighted (with track changes) in Appendix B. They include the following course title / name changes and deletion of CEGR 6253 Design of Waste Containment Systems (as it is replaced by CEGR 5264 Landfill Design and Site Remediation currently offered by CEE).

- 1) CEGR 5142 Water Treatment Engineering (title / name in the current catalog is “Water/Wastewater Engineering”)
- 2) CEGR 6251 Foundation Engineering (title / name in the current catalog is “Analysis and Design of Deep Foundations”)

B. JUSTIFICATION.

The CEE department hired several new tenure-track faculty and non-tenure track lecturers during the last ten years, while five faculty retired or relocated to other universities. The new faculty added breadth and depth to the expertise of the department. They offered several new courses to introduce our students to the civil engineering topics and prepare them for their future.

The listed courses were taught at least once in recent years. The courses and discussions provided ample opportunities for CEE graduate students to explore the concepts and, therefore, became an integral part of CEE graduate curriculum. There is growing demand and need to offer these courses regularly, the best solution apparent to solve this problem is to have permanent course numbers and titles.

C. IMPACT.

Graduate students admitted to MSCE and MSE programs and in good standing will be served by this proposal. Good-standing graduate students who meet the prerequisites / corequisites for the courses are eligible to register. These students are expected to have adequate fundamentals, concepts, and credentials to enroll and successfully complete the aforementioned courses.

The listed courses are at 5000- and 6000-level, which is consistent with the level of academic advancement of students for whom the courses are intended. The proposal or proposed courses does not have any effect on degree completion requirements.

It is anticipated that 10 to 15 graduate students may take the proposed courses when offered. The proposed courses will be offered based on demand. The Focus Area Improvement Team (FAIT)

leader will work with faculty to identify suitable semester to offer the courses and advertise as needed (at the start of previous semester) so that students can plan in advance to take these courses. The content and other details are provided in the enclosed graduate syllabus for each proposed course (Appendix A).

As stated previously, several of these courses were offered multiple times during the past several years. Since they have been an integral part of CEE graduate curriculum as “topics” courses, the proposed courses are not expected to have an effect on other courses offered regularly by the faculty of CEE department. In fact, they nicely complement and strengthen the program.

The addition of the proposed courses will have an effect on information in the CEE portion of the Graduate Catalog. The assigned numbers are added to the recommended courses listed by concentration. Descriptions, as required, are also added for each proposed course. The recommended changes to the Graduate Catalog are shown in Appendix B.

III. RESOURCES REQUIRED TO SUPPORT PROPOSAL.

A. PERSONNEL.

No new faculty are needed to teach the courses. Current faculty who taught the courses in the past are indicated in the parenthesis for each proposed course.

CEGR 5147 Stormwater Management (William Saunders)

CEGR 5242 Wastewater Treatment Plant Design (Olya Keen)

CEGR 5247 Sustainability (Brett Tempest)

CEGR 6222 Experimental Structural Mechanics and Nondestructive Evaluation (Matthew Whelan)

CEGR 6166 Urban Transportation Networks: Operations & Optimization (Wei Fan)

Other faculty in the CEE Department has the knowledge and expertise to supplement and teach the proposed courses.

B. PHYSICAL FACILITY. CEE has adequate space available to teach the aforementioned courses.

C. EQUIPMENT AND SUPPLIES: No additional funding is allocated for any special equipment or supplies needed to teach the listed courses.

D. COMPUTER. Software installed in CEE teaching/research labs or available on Mosaic are required by students and/or faculty for some of the listed courses. The software and the number of licenses possessed by CEE are adequate and meet the anticipated needs.

E. AUDIO-VISUAL. No audio-visual facilities beyond the standard classroom podiums are needed to teach the courses.

F. OTHER RESOURCES. No new/added resources (travel, communication, printing and binding) are required, hence, costs were not estimated or requested.

G. SOURCE OF FUNDING. No additional sources are required.

IV. CONSULTATION WITH THE LIBRARY AND OTHER DEPARTMENTS OR UNITS

A. LIBRARY CONSULTATION.

A copy of written consultation with the Library Reference Staff (Jeffrey McAdams) is attached for each proposed course (Appendix C).

B. CONSULTATION WITH OTHER DEPARTMENTS OR UNITS.

Consultation with other departments or units was not necessary as the proposed courses were offered in the past, widely received by CEE graduate students, and intended primarily for CEE graduate students.

V. INITIATION, ATTACHMENTS AND CONSIDERATION OF THE PROPOSAL

A. ORIGINATING UNIT.

Discussions regarding the proposed courses contained in this proposal were initiated during the 2014-2015 academic year. The proposed courses were reviewed by the respective FAIT faculty at meetings held during fall 2014 and spring 2015. All faculty members who participated in the FAIT discussions voted in favor of the proposed courses. As needed, this was followed by preparation of long-form proposal during spring 2015.

B. CREDIT HOUR.

Review statement and check box once completed:

X The appropriate faculty committee has reviewed the course outline/syllabus and has determined that the assignments are sufficient to meet the University definition of required 3 credit hours.

C. ATTACHMENTS.

1. CONSULTATION:

Consultation with other departments or units was not necessary as the proposed courses were offered in the past, widely received by CEE graduate students, and intended primarily for CEE graduate students.

2. COURSE OUTLINE/SYLLABUS:

Syllabi with necessary details, as required for graduate courses, is provided for each proposed course in Appendix A.

3. PROPOSED CATALOG COPY: Copy should be provided for all courses in the proposal. Include current subject prefixes and course numbers, full titles, credit hours, prerequisites and/or corequisites, concise descriptions, and an indication of when the courses are to be offered as to semesters and day/evening/weekend. Copy and paste the [current catalog copy](#) and use the Microsoft Word “track changes” feature (or use **red text with “~~striketrough~~”** formatting for text to be deleted, and adding **blue text with “underline”** formatting for text to be added).

a. For a new course or revisions to an existing course, check all the statements that apply:

_____ This course will be cross listed with another course.

- There are prerequisites for this course.
- There are corequisites for this course.
- This course is repeatable for credit.
- This course will increase/decrease the number of credits hours currently offered by its program.
- This proposal results in the deletion of an existing course(s) from the degree program and/or catalog.

For all items checked above, applicable statements and content must be reflected in the proposed catalog copy.

- b. If overall proposal is for a new degree program that requires approval from General Administration, please contact the facultygovernance@uncc.edu for consultation on catalog copy.

A copy of CEE portion of the Graduate Catalog with track changes is enclosed as Appendix B.

4. **ACADEMIC PLAN OF STUDY (UNDERGRADUATE ONLY):** Does the proposed change impact an existing Academic Plan of Study?
 - Yes. If yes, please provide updated [Academic Plan of Study](#) in template format.
 - No.

5. **STUDENT LEARNING OUTCOMES:** Does this course or curricular change require a change in SLOs or assessment for the degree program?
 - Yes. If yes, please detail below.
 - No.

6. **TEXTBOOK COSTS:** It is the policy of the Board of Governors to reduce textbook costs for students whenever possible. Have electronic textbooks, textbook rentals, or the buyback program been considered and adopted?
 - Yes. Faculty will make every effort to reduce the costs of textbooks for students by requiring online or free download texts.
 - No.

APPENDIX A.

CEGR 5147 Stormwater Management

Proposed and to be taught by:
Dr. Bill Saunders, Lecturer and Undergraduate Program Director of Civil & Environmental Engineering

Graduate Catalog – Information and Description

CEGR 5147. Stormwater Management. (3). Prerequisites: CEGR 3143 and CEGR 3141, Consent of the instructor, graduate student status. Introduction to the impacts and water quality parameters due to urbanization. Develop a numerical model to analyze water stormwater impacts and evaluate different mitigation methods. Understand and utilize the guiding principles of low impact design (LID) and evaluate the available BMPs and understand their limitations. (*On demand*)

Credit Hours: 3

Frequency: On-demand

Instruction Method: Lecture

Textbooks

- 1) Stormwater Management for Smart Growth by Allen P. Davis and Richard H. McCuen
- 2) Elements of Urban Stormwater Design by Dr. Malcom

Prerequisites: CEGR 3143, CEGR 3141, and CEGR 3155

Course Objectives

The objective of this course is to provide the student with an understanding of flooding and water quality parameters as a result of urbanization. Numerical models will be developed to analyze water quantity impacts due to urbanization and evaluate different mitigation methods. By the end of the class the student will be able to:

- Evaluate the water quantity and quality impacts due to urbanization,
- Create spreadsheets using numerical methods to design storm water detention basins,
- Understand and utilize the guiding principles of low impact design (LID),
- Evaluate the available BMPs and understand their limitations, and
- Complete a design project to mitigate storm water impacts using LID techniques and BMPs.

Student Conduct

Students have the responsibility to know and observe the requirements of The UNCC Code of Student Academic Integrity (latest revision). This code forbids cheating, fabrication, or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. Students who violate the code can be expelled from UNCC. The normal penalty for a first offense is zero credit on the work involving dishonesty and further substantial reduction of the course grade.

In almost all cases, the course grade is reduced by a letter grade – at a minimum. Copies of the code can be obtained from the Dean of Student Office. CE Department policy is that ALL instances of suspected cheating be handled according to The UNCC Code of Student Academic Integrity (latest revision). *During this class, each student will be required to work independently, and submit their own solution for each assignment, unless the assignment specifies a team project. No teamwork or copying will be allowed.*

Homework Assignments

New assignments will be given at the beginning of the class. Unless otherwise specified, each problem will be solved using calculators (not computers). Homework problems are due at the start of the class on the due date! Each problem will contain: problem number, a complete statement (figures, etc.) of the given and the required, and a complete solution. **The answer will be clearly indicated, including all the necessary calculations and drawings.** Problems not submitted on time and in proper format will not be accepted without an acceptable excuse. Copying the homework is not allowed, anyone so doing, or so allowing, will be charged according to the Academic Code.

Midterm and Exam Schedule

Students are expected to attend class regularly and punctually, failure to do so will result in a lower class grade. A grade zero will be given any student who misses an exam unless a valid excuse is presented promptly in writing. Any absence that is predictable should be discussed with the course instructor in advance. **Check the exam schedules to see if you have a valid exam conflict.** You must notify me via an appropriate form of any such conflict involving this class by the end of Drop-Add.

Grading

Grading Scale: A=90-100, B=80-89.9, C=70-79.9, U=0-69.9.

Grading Distribution

Homework*:	15%
Exam 1*	25%
Exam 2*	25%
Design Project**	10%
Final Exam*	25%

* Exams for graduate students will include additional problems and graded more critically. The homework grade will include an additional report with a presentation.

** Project will include working with the instructor to identify a topic and scope of work, submit the final report and share findings through a presentation with the class.

Student Conduct

Students will be working in groups in and out of class. Homework and group projects will be submitted as groups; however, each member is expected to equally contribute to its content. Otherwise, all materials submitted for grades (e.g. test and final problems) must represent the student's original work. Students may discuss homework problems, including comparing answers. Copying another student's work, or copying a solutions manual is strictly forbidden. It

is the responsibility of every student to know and observe the requirements of the UNCC Code of Student Academic Integrity. This code forbids cheating, fabrication or falsification of information, multiple submissions of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. Any student violating the code will be subject to the penalties described in this document. If in doubt, please ask before you engage in any activity about which you are unsure. The use of any electronic device other than an approved FE calculator during an exam will result in an automatic F for the course. The full code is available online at <http://www.uncc.edu/policystate/ps-105.html>

Students are responsible for meeting all class deadlines (e.g. completing homework assignments, taking tests and finals). Students must appear at the designated time for tests and finals to receive any credit.

Class Credit

This 3-credit class requires three hours of direct faculty instruction and 6 to 9 hours of out-of-class student work each week for approximately 15 weeks. Out-of-class work may include but is not limited to: required reading, library research, written assignments, Excel spreadsheets, and studying for quizzes and exams.

Use of cell phones, beepers, or other communication devices in the classroom

Place all electronic devices in “silent” or “vibrate” mode prior to entering the classroom. The use of cell phones, beepers, or other communication devices during class is disruptive, and is therefore prohibited. Those found using cell phones during class or lab will be asked to bring doughnuts next class meeting for the entire class or write a two page paper on company policies being implemented to control cell phone usage or one letter grade reduction in your final grade. In case of an emergency, those using such devices must leave the classroom.

Class Attendance

Attendance is required. One point will be subtracted from the final grade for each absence beyond 2 excused absences.

Course Outline

- 1) Urban Sprawl and Smart Growth
- 2) Water Quality Parameters
- 3) Hydrology
- 4) Numerical Modeling
- 5) Stormwater Quality
- 6) Improvement of Stormwater Quality
- 7) Storage and Flow Control
- 8) Vegetative Control Methods
- 9) Traps , Basins, and Filters
- 10) Wetlands
- 11) Low Impact Development

CEGR 5242 Wastewater Treatment Plant Design

Proposed and to be taught by:

Dr. Olya Keen, Assistant Professor of Civil & Environmental Engineering

Graduate Catalog – Information and Description

CEGR 5242. Wastewater Treatment Plant Design. (3). Prerequisites: Consent of the instructor, graduate student status. The course focuses on design of treatment processes for municipal wastewater treatment plants. It discusses the basics of physical, biological and chemical processes and their applications in wastewater treatment. (*On demand*)

Course Objectives

To provide the students with the basic skills of wastewater treatment plant design, including regulatory aspects, process design, cost estimation and use of design software. To improve the students ability to present their design in written and oral format.

Credit Hours: 3

Frequency: Every spring

Instruction Method: Lecture

Textbook

Wastewater Engineering, Treatment and Reuse, Metcalf & Eddy, 5th Ed., ISBN-13: 9780073401188

Grading:

Grading Scale: A=90-100, B=80-89.9, C=70-79.9, U=0-69.9.

Grade Distribution

Item	Undergraduate	Graduate
Homework	25%	25%
Exam 1	15%	15%
Exam 2	15%	15%
Exam 3	15%	15%
Treatment plant design group report	15%	10%
Wastewater relevant research topic report	N/A	10%
Design group presentation	15%	10%

Homework

Homework assignments will be distributed at the beginning of the new topic and will be due a week from the distribution date (e.g. if it was distributed at the beginning of class Tuesday Sept 3rd, it will be due at the beginning of class Tuesday Sept 10th). Late homework is only accepted with a documentable reason and until the graded homework is returned. Graduate students will have additional, more in-depth and often qualitative questions on each homework. Students may

discuss the homework with each other, but each student must perform his/her own calculations individually. Copying someone else's work will be considered cheating and will be addressed per UNCC standard procedures.

Exams

Exams will consist of multiple choice, short answer and quantitative problems. A review session will precede each exam. Exams will be in-class and will be closed books and notes.

Field Trip

Field trip may be taken during this class, but will not be mandatory. Towards the end of the semester when you know more about design, I would like everyone to see a full-scale wastewater treatment plant. Details TBD.

Group Work and Design Presentation

Group work is part of life, so it will be part of the class as well. I will do my best to make it as painless and conflict-free as possible. I would like each group to have at least 1 grad student in for leadership and guidance. Each group will consist of 3-4 people so the responsibilities can be split. The team members will evaluate the contribution by the other team members, so people who do not carry their part of the load will receive lower grade. For the project, you will design a wastewater treatment plant given the problem statement that will come from the WEFTEC student design competition. The deliverables are a technical report and an in-class 30 min presentation with 5 min for questions. Good technical questions to opposing teams will be expected and will be factored into the grade. The guidelines for the report will be distributed with the project announcement later in the semester.

This group project presentation will take place during the final exam time slot and will be considered a final examination for this class. The best team will be competing at the state level for a chance to attend the national competition at WEFTEC conference September 26-30th, 2015, in Chicago, IL. Judges from engineering consulting will be attend your presentations and will help throughout the semester in your design preparation.

Research report

Graduate students will have an additional deliverable in this class. They will be required to write a 4-6 page report (single space) on a wastewater relevant topic of their choosing. The topic will need to be approved by me. It may be relevant to your research but cannot match it exactly. The report will be due Tuesday of the last week of class, but can be turned in earlier.

Student Conduct & Academic Integrity Policy

You are expected to attend all lectures and will be responsible for all material presented in class. You are encouraged to work together and discuss homework problems. However, copying another student's work, solutions manual or information from references, internet sources or other information is strictly forbidden and will constitute a violation of the UNC Charlotte Code of Student Academic Integrity.

Standards of academic integrity will be enforced in this course. Students are expected to report cases of academic dishonesty they become aware of to the instructor who is responsible for

dealing with them. Students have the responsibility to know and observe the requirements of the UNCC Code of Student Academic Integrity which is available from the Dean of Students Office or online at: <http://legal.uncc.edu/policies/up-407>. This code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. Faculty may ask students to produce identification at examinations and may require students to demonstrate that graded assignments completed outside of class are their own work. ***All acts of academic dishonesty will be reported to the Dean of Students Office and the settlement procedure outlined in the Code will be initiated. First offenses will result in a formal warning, an F on the assignment, and at least one letter grade reduction in the final course grade (after the failed assignment has been factored in) based on the nature of the offense.*** Whatever the penalty, a form that has been signed by both the student and the instructor recording the settlement will be kept for eight years in the Office of the Dean of Students.

Course Outline

- 1) Basics and terminology
- 2) Regulations: past, present, future
- 3) Wastewater constituents and measurements
- 4) Overview of mass balances, process design and reaction kinetics
- 5) Pretreatment processes
- 6) Biological treatment
 - a. Suspended growth modeling and aerobic treatment
 - b. Suspended growth with nitrification
 - c. Biological nutrient removal
 - d. Anaerobic processes
 - e. Attached growth
- 7) Solids processing
- 8) Disinfection
- 9) Hydraulic profile
- 10) BioWin wastewater modeling software
- 11) Budgeting and cost estimation
- 12) Advanced treatment processes and water reuse

CEGR 5247 Sustainability

Proposed and to be taught by:

Dr. Brett Tempest, Assistant Professor of Civil & Environmental Engineering

Graduate Catalog – Information and Description

CEGR 5247. Sustainability. (3) Prerequisite: CEGR 3141. The course will focus on sustainability as it applies to civil engineering, including land development choices, infrastructure planning, material selection and disposal, energy sources, and water supply and treatment. Methods of assessing sustainability and incorporating sustainable features in design will be reviewed. (*On demand*)

Course Learning Objectives

Students will be provided with presentations, materials, and opportunities that will help them learn to do the following:

- Articulate a good definition of sustainable development
- Argue the scientific case for designing sustainably in the future
- Describe several key interdisciplinary issues related to sustainability
- Describe several discipline-specific issues related to sustainability
- Explain some of the key features that distinguish sustainable design from conventional design
- Assess the sustainability of land development designs, material selection, energy options, and water management plans
- Conduct a life cycle analysis
- Apply typical certification systems and software packages to design a sustainable structure

Course Description

The course will include lectures (including guest presentations); homework (that may take the form of calculations, short answer, essays, inquiry-based activities, presentations, and small projects); class participation; two tests and a final examination. All team submissions will include peer evaluations that will be incorporated into each individual's grade. There will also be a requirement to attend some out-of-class events or negotiate some alternative activities.

Credit Hours: 3

Frequency: On-demand

Instruction Method: Lecture

Textbook

Sustainable Design: The Science of Sustainability and Green Engineering. Daniel A. Vallero & Chris Brasier. Wiley; 1st edition.

Grading:

Grading Scale: A=90-100, B=80-89.9, C=70-79.9, U=0-69.9.

Grade Distribution

Tests (2)*	10% each
Homework (10)	3% each
In-class assignments and Quizzes	10%
Project***	20%
Final Exam	15%
Attendance & Participation**	5%

* Extra questions for graduate students

** Graduate Students will read and summarize select material from books "Cradle to Cradle" by William McDonough, and "Creation" by EO Wilson

*** Project will include working with the instructor to identify a topic and scope of work, submit the final report and share findings through a presentation with the class.

Course Outline

- Intro: Science and Sensibility
- Science for Sustainable Designers
- Risk, Responsibility and Policy
- Design Processes
- Indicators and Assessments
- Buildings and Materials
- Waste
- Water
- Energy
- Urban Zones
- Social Sustainability

CEGR 6222: Experimental Structural Mechanics and Nondestructive Evaluation

Proposed and to be taught by:

Dr. Matthew Whelan, Assistant Professor of Civil & Environmental Engineering

Graduate Catalog – Information and Description

CEGR 6222. Experimental Structural Mechanics and Nondestructive Evaluation. (3).

Prerequisites: Consent of the instructor, graduate student status. This course presents a comprehensive overview of experimental techniques used to develop phenomenological understanding of and characterization of solid mechanics, stress analysis, and fracture mechanics problems. Additionally, the course presents experimental methods routinely employed for nondestructive evaluation of in-service structures, structural components, and structural materials. Students are expected to develop a familiarity with and ability to conduct data acquisition, signal processing, and data interpretation. (*On demand*)

Credit Hours: 3

Frequency: On-demand

Objectives

The objective of this course is to provide students with a background in both experimental techniques for fundamental research of structural mechanics problems and practical, standards-based methods for nondestructive inspection, testing, and evaluation of in-service structures. Course materials and assignments will enhance students understanding of solid mechanics and elasticity, particularly with respect to stress concentration and fracture mechanics problems where Saint-Venant assumptions are no longer valid. Students are expected to develop competency in reading and interpreting test standards, prescribing test methods for nondestructive evaluation, and analyzing nondestructive test data.

Instructional Method: Lecture

Textbook and Other Resources

Timoshenko, S. and Goodier, J.N. (1951) Theory of Elasticity McGraw-Hill. (*Can be purchased or available freely online*)

Malhotra, V.M. and Carino, N.J. (2004) Handbook on nondestructive testing of concrete CRC Press. (*Available as a free E-book through J. Murrey Atkins Library*)

Dekker, M. (2002) Nondestructive evaluation: theory techniques, and applications CRC Press (*Available as a free E-book through J. Murrey Atkins Library*)

Grading

Grading Scale: A=90-100, B=80-89.9, C=70-79.9, U=0-69.9.

Grading Distribution

Course Assignments	25%
Quizzes	5%
Course Project**	15%
Midterm Examination	25%
Final Examination	30%

** Project will include working with the instructor to identify a topic and scope of work, submit the final report and share findings through a presentation with the class.

Attendance Policy: Class attendance is required and will be recorded on a routine basis.

Assignment Expectations: Solution of course problems should be carried out on engineering paper in a professional manner. When computational work or computer-based data processing is required, all code and relevant solutions should be printed out. Either MATLAB or GNU Octave should be used for generating any plots or graphs; Microsoft Excel will not be accepted. Work must be clear and legible and with sufficient detail to demonstrate competent solution of the problems with final numerical answers indicated in boxes.

University Policy 407: The Code of Student Academic Integrity: Plagiarism, cheating, or otherwise leveraging unfair advantage over your peers will face zero tolerance. Use of mobile phones and similar technology during examinations is strictly prohibited and will result in loss of exam and an assigned grade of zero. Students are required to be familiar with and abide by the Code of Student Academic Integrity available from the Dean of Students Office or online at: <http://www.legal.uncc.edu/policies/ps-105.html> Students should be aware of University definitions for violations of academic integrity, which include cheating, fabrication and falsification, multiple submission, plagiarism, abuse of academic materials, compliance in academic dishonesty, and group work.

University Policy 409: Religious Accommodation for Students: This policy requires UNC Charlotte to (1) authorize a minimum of two excused absences each academic year for religious observances as required by the faith of a student; and (2) provide students the opportunity to make up any missed work. In order to mitigate the burden on faculty, students are asked to submit their request for religious accommodation to faculty prior to the census date of each semester (August 30, 2013)

General:

- All homework is due at the *beginning of class* on the date that it is due. No late homework will be accepted without prior approval from the course instructor.
- **Absence from an examination will require prior notification to the instructor**
- Moodle will be used to post homework assignments, solutions, and additional course materials for electronic access.

Course Outline

Experimental Mechanics:

- Elementary Elasticity
- Instrumentation and Data Acquisition Fundamentals
- Strain Gauge Principles and Techniques
- Photoelastic Stress Analysis
- Optical Methods

Nondestructive Evaluation:

- Stress Wave Propagation Techniques
 - Impact echo (IE)
 - Ultrasonic methods and ultrasonic pulse velocity (UPV)
 - Sonic pulse velocity
- Surface Hardness Tests
- Penetration Resistance Methods
- Corrosion Evaluation of Reinforcement
- Vibration-based Techniques
 - Resonant Frequency
 - Impulse Response
- Visual Testing (VT)
- Dye Penetrant Testing (PT)
- Magnetic Particle Testing (MT)
- Ultrasonic Testing (UT)

CEGR 6166 Urban Transportation Networks: Operations & Optimization

Proposed and to be taught by:

Dr. Wei Fan, Associate Professor of Civil & Environmental Engineering

Graduate Catalog – Information and Description

CEGR 6166. Urban Transportation Networks: Operations & Optimization. (3). Prerequisites: CEGR 3161, Consent of the instructor, graduate student status. Introduction to planning and optimization techniques for the analysis of transportation networks; Principles of precise algorithms for finding transport network equilibrium flows and applications that relate to these flows; Topics include basic optimization skills, shortest path algorithms, user equilibrium, system optimal, elastic demand, OD matrix estimation, network design, congestion pricing, and stochastic user equilibrium. (*On demand*)

Credit Hours: 3

Frequency: On-demand

Prerequisites: CEGR 3161

Course Objectives

The objective of this course is to expose students to the basic concepts of transportation network analysis, as well as explore some applications. Network analysis answers questions such as, “where will people change their routes if we build a new bridge across the river?”, “where will the congestion hotspots be 30 years from now?”, “how will traffic patterns change if LYNX light rail lines are extended from Pineville to downtown to UNCC and/or Charlotte Motor Speedway??”, or “how will traffic patterns change if I-77 charges a toll rate of \$X.XX from milepost Y to Z?” Basically, any problem which requires a “big-picture” view of what routes people will take relies on a network model. The focus is on a large area, such as a city or metropolitan region, rather than on a specific intersection or roadway.

By the end of this course, you should/will have all of the necessary tools to answer these questions. You will be able to formulate a variety of transportation systems analysis, planning and operations problems as network models, and have the practical knowledge needed to solve them. Furthermore, you will have a conceptual understanding of these models which allows you to understand and critically evaluate model results which others may present to you. This course will require you to understand both the basic concepts of transportation network analysis, and to apply them in a project involving an oral presentation and written report. This course uses some techniques of optimization, but there are no formal prerequisites - any necessary material will be taught in this class... I am confident that you will find this course to be interesting, challenging, and rewarding. A tentative course schedule and Introduction to Instructor are attached in enclosures 1 and 2. Specific course objectives are provided in enclosure 3.

Instructional Method: Lecture

Evaluation and Grading

Grading Scale: A=90-100, B=80-89.9, C=70-79.9, U=0-69.9.

Homework	600 (30%)
Professional Practice Grade	200 (10%)
Final Project**	400 (20%)
Examination	800 (40%)
	2,000 (100%)

** Project will include working with the instructor to identify a topic and scope of work, submit the final report and share findings through a presentation with the class.

Textbook

Urban Transportation Networks by Yosef Sheffi, which is available for free download online (<http://web.mit.edu/sheffi/www/urbanTransportation.html>).

Additional background and more detail on specific topics.

Ahuja, R., T. Magnanti, and J. Orlin. (1993). Network Flows. Prentice-Hall. Very good textbook on computer implementation of network algorithms, and applications beyond the transportation domain.

Bell, M. G. H. and Y. Iida. (1997). Transportation Network Analysis. Wiley. More recent than Sheffi's text, but not as detailed in its explanations.

Course Outline

- User equilibrium and system optimum
- Basic optimization concepts
- Solving the Beckmann formulation
- MSA, Frank-Wolfe and gap measures
- Link flows and path flows
- Combined assignment and proportionality
- Congestion pricing
- OD matrix estimation
- Network design

APPENDIX B

Civil and Environmental Engineering

1. **M.S. in Civil Engineering**

2. **M.S. in Engineering**

3. **Ph.D. in Infrastructure and Environmental Systems** (*see the Infrastructure and Environmental Systems heading*)

Formatted: Bulleted + Level: 1 + Aligned at: 0.06" + Tab after: 0.31" + Indent at: 0.31", Tab stops: Not at 0.5"

Department of Civil and Environmental Engineering

cee.uncc.edu

Graduate Program Director

Dr. Srinivas S. Pulugurtha

Graduate Faculty

Dr. James E. Amburgey, Associate Professor

Dr. James D. Bowen, Associate Professor

Dr. Shen-en Chen, P.E., Professor

Dr. John L. Daniels, P.E., Department Chair and Professor

[Dr. Venkata R. Duddu, Faculty Associate](#)

Dr. Wei Fan, P.E., Associate Professor

Dr. Janos I. Gergely, S.E., P.E., Associate Professor

~~Dr. Edd Hauser, Professor~~

Dr. Rajaram Janardhanam, Professor

Dr. Martin R. Kane, P.E., Associate Professor

Dr. Olya Keen, Assistant Professor

Dr. Milind V. Khire, P.E., Professor

~~Dr. Sara McMillan, P.E., Assistant Professor~~

Dr. David Naylor, P.E., Lecturer

Dr. Vincent O. Ogunro, Associate Professor

Dr. Shubhashini Oza, Faculty Associate

Dr. Miguel A. Pando, Associate Professor

Dr. Youngjin Park, Faculty Associate

Dr. Srinivas S. Pulugurtha, P.E., Professor

Dr. William Saunders, P.E., Lecturer

Dr. Brett Q. Tempest, Assistant Professor

Dr. Kimberly A. Warren, Associate Professor

Dr. David C. Weggel, P.E., Professor

Dr. Matthew J. Whelan, Assistant Professor

[Dr. Erika Weber, P.E., Lecturer](#)

Dr. Jy S. Wu, P.E., P.H., Professor

Dr. David Young, P.E., Professor

P.E. = Professional Engineer

P.H. = Professional Hydrologist

S.E. = Structural Engineer

Programs of Study

The Department of Civil and Environmental Engineering (CEE) provides opportunities for discipline-specific and multidisciplinary graduate-level education in Civil and Environmental Engineering and closely related areas.

Advanced coursework and research are used to enhance professional development, improve technical competency, and initiate a life-long learning experience. The Department has ongoing collaborative research and student exchange programs with several international institutions.

The Department offers graduate studies leading to a master's degree (MSCE or MSE) in five areas of concentration:

1. Environmental and water resources engineering
2. Geo-environmental engineering
3. Geotechnical engineering
4. Structural engineering ~~and structural materials~~
5. Transportation engineering

Formatted: Numbered + Level: 1 + Numbering Style: 1, 2, 3, ... + Start at: 1 + Alignment: Left + Aligned at: 0.06" + Tab after: 0.31" + Indent at: 0.31", Tab stops: Not at 0.5"

Doctoral studies leading to the Ph.D. in Infrastructure and Environmental Systems (INES) are available in an interdisciplinary, inter-college program. See the *Infrastructure and Environmental Systems* heading for details.

MASTER OF SCIENCE IN CIVIL ENGINEERING (MSCE) AND MASTER OF SCIENCE IN ENGINEERING (MSE)

Admission Requirements

In addition to the general requirements for admission to the Graduate School, the Department of Civil and Environmental Engineering seeks the following from applicants to the Master's programs in Civil Engineering:

1. An earned undergraduate degree in Civil Engineering for the MSCE master's program or a closely related field for the MSE master's program
2. An undergraduate GPA of 3.0 or better
3. A satisfactory score from the Aptitude Portion of the GRE
4. Three letters of recommendation
5. An acceptable TOEFL score as required by UNC Charlotte for international students
6. And any other appropriate credentials as required by the Graduate School

Formatted: Bulleted + Level: 1 + Aligned at: 0" + Tab after: 0.25" + Indent at: 0.25", Tab stops: Not at 0.5"

Additional Admission Requirements

7. Admission to the MSE program may require completion of certain deficiencies as specified by each area of concentration
1. Admission to the Early Entry Program requires a minimum GPA of 3.2, completion of at least 75 hours toward the BSCE degree, and acceptance by the Graduate School to the MSCE ~~or MSE~~ programs at UNC Charlotte.

Formatted: Bulleted + Level: 1 + Aligned at: 0" + Tab after: 0.25" + Indent at: 0.25", Tab stops: Not at 0.5"

Early Entry Program

Undergraduate students at UNC Charlotte with outstanding academic performance, and satisfying the requirements described above, may be admitted to the Early Entry Program to pursue graduate study while completing the undergraduate degree requirements. Early Entry students are dually enrolled with both undergraduate and graduate status, may request two graduate Civil Engineering (CEGR) courses to be applied to both their graduate and undergraduate programs (double-counting), and may complete up to 15 credits toward their MS degree prior to graduating with their BSCE degree.

Application Deadline

Applications for admission must be submitted online directly to the Graduate School. They may be submitted any time prior April 1 for Fall admission, and October 1 for Spring admission. To be considered for assistantships and tuition grants for the following academic year, students should apply by February 15 because the Department makes the first round of award decisions by March 15.

Assistantships

Research and teaching assistantships are available from the Department on a competitive basis to highly qualified applicants/students. Interested students are encouraged to directly contact faculty in their area of interest for research assistantships.

Tuition Grants

Tuition grants including Non-Resident Tuition Differentials and Resident Tuition Aids are available on a competitive basis for both out-of-state and in-state students, respectively.

Degree Requirements

A minimum of 30 approved graduate credit hours is required for graduation. At least half of the approved graduate credit hours must be in courses numbered 6000 or above. A student may fulfill the 30-hour requirement by pursuing one of the three study options: (a) 24 hours of coursework plus 6 hours of thesis, (b) 27 hours of coursework plus 3 hours of a ~~directed research~~ project, or (c) 30 hours of coursework and a comprehensive examination. Each student is limited to one individual study class within the 30-hour requirement.

Concentration Requirements

Required core courses for the five concentrations are listed below, ~~as well as additional recommended courses.~~

Environmental and Water Resources Engineering Concentration

CEGR 6243 Physical Processes in Environmental Systems (3)
CEGR 6245 Chemical and Biological Processes in Environmental Systems (3)

Geo-Environmental Engineering Concentration

CEGR 5145 Groundwater Resources Engineering (3)
CEGR 5264 Landfill Design and Site Remediation (3)
~~CEGR 6253 Design of Waste Containment Systems (3)~~

Geotechnical Engineering Concentration

CEGR 5270 Earth Pressures and Retaining Structures (3)
CEGR 6251 ~~Analysis and Design of Deep~~ Foundation Engineerings (3)
CEGR 6254 Experimental Soil Mechanics (3)
CEGR 6255 Slope Stability and Earth ~~Struct~~Pressures (3)
CEGR 6268 Advanced Soil Mechanics (3)

~~Additional recommended courses:~~

~~CEGR 5145 Groundwater Resources Engineering (3)
CEGR 5264 Landfill Design and Site Remediation (3)
CEGR 5271 Pavement Design (3)
CEGR 5272 Design with Geosynthetics (3)
CEGR 5273 Soil Improvement (3)
CEGR 5274 Site Characterization (3)
CEGR 5278 Geotechnical Engineering II (3)
CEGR 6146 Advanced Groundwater Analysis (3)
CEGR 6252 Soil Dynamics and Earthquake Engineering (3)~~

~~Structural Engineering or Structural Materials Concentration~~

CEGR 5108 Finite Element Analysis and Applications (3)
CEGR 5222 Structural Steel Design II (3)
CEGR 5224 Advanced Structural Analysis (3)
CEGR 5226 Reinforced Concrete Design II (3)
CEGR 6129 Structural Dynamics (3)

~~Additional recommended courses for the two tracks in Structural Engineering are:~~

~~Structural Analysis and Design~~

~~CEGR 5121 Prestressed Concrete Design (3)
CEGR 5123 Bridge Design (3)
CEGR 5125 Forensic Engineering (3)
CEGR 5223 Timber Design (3)
CEGR 6124 Masonry Design (3)~~

~~CEGR 6126 Analysis of Plates and Shells (3)~~
~~CEGR 6127 Fracture Mechanics and Fatigue (3)~~
~~CEGR 6128 Structural Optimization (3)~~

Structural Materials

~~CEGR 6125 Structural Strengthening (3)~~
~~CEGR 6127 Fracture Mechanics and Fatigue (3)~~
~~MEGR 6141 Theory of Elasticity I (3)~~

Transportation Engineering Concentration

CEGR 5161 Advanced Traffic Engineering (3)
 CEGR 5162 Transportation Planning (3)
 CEGR 5185 Geometric Design of Highways (3)
 CEGR 6161 Traffic Control and Operation (3)
 GEOG 6100 Quantitative Methods in Geography (3)

Additional recommended courses (does not include CEGR 6892 or CEGR 6991) for each concentration are shown next in the table.

<u>Concentration</u>	<u>Additional Recommended Courses</u>
<u>Environmental and Water Resources Engineering</u>	<u>CEGR 5141: Process Engineering, CEGR 5142: Water Treatment Engineering, CEGR 5143: Solid Waste Management, CEGR 5144: Engineering Hydrology, CEGR 5145: Groundwater Resources Engineering, CEGR 5146: Advanced Engineering Hydraulics, CEGR 5147: Stormwater Management, CEGR 5234: Hazardous Waste Management, CEGR 5235: Industrial Pollution Control, CEGR 5237: Environmental Risk Management, CEGR 5241: Chemical Processes in Water and Wastewater Treatment, CEGR 5242: Wastewater Treatment Plant Design, CEGR 5243: Topics in Environmental Health, CEGR 5247: Sustainability, CEGR 6141: Water Quality Modeling, CEGR 6142: Bioenvironmental Engineering, CEGR 6144: Environmental Biotechnology, CEGR 6145: Waste Incineration, CEGR 6146: Advanced Groundwater Analysis, CEGR 6147: Watershed Modeling, CEGR 6148: Water Conservation, CEGR 6149: Watershed Analysis, CEGR 6171: Air Quality Control, CEGR 6172: Air Dispersion Modeling, CEGR 6173: Environmental Aquatic Chemistry, CEGR 6244: Chemical Fate and Transport, and CEGR 5090 / 6090 special topics courses in environmental and water resources engineering</u>
<u>Geo-environmental Engineering</u>	<u>CEGR 5270: Earth Pressure and Retaining Structures, CEGR 5271: Pavement Design, CEGR 5272: Design with Geosynthetics, CEGR 5273: Soil Improvement, CEGR 5274: Site Characterization, CEGR 5278: Geotechnical Engineering II, CEGR 6146: Advanced Groundwater Analysis, CEGR 6243: Physical Processes in Environmental Systems, CEGR 6244: Chemical Fate and Transport, CEGR 6245: Chemical & Biological Processes in Environmental Systems, CEGR 6251: Foundation Engineering, CEGR 6252: Soil Dynamics and Earthquake Engineering, CEGR 6254: Experimental Soil Mechanics, CEGR 6255: Slope Stability and Earth Structures, CEGR 6268: Advanced Soil Mechanics and CEGR 5090 / 6090 special topics courses in geo-environmental engineering</u>
<u>Geotechnical Engineering</u>	<u>CEGR 5145: Groundwater Resources Engineering, CEGR 5264: Landfill Design and Site Remediation, CEGR 5271: Pavement Design, CEGR 5272: Design with Geosynthetics, CEGR 5273: Soil Improvement, CEGR 5274: Site Characterization, CEGR 5278: Geotechnical Engineering II, CEGR 6252: Soil Dynamics and Earthquake Engineering, and CEGR 5090 / 6090 special topics courses in geotechnical engineering</u>
<u>-Structural Engineering</u>	<u>CEGR 5121: Prestressed Concrete Design, CEGR 5123: Bridge Design, CEGR 5125: Forensic Engineering, CEGR 5126: Codes, Nodes and Loads, CEGR 5127: Green Building and Integrative Design, CEGR 5128: Matrix Methods of Structural Analysis, CEGR 5223: Timber Design, CEGR 6122: Advanced Topics in Structural Steel, CEGR 6124: Masonry Design, CEGR 6125: Structural Strengthening, CEGR 6126: Analysis of Plates and Shells, CEGR 6127: Fracture Mechanics and Fatigue, CEGR 6128: Structural Optimization, CEGR 6222: Experimental Structural Mechanics and Nondestructive Evaluation, MEGR 6141: Theory of Elasticity I and CEGR 5090 / 6090 special topics</u>

Formatted Table

Formatted Table

credit hours of coursework plus 3 credit hours of a directed project; or 30 credit hours of coursework plus a written and/or oral comprehensive examination. All three options require the formation of a program committee as described above. The thesis and project options require students to submit a written thesis or project report, and orally defend their work before their program committee.

A student's comprehensive exam may be taken once all core courses are completed, and at least 18 hours of graduate coursework are either completed or in progress. Core courses taken at the graduate level may be included in the 18 hours. The student's graduate advisor and the examining committee coordinate the examination (typically offered once in the Fall semester and once in the Spring semester), preparing the exam with the assistance of members of the student's Program Committee. The exam measures the student's mastery of theories and applications in core courses and/or in the selected area of specialization within the discipline. Students have only two attempts to pass the examination. All students passing the written examination are assessed further on their oral communication effectiveness.

Research Opportunity/Experience

Students in Civil and Environmental Engineering enjoy a curriculum with opportunities for interdisciplinary research, study abroad, and active participation in a growing research program. Programs of study can be tailored to suit individual needs and interests. The CEE website (cee.uncc.edu) provides current areas of research conducted by the Civil and Environmental Engineering faculty.

Program Learning Outcomes

Students completing master's degree will demonstrate abilities to analyze and evaluate advanced topics in engineering, and to communicate technical information effectively. Achievement of these outcomes will prepare students to function professionally in their chosen careers.

Program learning outcomes for doctoral students are described in the "Infrastructure and Environmental Systems" section of this *Catalog*.

COURSES IN CIVIL AND ENVIRONMENTAL ENGINEERING (CEGR)

CEGR 5090. Special Topics in Civil Engineering. (1-4) Study of specific new areas emerging in the various fields of civil engineering. *May be repeated for credit. (On demand)*

CEGR 5108. Finite Element Analysis and Applications. (3) Prerequisites: CEGR 4224 and permission of department. Finite element method and its application to engineering problems. Application of displacement method to plane stress, plane strain, plate bending and axisymmetrical bodies. Topics include: dynamics, fluid mechanics, and structural mechanics. *(On demand/Fall)*

CEGR 5121. Prestressed Concrete Design. (3) Prerequisites: CEGR 3225, CEGR 4224, and permission of department. Analysis and design of prestressed components and systems, including materials and systems for prestressing, loss of prestress, flexural and shear design in accordance with current building codes, analysis of indeterminate prestressed systems, and control of camber, deflection and cracking. *(On demand/Spring) (Alternate years)*

CEGR 5123. Bridge Design. (3) Prerequisites: CEGR 3221, CEGR 3225, and permission of department. Review of bridge design codes and loadings; superstructure and substructure design of short, intermediate, and long span bridges constructed of steel and concrete; earthquake design; segmental and cable-stayed bridges. *(On demand/Spring) (Alternate years)*

CEGR 5125. Forensic Engineering. (3) Prerequisites: CEGR 3122 and permission of department. Evaluation of structural and construction failures through review of case studies, types and causes of failures, and relevant methods of failure investigation; analysis of failures occurring in a variety of structures, involving a variety of materials, and resulting from a variety of causes; development, expression, and defense of opinions and conclusions, orally and in writing, with an understanding of the impact on the legal process surrounding a failure claim. *(On demand/Fall, Alternate years)*

CEGR 5126. Codes, Loads, and Nodes. (3) Prerequisites: CEGR 3122 and permission of department. Building systems and components; code requirements according to the latest ASCE Standard 7 pertaining to buildings and other structures; gravity load analysis including dead, live, roof live and snow loads; lateral load analysis focusing on wind and seismic forces, and applied to the main lateral load resisting systems; software applications using the SAP2000 tool, with 2-D and 3-D models loaded with gravity and lateral loads. (*On demandFall*)

CEGR 5127. Green Building and Integrative Design. (3) Prerequisites: CEGR 3122 and permission of department. Prepares students to function in multidisciplinary design teams working to produce buildings, sites and coupled environmental-infrastructure systems with resilience and sustainability as design priorities. Focus areas include: civil engineering aspects of energy use, material use, emissions generation and design strategies for integrated design. (*On demand*)

CEGR 5128. Matrix Methods of Structural Analysis. (3) Prerequisite: permission of department. Derivation of the basic equations governing linear structural systems. Application of stiffness and flexibility methods to trusses and frames. Solution techniques utilizing digital computer. (*On demand*)

CEGR 5141. Process Engineering. (3) Prerequisites: CEGR 3141 and permission of department. Applications of material and energy balance principles to the study of chemical, biological and environmental engineering processes. Overview of applied biotechnology, engineering thermodynamics and kinetics. (*On demandFall*)

CEGR 5142. Water Treatment/Wastewater Engineering. (3) Prerequisites: CEGR 3141 and permission of department. Analysis and design of water and wastewater treatment processes including: physical, chemical and biological treatment. Computer-aided design of treatment systems. (*On demandSpring*)

CEGR 5143. Solid Waste Management. (3) Prerequisites: CEGR 3141 and permission of department. Solid waste management, sources, generation rates, processing and handling, disposal, recycling, landfill closures, and remedial actions for abandoned waste sites. (*On demandSpring*)(*Alternate-years*)

CEGR 5144. Engineering Hydrology. (3) Prerequisites: CEGR 3143 and permission of department. A quantitative study of the various components of the water cycle, including precipitation, runoff, ground water flow, evaporation and transpiration, and stream flow. Hydrograph analysis, flood routing, frequency and duration, reservoir design, and computer applications. (*On demandFall*)(*Alternate-years*)

CEGR 5145. Groundwater Resources Engineering. (3) Prerequisites: CEGR 3143 and permission of department. Overview of hydrological cycle. Principles of groundwater flow and well hydraulics. Regional groundwater flow and flow nets. Water chemistry and contamination. Applications of groundwater modeling. (*On demandFall*)

CEGR 5146. Advanced Engineering Hydraulics. (3) Prerequisites: CEGR 3143 and permission of department. Problems of liquids as applied in civil engineering; open channel flow; dams and spillways; water power; river flow and backwater curves; pipe networks, fire flow, sewage collection, groundwater, computer applications. (*On demand*)

CEGR 5147. Stormwater Management. (3). Prerequisites: CEGR 3143 and CEGR 3141. Consent of the instructor, graduate student status. Introduction to the impacts and water quality parameters due to urbanization. Develop a numerical model to analyze water stormwater impacts and evaluate different mitigation methods. Understand and utilize the guiding principles of low impact design (LID) and evaluate the available BMPs and understand their limitations. (*On demand*)

CEGR 5161. Advanced Traffic Engineering. (3) Prerequisites: CEGR 3161 and permission of department. Analysis of basic characteristics of drivers, vehicles and roadway that affect the performance of road systems. Stream flow elements, volume, density, speed. Techniques of traffic engineering measurements, investigations and data analysis, capacity analysis. Intersections, accidents, parking. (*On demandFall*)

Formatted: Font: 10 pt

Formatted: Font: 10 pt, Not Bold, Font color: Auto

Formatted: Default, Justified

Formatted: Font: 10 pt, Not Bold

Formatted: Font: 10 pt, Not Bold

Formatted: Font: 10 pt

CEGR 5162. Transportation Planning. (3) Prerequisites: CEGR 3161 and permission of department. Urban transportation; travel characteristics of urban transportation systems; analysis of transportation-oriented studies; analytic methods of traffic generation, distribution, modal split and assignment; traffic flow theory. (*On demandSpring*)

CEGR 5171. Urban Public Transportation. (3) Prerequisites: CEGR 3161 and permission of department. Planning, design, and operation of bus, rail, and other public modes. Relationship between particular modes and characteristics of urban areas. Funding, security and other administrative issues. (*On demand*)

CEGR 5181. Human Factors in Traffic Engineering. (3) Prerequisites: CEGR 3161 and permission of department. Study of the driver's and pedestrian's relationship with the traffic system, including roadway, vehicle and environment. Consideration of the driving task, driver and pedestrian characteristics, performance and limitations with regard to traffic facility design and operation. (*On demandAlternate years*)

CEGR 5182. Transportation Environmental Assessment. (3) Prerequisite: permission of department. A study of the environmental impact analysis and assessment procedures for transportation improvements. Route location decisions. Noise, air quality, socio-economic, and other impacts. (*On demand*)

CEGR 5183. Traffic Engineering Studies. (3) Prerequisites: CEGR 3161 and permission of department. Introduction to the traffic engineering studies most used by traffic engineers including data collection techniques, statistical analysis procedures, report writing and presentation. One hour of lecture and three hours of laboratory per week. (*On demand*)

CEGR 5184. Highway Safety. (3) Prerequisites: CEGR 3161 and permission of department. Engineering responses at the state and local levels to the problem of highway safety. Extent of the highway safety problem, elements of traffic accidents, common accident countermeasures, collection and analysis of accident data, evaluation of safety-related projects and programs, and litigation issues. (*On demand*)

CEGR 5185. Geometric Design of Highways. (3) Prerequisites: CEGR 3161 and permission of department. Theory and practice of geometric design of highways including intersections, interchanges, parking and drainage facilities. Driver ability, vehicle performance, safety and economics are considered. Two hours of lecture and three laboratory hours per week. (*On demandFall*)

CEGR 5222. Structural Steel Design II. (3) Prerequisites: CEGR 3221 and permission of department. Analysis and design of structural steel components and systems with emphasis on theories necessary for a thorough understanding of the design of complete structures. Compression members affected by local buckling, beams with lateral-torsional buckling, continuous beams and beam columns are covered. Welded and bolted connections. Current AISC Specifications used. (*On demandSpring*)

CEGR 5223. Timber Design. (3) Prerequisites: CEGR 3122 and permission of department. Principles of timber design. Design of simple timber structures subjected to gravity loads and lateral forces. Computation of design loads; formulation of structural systems; design/analyze structural components and connections; structural system analysis of timber structures. Analysis of light commercial and residential structures. (*On demandFall*)

CEGR 5224. Advanced Structural Analysis. (3) Prerequisites: CEGR 3122 and permission of department. A continuation of CEGR 3122. Methods to determine deflections in structural members, including moment area, conjugate beam, virtual work, and Castigliano's theorem. Analyze statically indeterminate structures, including approximate method, slope deflection, moment distribution, and matrix stiffness methods. Project to compare analysis techniques and introduce use of structural analysis computer programs. (*On demandFall*)

CEGR 5226. Reinforced Concrete Design II. (3) Prerequisites: CEGR 3225 and permission of department. Analysis and design of reinforced concrete components and systems with emphasis on the fundamental theories necessary for a thorough understanding of concrete structures. Concentrically loaded slender columns, slender columns under compression plus bending. Wall footings and column footings. Analysis of continuous beams and frames. Total design project involving the analysis and design of a concrete structure. Current ACI Specifications used. (*On demandSpring*)

CEGR 5234. Hazardous Waste Management. (3) Prerequisites: CEGR 3141 and permission of department. Integration of scientific and engineering principles with legislation, regulation and technology in the management of hazardous wastes. Study of thermal, chemical, physical and biological systems and processes used in the treatment of hazardous wastes and the remediation of hazardous waste sites. *(On demand)*

CEGR 5235. Industrial Pollution Control. (3) Prerequisite: permission of department. Source and characterization of industrial wastewaters. Fundamentals of chemical and physical treatment processes. Biological treatment technologies. Waste minimization and reduction technologies. Sludge handling and toxicity reduction. Implementation of field or laboratory treatability study. *(On demand)*

CEGR 5237. Environmental Risk Management. (3) Prerequisite: permission of department. Review of legislation and requirements pertaining to spills and releases of chemicals to the environment. Fundamentals of fires, explosions, toxic emissions and dispersion, hazardous spills, and other accidents. Study of techniques for accident prevention and spill control, and hazardous and risk assessment. *(On demand)*

CEGR 5241. Chemical Processes in Water and Wastewater Treatment. (3) Prerequisites: CHEM 1252, CEGR 3141, and permission of department. Chemical principles involved in the treatment of water and wastewaters; principles of chemical equilibrium relevant to natural water systems; the nature and effect of chemical interactions of domestic and industrial waste effluents on natural water systems. *(On demand)*

CEGR 5242. Wastewater Treatment Plant Design. (3). Prerequisites: Consent of the instructor, graduate student status. The course focuses on design of treatment processes for municipal wastewater treatment plants. It discusses the basics of physical, biological and chemical processes and their applications in wastewater treatment. *(On demand)*

Formatted: Font: Not Bold

Formatted: Justified, Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers

CEGR 5243. Topics in Environmental Health. (3) Prerequisites: CEGR 3141, CEGR 4142, and permission of department. Study of contemporary environmental health problems and practices as they relate to groundwater pollution, food and water-borne diseases, radiological health, occupational health and risk assessment. Provides an introduction to epidemiology and toxicology, and a historical review of federal environmental policy and legislative action. *(On demand)*

CEGR 5247. Sustainability. (3) Prerequisite: CEGR 3141 and permission of department. The course will focus on sustainability as it applies to civil engineering, including land development choices, infrastructure planning, material selection and disposal, energy sources, and water supply and treatment. Methods of assessing sustainability and incorporating sustainable features in design will be reviewed. *(On demand)*

Formatted: Font: 10 pt

Formatted: Justified, Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers

CEGR 5262. Traffic Engineering. (3) Prerequisites: CEGR 3161 and permission of department. Operation and management of street and highway systems. Traffic control systems, traffic flow theory, and highway capacity. Evaluation of traffic engineering alternatives and the conduct of traffic engineering studies. *(On demandSpring)*

Formatted: Font: 10 pt, Not Bold

Formatted: Font: 10 pt, Not Bold

Formatted: Font: 10 pt

CEGR 5264. Landfill Design and Site Remediation. (3) Prerequisites: CEGR 3258, CEGR 3278, and permission of department. Principles of waste disposal and sanitary landfill siting including design, construction, operation and maintenance. Site assessment of underground storage tank leaks; site remediation, and clean up technologies using choice and economic analysis and computer applications. *(On demandSpring)(Alternate years)*

CEGR 5270. Earth Pressures and Retaining Structures. (3) Prerequisites: CEGR 3122, CEGR 3278, CEGR 4278, and permission of the department. Corequisite: CEGR 4278 can be a corequisite. Lateral earth pressure theory and the effects of wall friction, external loads, groundwater, and layered soils; design procedures and construction details associated with selected rigid and modular gravity/semi-gravity walls, mechanically stabilized earth walls, and externally supported structural walls. *(On demandFall)*

CEGR 5271. Pavement Design. (3) Prerequisites: CEGR 3161, CEGR 3278, and permission of department. Pavement design concepts and considerations; engineering properties of pavement materials including soils, bases, asphalt concrete, and Portland cement concrete; design of flexible and rigid pavements including shoulders and drainage; computer applications for pavement analysis and design. *(On demand)*

CEGR 5272. Design with Geosynthetics. (3) Prerequisites: CEGR 3258, CEGR 3278, CEGR 4278, and permission of department. Corequisite: CEGR 4278 can be a corequisite. Introduction to geosynthetic materials, properties, laboratory test procedures, and functions; geosynthetic design methods used for geotechnical, transportation hydraulic, and geo-environmental applications (roadways, walls, slopes, foundation soils, landfills, and dams); the incorporation of geosynthetics for soil reinforcement, separation, filtration, drainage and containment. (*On demandSpring*)

CEGR 5273. Soil Improvement. (3) Prerequisites: CEGR 3278 and permission of department. Engineering principles of soil improvement as they relate to applications in both geotechnical and geoenvironmental engineering; innovative techniques to improve soils to meet technical and economic requirements. (*On demandSpring*)

CEGR 5274. Site Characterization. (3) Prerequisites: CEGR 3278 and permission of department. Site investigation and site assessment technologies employed in geotechnical and environmental engineering; Site investigation planning and various geophysical methods including: seismic measurements, ground penetrating radar, electrical resistivity, and electromagnetic conductivity; Drilling methods for soil, gas and ground water sampling; decontamination procedures; and long term monitoring methods; Conventional and state-of-the-art in situ methods for geotechnical and environmental site characterization: standard penetration test, vane shear test, dilatometer test, pressure-meter test and cone penetration tests. Modern advances in cone penetrometer technology, instrumented with various sensors (capable of monitoring a wide range of physical and environmental parameters: load, pressure, sound, electrical resistivity, temperature, PH, oxidation reduction potential, chemical contaminants). (*On demandFall*)

CEGR 5278. Geotechnical Engineering II. (3) Prerequisites: CEGR 3258, CEGR 3278, and permission of department. Design of shallow and deep foundations, including structural considerations; lateral earth pressure theories; design of rigid and flexible earth retaining structures; advanced aspects of slope stability analysis; and computer applications. (*On demandSpring*)

CEGR 5892. Individualized Study and Projects. (1-6) Prerequisite: permission of department. Individual investigation and exposition of results. *May be repeated for credit. (On demand)*

CEGR 5991. Graduate Research in Civil Engineering. (1-6) Prerequisite: permission of department. Independent study of a theoretical and/or experimental problem in a specialized area of civil engineering. *May be repeated for credit. (On demand)*

CEGR 6090. Special Topics in Civil Engineering. (1-6) Prerequisite: permission of department. Directed study of current topics of special interest. *May be repeated for credit. (On demand)*

CEGR 6122. Advanced Topics in Structural Steel. (3) Prerequisites: CEGR 4222 and permission of department. Theory of plastic-behavior of steel structures; current topics in structural steel. (*On demand*)

CEGR 6124. Masonry Design. (3) Prerequisites: CEGR 3225 and permission of department. Introduction of masonry materials and systems, engineering and materials properties and testing procedures. Design of reinforced and unreinforced masonry (clay and concrete) walls, beams, and columns for vertical, wind, and seismic loads. Analysis and design of masonry structures and introduction to computer applications. (*On demandSpring*)(*Alternate years*)

CEGR 6125. Structural Strengthening. (3) Prerequisites: CEGR 3221, CEGR 3225, and permission of department. Code requirements for the evaluation of existing structures; analysis of existing structures; performance based design of buildings and bridges; strengthening/retrofit techniques for concrete, structural steel, masonry and timber elements, such as beams, columns, shear/bearing/retaining walls, and slabs; studies of actual strengthening projects using innovative techniques and materials. (*On demandSpring*)

CEGR 6126. Analysis of Plates and Shells. (3) Prerequisite: CEGR 4224 and permission of department. Analysis of rectangular and circular plates using classical as well as numerical methods; orthotropic and continuous plates and plate buckling. Analysis of thin shells and shells of revolution with and without bending; membrane

theory of cylindrical shells; symmetric and unsymmetric loading; pipes, tanks, and pressure vessels; computer applications. (*On demand*)

CEGR 6127. Fracture Mechanics and Fatigue. (3) Prerequisites: CEGR 3221 and permission of department. Introduction to fracture mechanics and fatigue, including Griffith Theory, plane strain-stress conditions, critical stress intensity factors, factors influencing fracture toughness, fracture mechanics design principles, fatigue performance, and fatigue initiation and propagation. (*On demand*)

CEGR 6128. Structural Optimization. (3) Prerequisites: CEGR 4224 and permission of department. Introduction to optimization concepts; reformulation of common structural analysis and design problems to an optimization format; optimization of constrained, unconstrained, linear, and nonlinear problems by classical and numerical techniques; and computer applications. (*On demand*)

CEGR 6129. Structural Dynamics. (3) Prerequisites: CEGR 3122 and permission of department. Methods for dynamic analysis of single and multiple degree of freedom systems. Topics include: free vibrations, dynamic response of simple structures under time dependent loads (e.g., harmonic, periodic, impulsive, general dynamic loading), support motion, frequency domain analysis, response spectra, earthquake engineering. (*On demandSpring*)

CEGR 6141. Water Quality Modeling. (3) Prerequisite: permission of department. Mathematical modeling of water quality in receiving streams including: generation of point and nonpoint sources of pollution; formulation of transport equations for contaminants in stream and estuarine water; and prediction of the fate, persistence and transformation of chemical pollutants in aquatic ecosystems. Computer model simulation and case studies. (*On demand*)

CEGR 6142. Bioenvironmental Engineering. (3) Prerequisites: CEGR 3141 and permission of department. Theoretical principles and design of aerobic and anaerobic biological unit processes for renovating waters and wastewaters. Activated sludge, aerated and facultative lagoons, rotating biological contractors, trickling and anaerobic filters. (*On demand*)

CEGR 6144. Environmental Biotechnology. (3) Prerequisite: permission of department. Application of biotechnology to the management of environmental problems. Study of bioprocess principles, bioremediation of waste disposal sites, cell immobilization technology and innovative biotechnologies. (*On demand*)

CEGR 6145. Waste Incineration. (3) Prerequisite: permission of department. Fundamentals of incineration of hazardous/solid wastes. Thermochemical applications and equipment design. Computer modeling of the incineration process and air quality control. (*On demand*)

CEGR 6146. Advanced Groundwater Analysis. (3) Prerequisite: permission of department. Modeling of groundwater flow in saturated and unsaturated zones. Contaminant transport including advection, dispersion and numerical modeling. Groundwater remediation technology. (*On demandAlternate years*)

CEGR 6147. Watershed Modeling. (3) Prerequisite: Permission of department. Characterization of non-point source pollution; modeling of flow and pollutant transport in storm runoff. Watershed modeling in a GIS environment including applications of SWIMM, BASINS, HEC-HMS, HEC-RAS, and NRCS models. (*On demandSpring*)

CEGR 6148. Water Conservation. (3) Prerequisite: permission of department. Principles and issues concerning water conservation and methods for effecting water conservation, including residential, industrial, commercial, and agricultural water conservation; water rates, audits and reuse/reclamation as they relate to water conservation; and case studies. (*On demand*)

CEGR 6149. Watershed Analysis. (3) Prerequisite: permission of department. Study of NPS problems in urban and non-urban watersheds and from highway runoff. Estimate of sediment yield and design of BMP's including sediment control structures. Introduction to monitoring and modeling of hydrologic systems. Watershed modeling in a GIS environment. (*On demandFall*)

CEGR 6161. Traffic Control and Operation. (3) Prerequisites: CEGR 5161 and permission of department. Traffic control theory and application; traffic regulation, laws and ordinances; speed control, intersection control, flow control and parking control; design and application of control devices, investigation, evaluation techniques; statistical analysis; administration. *(On demandSpring)*

CEGR 6162. Computer Applications for Transportation Engineers. (3) Prerequisites: CEGR 3161 and permission of department. Apply analytical techniques using traffic simulation and transportation planning software to evaluate various transportation facilities; Emphasis on computer applications and software packages such as HCS, SYNCHRO/SimTraffic, and VISSIM; 4-Step planning process using TransCAD; Build mathematical models. *(On demandSpring, Alternate years)*

CEGR 6163. GIS for Civil Engineers. (3) Prerequisites: CEGR 2101 and permission of department. Apply Geographic Information System (GIS) tools to solve Civil Engineering problems: add layers, label, and symbolize features, create maps in ArcMap, generate tables and spatial databases, address matching, query and join tables, perform spatial overlays, generate buffers, and conduct spatial analysis. Civil Engineering case studies. *(On demandFall, Alternate years)*

CEGR 6164. Traffic Safety. (3) Prerequisites: CEGR 3161 and permission of department. Crash data elements and source of data; Crash site reconstruction; Quantifying risk; Safety evaluation process: Problem definition, high crash locations, ranking and prioritization, understanding causal factors, countermeasure selection, before-after evaluation; Crash prediction Modeling; Economic appraisal; Safety conscious planning. *(On demandFall, Alternate years)*

CEGR 6165. Urban Systems Engineering. (3) Prerequisites: CEGR 3202 and permission of department. Survey of economic, political, sociological and technological factors affecting modern growth; a planning process and its role in solving selected urban problems with emphasis on engineering contributions. *(On demand)*

CEGR 6166. Urban Transportation Networks: Operations & Optimization. (3). Prerequisites: CEGR 3161, Consent of the instructor, graduate student status. Introduction to planning and optimization techniques for the analysis of transportation networks; Principles of precise algorithms for finding transport network equilibrium flows and applications that relate to these flows; Topics include basic optimization skills, shortest path algorithms, user equilibrium, system optimal, elastic demand, OD matrix estimation, network design, congestion pricing, and stochastic user equilibrium. *(On demand)*

Formatted: Justified

Formatted: Font: Not Bold

Formatted: Font: 11 pt

CEGR 6171. Air Quality Control. (3) Prerequisite: permission of department. Study of various types of air pollutants, their sources, nature and effects. Examination of air quality criteria, standards and monitoring. Analysis of feasibility, applicability and efficiency of diverse systems of control. Evaluation of goal and research needs in the future. *(On demand)*

CEGR 6172. Air Dispersion Modeling. (3) Prerequisite: permission of department. Atmospheric pollution problems, federal regulations, boundary layer meteorology, dispersion theory, Gaussian model, plume rise formulas, air toxics, and computer modeling of point area, line and mobile sources. *(On demand)*

CEGR 6173. Environmental Aquatic Chemistry. (3) Prerequisites: CHEM 3111, CEGR 3141, or equivalent; and permission of department. Concepts of chemical equilibrium applied to natural aquatic systems. Topics include: acid-base reactions, buffer systems, mineral precipitation, coordinate chemistry, redox reactions, adsorption phenomena and chemical-equilibria computer programs. *(On demand)*

CEGR 6181. Traffic Flow Theory. (3) Prerequisites: CEGR 5161 and permission of department. Logical foundations and mathematical representation of traffic flow; interrelation between microscopic and macroscopic equations of motion for highway traffic; stochastic properties of traffic at low and moderate densities. Car-following theories of traffic flow at high densities. Applications of queuing theory. *(On demand)*

CEGR 6182. Transportation Systems Analysis. (3) Prerequisites: CEGR 5161 and permission of department. Issues, concepts and methods of transportation systems engineering and planning. Decision making in

transportation management. The application of analytical methods to the development and evaluation of transport systems. *(On demand)*

CEGR 6222. Experimental Structural Mechanics and Nondestructive Evaluation. (3). Prerequisites: Consent of the instructor, graduate student status. This course presents a comprehensive overview of experimental techniques used to develop phenomenological understanding of and characterization of solid mechanics, stress analysis, and fracture mechanics problems. Additionally, the course presents experimental methods routinely employed for nondestructive evaluation of in-service structures, structural components, and structural materials. Students are expected to develop a familiarity with and ability to conduct data acquisition, signal processing, and data interpretation. *(On demand)*

Formatted: List Bullet, Justified

Formatted: Font: Not Bold

Formatted: Font: Garamond

CEGR 6243. Physical Processes in Environmental Systems. (3) Prerequisites: CEGR 3141, CEGR 3143, MATH 2171, and permission of department. Physical processes that describe the behavior of materials in natural and engineered environmental systems including transport, diffusion/dispersion, volatilization, sorption/desorption, flocculation, filtration, and sedimentation. *(On demand/Fall)*

CEGR 6244. Chemical Fate and Transport. (3) Prerequisites: CEGR 3141 and permission of department. Fate of chemicals in the environment and transport processes within and between phases; Environmental chemodynamics; Volatilization, dissolution and adsorption from an equilibrium perspective; Evaluation of mass transfer kinetics across environmental compartments. *(On demand)*

CEGR 6245. Chemical and Biological Processes in Environmental Systems. (3) Prerequisites: CHEM 1251, CEGR 3141, and permission of department. Chemical and biological processes that describe the behavior of materials in natural and engineered environmental systems. Chemical processes to be covered may include acid-base reactions, equilibrium partitioning, pH buffering, precipitation/dissolution, complex formation, adsorption, oxidation-reduction, coagulation, and adsorption. Fundamentals of biological theories to be covered may include kinetics, bioenergetics, genetics, and cellular functions. *(On demand/Fall)*

CEGR 6251. Analysis and Design of Deep Foundation Engineerings. (3) Prerequisites: CEGR 3278 and permission of department. Methodologies for analysis and design of deep foundations including different construction layouts and configurations (e.g., single and group piles), different installation techniques (e.g., driven, drilled, ACIP, etc.), different loading conditions (e.g., axial compression, axial tension, lateral, general loading, etc), different design approaches (e.g., allowable stress design – ASD, and load and resistance factor design - LRFD), among other topics; New emerging technologies, construction and inspection aspects and their implications on deep foundation design, and other topics. *(On demand/Fall)*

CEGR 6252. Soil Dynamics and Earthquake Engineering. (3) Prerequisites: CEGR 3122, CEGR 3278, and permission of department. Review of the dynamics of single and multi-degree of freedom systems. Earthquake mechanism, distribution, magnitude, intensity, ground shaking, site effects, prediction, and response spectra. Soil liquefaction; aseismic design of foundations; seismic codes; and machine foundation design. *(On demand)*

CEGR 6253. Design of Waste Containment Systems. (3) Prerequisite: permission of department. Types and function of containment systems; Selection of effective containment system and its design; Design and analysis of landfills, grout curtains and slurry walls; Degradation mechanisms and monitoring of containment systems. *(On demand/Fall)*

CEGR 6254. Experimental Soil Mechanics. (3) Prerequisites: CEGR 3278 and permission of department. Experimental methods, with emphasis on laboratory tests, to determine engineering soil properties and investigate soil behavior; 1) classification tests (i.e., used to identify soil classification and identify general engineering behavior type); and 2) assessment of engineering properties, such as permeability, shear strength, stiffness, and compressibility. Primary lab tests to be covered in this course are: consolidation, direct shear, static tri-axial, cyclic tri-axial, cyclic simple shear, resonant column, and other advanced geotechnical laboratory tests. Also includes discussion on field sampling and testing, reconstituted samples, laboratory instrumentation, and measurement techniques. *(On demand/Spring)*

CEGR 6255. Slope Stability and Earth Structures. (3) Prerequisites: CEGR 3278 and permission of department. Soil and rock slope stability including the aspects of analysis, design, and stabilization within a

geotechnical framework; Concepts related to seepage analysis of isotropic and anisotropic soil structures to relate the influence of groundwater conditions in slope stability problems; Presentation of slope stability analysis procedures based on limit equilibrium principles and stress-deformation analyses; Stability considerations of natural slopes and human-made soil structures. Computer software for seepage and slope stability analysis is explained. *(On demand~~Spring~~)*

CEGR 6261. Traffic Signal Control Systems. (3) Prerequisites: CEGR 6161 and permission of department. Study of control systems for isolated intersections, arterial streets, closed networks, and freeways. Emphasis on computer models; state-of-the-art detection, control, and communications equipment and software; and intelligent vehicle/highway systems. *(On demand)*

CEGR 6268. Advanced Soil Mechanics. (3) Prerequisites: CEGR 3258, CEGR 3278, and permission of department. One and two-dimensional consolidation, layered strata effects, and creep; seepage in layered strata, flow net, and seepage forces; shear strength parameters, effective and total stress paths, and application for slope stability evaluation; principles of critical state soil mechanics; computer applications. *(On demand~~Fall~~)*

CEGR 6892. Individualized Study and Projects. (1-6) Prerequisite: permission of department. Individual investigation or exposition of results for the 3-hour MS project. *May be repeated for credit. (Fall, Spring, Summer)*

CEGR 6990. Industrial Internship. (1-3) Prerequisite: Completion of nine hours of graduate coursework. Full- or part-time academic year internship in engineering complementary to the major course of studies and designed to allow theoretical and course-based practical learning to be applied in a supervised industrial experience. Each student's program must be approved by their graduate program director and requires a mid-term report and final report to be graded by the supervising faculty. *Graded on a Pass/Unsatisfactory basis. Credit hours gained from Internship shall not be part of the minimum credit hours requirement for graduation. (On demand)*

CEGR 6991. Graduate Master Thesis Research. (1-6) Prerequisite: permission of department. Individual investigation culminating in the preparation and presentation of a thesis. *May be repeated for credit. (Fall, Spring, Summer)*

CEGR 8090. Special Topics. Directed study of current topics of special interest. *(See the Infrastructure and Environmental Systems heading for details.)*

APPENDIX C.



J. Murrey Atkins Library

Consultation on Library Holdings

To: Srinivas Pulugurtha
From: Jeff McAdams
Date: 03/12/15
Subject: CEGR 5147 – Stormwater Management

Summary of Librarian's Evaluation of Holdings:

Evaluator: Jeff McAdams Date: 03/12/15

Check One:

- 1. Holdings are superior _____
- 2. Holdings are adequate x
- 3. Holdings are adequate only if Dept. purchases additional items. _____
- 4. Holdings are inadequate _____

Comments:

Library holdings should be adequate to support student research for this course (see list of items held by subject heading below). Students will have access to relevant databases including *Compendex*, *Inspec*, *Web of Science*, *ASCE Digital Library*, *Science Direct*, *ENGnetBASE*, *Environmental Sciences and Pollution Management*, and many others.

LC Subject Heading	Books	Journals
Watershed management	664	8
Runoff	642	4
Urban runoff management	102	2
Hydrology mathematical models	61	0

Evaluator's Signature

03/12/15

Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: Srinivas Pulugurtha
From: Jeff McAdams
Date: 03/12/15
Subject: CEGR 5242 – Wastewater Treatment Plant Design

Summary of Librarian's Evaluation of Holdings:

Evaluator: Jeff McAdams Date: 03/12/15

Check One:

- 1. Holdings are superior _____
- 2. Holdings are adequate x
- 3. Holdings are adequate only if Dept. purchases additional items. _____
- 4. Holdings are inadequate _____

Comments:

Library holdings should be adequate to support student research for this course (see list of items held by subject heading below). Students will have access to relevant databases including *Compendex*, *Inspec*, *Web of Science*, *ASCE Digital Library*, *Science Direct*, *ENGnetBASE*, *Environmental Sciences and Pollution Management*, and many others.

LC Subject Heading	Books	Journals
Water Treatment Plants	122	1
Sewerage	109	6
Water reuse	220	2

Evaluator's Signature

03/12/15

Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: Srinivas Pulugurtha
From: Jeff McAdams
Date: 03/20/15
Subject: CEGR 5247 - Sustainability

Summary of Librarian's Evaluation of Holdings:

Evaluator: Jeff McAdams Date: 03/20/15

Check One:

- 1. Holdings are superior _____
- 2. Holdings are adequate x
- 3. Holdings are adequate only if Dept. purchases additional items. _____
- 4. Holdings are inadequate _____

Comments:

Library holdings should be adequate to support student research for this course (see list of items held by subject heading below). Students will have access to relevant databases including *Compendex*, *Inspec*, *Web of Science*, *Science Direct*, *ENGnetBASE*, *Environment Complete*, *ASCE Digital Library*, *Environmental Sciences and Pollution Management*, *SpringerLink*, *Wiley Online Library*, and many others.

LC Subject Heading	Books	Journals
Sustainable development	1657	45
Renewable energy sources	861	50
Refuse and refuse disposal	505	39
Water-supply engineering	182	14

Evaluator's Signature

03/20/15

Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: Srinivas Pulugurtha
From: Jeff McAdams
Date: 03/12/15
Subject: CEGR 6166 – Urban Transportation Networks: Operations & Optimization

Summary of Librarian's Evaluation of Holdings:

Evaluator: Jeff McAdams Date: 03/12/15

Check One:

- 1. Holdings are superior _____
- 2. Holdings are adequate x
- 3. Holdings are adequate only if Dept. purchases additional items. _____
- 4. Holdings are inadequate _____

Comments:

Library holdings should be adequate to support student research for this course (see list of items held by subject heading below). Students will have access to relevant databases including *Compendex*, *Inspec*, *Web of Science*, *ASCE Digital Library*, *Science Direct*, *ENGnetBASE*, *Environmental Sciences and Pollution Management*, and many others.

LC Subject Heading	Books	Journals
Transportation engineering	641	23
Network analysis (Planning)	73	2
Urban transportation	867	31
Mathematical optimization	874	16
Traffic estimation	101	0

Evaluator's Signature

03/12/15

Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: Srinivas Pulugurtha
From: Jeff McAdams
Date: 03/12/15
Subject: CEGR 6222 – Experimental Structural Mechanics and Nondestructive Evaluation

Summary of Librarian's Evaluation of Holdings:

Evaluator: Jeff McAdams Date: 03/12/15

Check One:

- 1. Holdings are superior _____
- 2. Holdings are adequate x
- 3. Holdings are adequate only if Dept. purchases additional items. _____
- 4. Holdings are inadequate _____

Comments:

Library holdings should be adequate to support student research for this course (see list of items held by subject heading below). Students will have access to relevant databases including *Compendex*, *Inspec*, *Web of Science*, *ASCE Digital Library*, *Science Direct*, *ENGnetBASE*, *Environmental Sciences and Pollution Management*, and many others.

LC Subject Heading	Books	Journals
Structural analysis (engineering)	477	10
Fracture mechanics	280	12
Strains and stresses	187	9
Materials testing	598	31
Nondestructive testing	310	13

Evaluator's Signature

03/12/15

Date