Syllabus CCE 520 – Pavement Design and Sustainability (3 credits) Spring 2015

LECTURES: TR 1000-1120, Kearney 202

INSTRUCTOR
Dr. Erdem Coleri
Office: Owen Hall - 242
E-mail: erdem.coleri@oregonstate.edu

Office Hours:
Coleri TR 1300-1400
Owen 242 *Also by appointment*

COURSE SPECIFICS
3 Credits
Pre-requisites: CCE 321 (or equivalent); or instructor's consent

SYLLABUS OVERVIEW
This syllabus serves as a guideline for the course. It describes the planned course content and schedule, learning objectives, criteria for completing class assignments, information regarding examinations (final exam and design project), and grading information. Listed course topics will be covered to the extent allowed by the schedule. The topics covered and the course schedule may change due to learning abilities, time conflicts and limitations, and other unforeseen circumstances.

EMAIL
When you send an email to the instructor please include "*CCE 520-PAVE*" in the subject line. This allows for easy searching to avoid missed emails pertinent to the class. If "*CCE 520-PAVE*" is NOT in the subject line, I cannot guarantee that I will respond to your email in a timely manner.

COURSE DESCRIPTION
This new class will:
1) explore innovative design methods that were developed to investigate distress mechanisms of pavements including alternatives intended to address some environmental performance goals,

2) investigate decision making and design tools that will encourage the use of more sustainable pavement materials and structures, such as permeable pavements, rubber asphalt, recycled asphalt pavement (RAP) and alternative cement binders, and

3) discuss possible applications of pavement design strategies that can have a considerable impact on fuel consumption, vehicle maintenance costs, greenhouse gas (GHG) emissions, and life-cycle costs.

Prerequisites: CCE 321 (or equivalent); or instructor's consent.

COURSE OBJECTIVES

Course objectives are:

a. Briefly review mechanisms responsible for primary pavement distresses, present models for distresses based on critical pavement stresses, strains and deflections under traffic and climate, relate distresses to serviceability of the facility.
b. Investigate the use of life cycle cost analysis, life cycle assessment, and environmental criteria in pavement design.
c. Present frameworks for mechanistic-empirical design methods for pavements.
d. Explore in detail methods for modeling of pavement structure for design, and materials characterization for stiffness and damage.
e. Identify and describe technologies for evaluating condition of existing pavements, with regard to roughness; stiffness, water content, thickness of pavement layers; presence of distresses at the surface.
f. Look at current methods for predicting climate effects on pavement structure, and modeling of traffic loads.
g. Use software and spreadsheet calculations to calculate stresses, strains and deflections in pavement (linear elastic assumption) and use results for pavement design.
h. Show the effects of reliability on the performance of pavement materials.
i. For all of the subject areas described above, identify gaps in the knowledge and gaps in application of the knowledge.

COURSE RESOURCES

Required

A. Scanned papers, reports, and software user's manuals uploaded to Blackboard.
B. Pavement Guide Interactive: http://www.pavementinteractive.org/
C. Openpave and EverFE software will be given to students (uploaded to blackboard).
D. MEPDG software will be available in the computer labs.

Additional

P. Ullidtz, *Modelling Flexible Pavement Response and Performance*, Polyteknisk Forlag, 1998.

Y. Huang, *Pavement Analysis and Design*, 1993, Prentice-Hall

COURSE INFORMATION

The primary method for dissemination of course information will be through **Blackboard**. Additional handouts may be given during lecture. Every effort will be made to post these additional materials to Blackboard as well. Occasionally, course-related information may be disseminated through the class e-mail list, which requires an ONID account; thus, it is advised that you check your ONID e-mail account daily.

SCHEDULE - The topics covered in the course are listed in the following schedule. Also listed are the minimum reading requirements for each topic.

Lecture	Topic	General papers and website for reading	ME Reading in MEPDG 1-37A on Blackboard	Homework assigned
1: 3/31	Course Overview, Pavement types, distress mechanisms, design objectives and context	Pavement interactive website ("Pavement" and "Materials" tabs)	Part 1 pp 1.1.1 to 1.1.30	
2: 4/2	Pavement types, distress mechanisms, design objectives and context (cont.)	Pavement interactive website ("Pavement" and "Materials" tabs)	Part 1 pp 1.1.1 to 1.1.30	
3: 4/7	Life cycle cost analysis (LCCA)			HW1 (LCCA)
4: 4/9	Calculation of stresses, strains and deflections-flexible pavements, Openpave software	Ullidtz book: Ch2,3, and 4.0-4.1 (uploaded to Blackboard)		
5: 4/14	Calculation of stresses, strains and deflections-rigid pavements, EverFE software	Ioannides; Westergaard papers; and Ullidtz book: Ch4.2		HW2 (flexible and rigid stress/strain/def)
6: 4/16	mechanistic-empirical design approaches	Stiffness handouts		HW3 (Material Characterization)
7: 4/21	Design inputs: materials, testing, and ME transfer functions		Part 3 - Chapters 3 and 4	
8: 4/23	Design inputs: materials, testing, and ME transfer functions	FWD, DCP, GPR and automated pavement condition survey procedure description handouts	Part 3 - Chapters 3 and 4	HW4 (FWD backcalculation)
9: 4/28	Pavement design using materials, climate and traffic inputs	Miner's law procedure handout		
10: 4/30	Pavement design using materials, climate and traffic inputs	Miner's law procedure handout		Quarter design project assigned
11: 5/5	Flexible and Rigid Pavement Mechanistic-Empirical Design Frameworks/ MEPDG software	Coleri et al. 2011, Khazanovich et al.2014	User's manual	

12: 5/7	Flexible and Rigid Pavement Mechanistic-Empirical Design Frameworks/ MEPDG software		User's manual	
13: 5/12	Flexible and Rigid Pavement Mechanistic-Empirical Design Frameworks/ MEPDG software	Consideration of fuel consumption in pavement design; Zaabar and Chatti, 2010 TRB	User's manual	HW5 (Designing pavements to reduce fuel consumption – Cost-Benefit analysis)
14: 5/14	Green pavement materials	Recycled asphalt (RAP), rubber asphalt, warm-mix, alternative cement, permeable pavement types handouts and papers (Coleri et al 2011-particle)		
15: 5/19	Incorporation of reliability (variability) into mechanistic-empirical design	Coleri et al. 2011 (reliability)		HW6 (Advantages of RAP and Reliability based ME design)
16: 5/21	Asphalt, aggregate and mix design	Pavement interactive website and handouts		
17: 5/26	Asphalt, aggregate and mix design	Pavement interactive website and handouts		HW7 (Superpave mix design)
18: 5/28	Quarter design project discussion			
19: 6/2	Wrap up			
20: 6/4	Presentation of student design projects			
Design Project Report: Tuesday 6/4/2015 at 10 am				
Final Exam: To be determined				

ASSIGNMENTS AND GRADING

Homework assignments are due in class at the beginning of the period (10:00 am).

Assignments submitted AFTER THE DUE DATE AND TIME AND UP TO ONLY TWO (2) DAYS LATE will receive a 25% penalty, once graded.
This means a regular score of 80 will receive a score 60 if it is turned in up to 2 days late.
Absolutely NO assignments will be accepted after the 2-day late (25% reduction) policy.
These assignments will receive a score of 0 "zero".

Homework

Homework assignments will be issued throughout the course. These are intended to help you grasp fundamental concepts and expose you to techniques and skills for applying these principles to real-life situations. Understanding how to do the homework problems will go a long way toward understanding how to do well on the final exam and quarter design project. You may discuss homework problems with your classmates and work together. However, the submitted solution should be only your own work written up independently.

Use the following guidelines for assignment preparation (see also Course Grades below):

- Engineering paper is preferred; neatness is important and **required**. Work that is difficult to follow may not be graded, or will receive a reduced score. Typewritten work is also acceptable and must have the same headings as that shown below.
- Write on only one side of the paper, and start a new problem on a new sheet of paper (unless a problem only requires a short answer).
- Write the following in the upper part of each page: assignment number (e.g., HW #1) and due date, CCE 520-PAVE, your name, and page number/total pages as follows:

	HW#1 May 6, 2014	CCE 520-PAVE	DOE, JOHN	1/5

- Provide a problem number before each problem. Provide sketches or screenshots whenever appropriate. Show all of your work (i.e., calculations). For graphical solutions, label the axes of your graph and include units. Double underline or box your final answer(s).
- Securely staple all pages; **do not fold the corner or use a paper clip**.
- Homework will be graded according to a set grading rubric. Grading discrepancies should be discussed with the Instructor.

In-Class Assignments

There may be in-class assignments throughout the term covering subject matter presented during lectures. In-class assignments will be due during the class period assigned and will count toward class participation.

Quarter Design Project
In the last 5 weeks of the quarter, students are given a pavement design case taken from recent consulting and government agency practice. Each student must prepare their own assumptions, calculations and report, but is encouraged to consult with others. Pavement design case includes elements of asphalt and concrete pavement design, and requires the use of pavement knowledge and mechanistic-empirical approaches learned in the first five weeks of the class. Students are given a set of raw data to characterize the traffic, materials and environment, and any additional design constraints imposed on the project. Students must design appropriate pavements, including the tasks of preparation of design inputs from the data, calculations, analysis, summarization and preparation of a letter report to the client with documentation of all decisions and calculations for the design included in appendices. Students will also present their work in class.

Final Exam
The course will include a final exam. These will cover material presented in the lectures, assigned reading, and homework problems. Final exam will be closed book/closed notes, unless otherwise noted, and are to be done individually. Help sheets will be provided if warranted.

If you must miss the final exam for an emergency, please let the instructor **know as soon as possible**. If you skip the final exam, you will **not** have an opportunity to make it up, you will receive a score of **0 (zero)**. If you have a valid (according to the instructor) time conflict and you let the instructor know in advance, there is the possibility of taking the final exam at an alternate time.

COURSE GRADING
Grades will be based upon examination of course work. A breakdown is as follows:

- Homework/In-class assignments 30%
- Quarter design project 40%
- Final exam 30%

CLASS PARTICIPATION
Each student is expected to participate in the class. Participation includes coming to class **on time**, being prepared for class, participating in class discussions, and interacting in a courteous, respectful, and professional manner in accordance with the policies prescribed by the University. If you do miss class, it is your responsibility to find out what was covered and any administrative information presented.

STUDENT CONDUCT
It is expected that you will know and abide by the Oregon State University Student Code:
http://oregonstate.edu/studentconduct/

It is expected that you know and will abide by the CCE Honor Code posted at:
http://cce.oregonstate.edu/node/258

Two other documents are posted at the website above: CCE as a Professional Community and the Student Code of Conduct. You are also expected to know and abide by these conducting yourself in an according manner.

CCE Honor Code
While representing himself or herself as a member of the CCE community, the CCE student will maintain the highest standards of honesty and integrity. The student will strive for these standards in his or her representations, academic pursuits, research and scholarly activity, and respect for the property and individual rights of others; will uphold the specific principles described in the Code; and will actively support the Code.

In addition to this Honor Code, all CCE students are expected to know fully the OSU Student Conduct Regulations. Likewise, the CE student is expected to read and understand the American Society of Civil Engineers (ASCE) Code of Ethics, and the Oregon State Board of Examiners for Engineering and Land Surveying (OSBEELS) Rules of Professional Conduct. The CEM student is expected to read and understand the AIC, American Institute of Constructors, http://www.professionalconstructor.org/code-of-ethics and the Construction Management Association of America (CMAA) Ethics Policy

Disruptive Behavior
While the university is a place where the free exchange of ideas allows for debate and disagreement, all classroom behavior and discourse should reflect the values of respect and civility. Behaviors that are disruptive to the learning environment will not be tolerated. OSU's policy on disruptive behavior may be found at:
http://oregonstate.edu/studentconduct/disruptive-behavior

Academic or Scholarly Dishonesty
You are expected to be honest and ethical in your academic work. OAR 576-015-0005(2) (see http://oregonstate.edu/studentconduct/) states that, "The assumption upon which this Code is based is that all persons must treat one another with dignity and respect in order for scholarship to thrive." This document describes academic and scholarly dishonesty as follows:

a) *Academic or Scholarly Dishonesty is defined as an act of deception in which a Student seeks to claim credit for the work or effort of another person, or uses unauthorized materials or fabricated information in any academic work or research, either through the Student's own efforts or the efforts of another.*
b) *It includes:*
   (i) *CHEATING - use or attempted use of unauthorized materials, information or study aids, or an act of deceit by which a Student attempts to misrepresent mastery of academic effort or information. This includes but is not limited to unauthorized copying or collaboration on a test or assignment, using prohibited materials and texts, any misuse of an electronic device, or using any deceptive means to gain academic credit.*
   (ii) *FABRICATION - falsification or invention of any information including but not limited to falsifying research, inventing or exaggerating data, or listing incorrect or fictitious references.*
   (iii) *ASSISTING - helping another commit an act of academic dishonesty. This includes but is not limited to paying or bribing someone to acquire a test or assignment, changing someone's grades or academic records, taking a test/doing an assignment for someone else by any means, including misuse of an electronic*

device. It is a violation of Oregon state law to create and offer to sell part or all of an educational assignment to another person (ORS 165.114).

(iv) TAMPERING - altering or interfering with evaluation instruments or documents.

(v) PLAGIARISM - representing the words or ideas of another person or presenting someone else's words, ideas, artistry or data as one's own, or using one's own previously submitted work. Plagiarism includes but is not limited to copying another person's work (including unpublished material) without appropriate referencing, presenting someone else's opinions and theories as one's own, or working jointly on a project and then submitting it as one's own.

The administration of the classroom rests with the instructor. When evidence of academic dishonesty comes to the instructor's attention, the instructor will (a) document the incident, (b) permit the accused Student to provide an explanation, (c) advise the Student of possible penalties, and (d) take action. The instructor may impose any academic penalty up to and including an "F" grade in the course after consulting with his school head and informing the Student of the action taken. Using the standard form, the instructor will report the incident and the action taken to his school head, who, in turn, shall forward the report to his dean.

For Students not enrolled in the College of Engineering, the Dean of the College of Engineering shall forward the report to the dean of the college or school in which the student is enrolled for possible disciplinary action.

STUDENTS WITH DISABILITIES

Oregon State University is committed to student success; however, we do not require students to use accommodations nor will we provide them unless they are requested by the student. The student, as a legal adult, is responsible to request appropriate accommodations. The student must take the lead in applying to Disability Access Services (DAS) and submit requests for accommodations each term through DAS Online. OSU students apply to DAS and request accommodations at our Getting Started with DAS (http://ds.oregonstate.edu/gettingstarted) page.