



# CE 331: Civil Engineering Materials II

Fall 2015

School of Civil Engineering, Purdue University

## Class Times

	Day	Time	Location	Sections
Lecture	M, W, F	12:30 PM – 1:20 PM	PHYS 203	001, 002
Lab	W	9:30 AM – 11:20 AM	HAMP G150C	003
	R	11:30 AM – 1:20 PM	HAMP G150C	006
	R	1:30 PM – 3:20 PM	HAMP G150C	007
	R	3:30 PM – 5:20 PM	HAMP G150C	009

## Instructor

Dr. Yaghoob Farnam  
Office: HAMP 3158  
Phone: 494-2255  
Email: [yfarnam@purdue.edu](mailto:yfarnam@purdue.edu)  
Web address: <http://web.ics.purdue.edu/~yfarnam>  
Blackboard Learn and Clickers will be used for class

Office Hours: M, F 2:00 PM - 3:00 PM, whenever I am in my office, or by appointment

## Teaching Assistants: (Sections and Office Hours to Be Announced During the First Week of Class)

Name	Email	Office	Section	Office Hours
Hadi Shagerdi	<a href="mailto:hshagerd@purdue.edu">hshagerd@purdue.edu</a>	G144	Coordinator	M, 11:00 AM-12:00 PM
Ali Behnood	<a href="mailto:abehnood@purdue.edu">abehnood@purdue.edu</a>	G223	Section 003	W, 4:00-5:00 PM
Hyungu Jeong	<a href="mailto:jeong52@purdue.edu">jeong52@purdue.edu</a>	G223	Section 006	W, 10:30- 11:30 AM
Ali Ghahari	<a href="mailto:sghahari@purdue.edu">sghahari@purdue.edu</a>	G144	Section 007	T, 2:30-3:30 PM
Raikhan Tokpatayeva	<a href="mailto:rtokpata@purdue.edu">rtokpata@purdue.edu</a>	G223	Section 009	T, 9.00-10.00 AM

## Textbook(s) and/or other material - OPTIONAL

Note: older versions of these books are fine if you would like to purchase them. You can easily match the sections with the class or the instructors will be glad to help you do that. Books are completely optional.

- Mamlouk, M.S., Zaniewski, J. P, Materials for Civil and Construction Engineers, 3rd Edition, Pearson, Prentice, Hall ISBN -13 978-0-13-611058-3
- Somayaji, S., "Civil Engineering Materials", 2nd Ed., Prentice Hall, © 2001, New Jersey, 07458

## Course Objectives (CE 331)

The objective of this course is that by the end of the semester students will be able to successfully assess the performance of civil engineering materials. This course builds on the use of fundamental material science and solid mechanics concepts developed in CE 231 to understand, explain, characterize, and predict the performance of civil engineering materials. The student will be able to describe the behavior of particulate materials, soils, portland cement and portland cement concrete, asphalt and bituminous concrete, wood, and composite materials. The students will be able to describe the behavior of these materials based on fundamental material science and will link this understanding with state-of-the art/practice testing, design, and analysis procedures. The student will achieve these objectives through laboratory and homework exercises that enable them to successfully implement, analyze, and report on laboratory testing procedures. CE 231 and CE 270 are prerequisites.



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## Course Description (CE 331)

A continuation of CE 231 but with an increased emphasis on engineering applications of civil engineering materials such as portland cement concrete, bituminous materials/ asphalt cement concrete, polymers, composites, and wood. In addition hands-on laboratory experiments are emphasized in this course.

## ABET Outcome Criteria (CE 331)

- a- an ability to apply knowledge of mathematics, science, and engineering
- b- an ability to design and conduct experiments, as well as to analyze and interpret data
- e- an ability to identify, formulate, and solve engineering problems
- g- an ability to communicate effectively

## Learning Objectives (CE 331)

- To formulate equations that describe the properties of composite materials based on boundary conditions, assumptions and constituent properties.
- To use non-destructive tests to estimate material properties.
- To use non-destructive tests to locate flaws in engineering systems.
- To compare and contrast strength of materials and fracture mechanics solutions.
- To use mathematics, science and engineering principles to estimate the influence of cracks on the mechanical response of engineering materials
- To use scientific and engineering principles to predict the elastic and viscoelastic response of a material.
- To interpret engineering properties from test data.
- To use standardized test procedures to describe the properties of engineering materials.
- To use mathematical, scientific and engineering principles to compute the influence of material proportions on the structure property relationships for concrete materials.
- To utilize experimental data with scientific and engineering models to predict service life of concrete structures.
- To be able to design the proportions for a concrete mixture.
- To understand the relationship between the properties of an asphalt mixture and its performance.
- To be able to select engineering materials for specific applications.
- To communicate effectively using graphs.
- To communicate effectively using an executive summary.
- To communicate effectively using email.
- To communicate effectively using an engineering report.
- To communicate the expected accuracy obtained from engineering data.

## GENERAL POLICIES AND RULES

Read these rules CAREFULLY. It will be assumed that you have read this material and understood it.

## General Information

I will attempt to address questions received via emails. This works well for short questions however for descriptions students are encouraged to attend office hours. I will attempt to respond to emails within one business day. I realize your cell/smart phone is an important part of your life. I request that you try to remember to turn off the ringer to be courteous to those around you. Should you need to attend to a call during class please quietly excuse yourself from the room so that you can attend to your call. I will do my best to not text during class and ask you to do the same. You are expected to come to class, to be prepared and to be ready to participate. Notes are provided in several forms on the blackboard. I will make every attempt to post them at least 24 hours before lecture. You are allowed and encouraged to print them prior to lecture. However if it helps you to take notes please do that and refer to the other notes as needed. I expect to start and finish on time. I request that if you need to arrive late, step out during the lecture or leave early that you do so in a way that is courteous to those around you.



## Attendance

Students are expected to attend all classes, laboratory sessions, and examinations. Students are expected to be present for every meeting of the classes in which they are enrolled. Students are expected to attend and actively participate in weekly laboratory sessions, consisting of either problem solving sessions or running experiments. Labs will not be able to be made up except in the case of EXTREME circumstances. When conflicts or absences can be anticipated, such as for many University sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. Only an instructor can excuse a student from a course requirement or responsibility. If you have a foreseeable conflict please contact Dr. Farnam WELL BEFORE the scheduled lab and possible options can be discussed. For unanticipated or emergency absences when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email, or by contacting the main office that offers the course. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases of bereavement, the student or the student's representative should contact the Office of the Dean of Students. Purdue University recognizes that a time of bereavement is very difficult for a student. The University therefore provides the following rights to students facing the loss of a family member through the Grief Absence Policy for Students (GAPS). GAPS Policy: Students will be excused for funeral leave and given the opportunity to earn equivalent credit and to demonstrate evidence of meeting the learning outcomes for missed assignments or assessments in the event of the death of a member of the student's family.

The link to the complete policy and implications can be found at:

<http://www.purdue.edu/odos/services/classabsence.php>.

A link to information on adverse weather procedures and announcements

[http://www.purdue.edu/newsroom/health\\_safety/2011/11130WinterWeather.pdf](http://www.purdue.edu/newsroom/health_safety/2011/11130WinterWeather.pdf)

A link to information on emergency preparedness is available here. You are expected to watch the safety videos

[http://www.purdue.edu/newsroom/health\\_safety/2011/11130WinterWeather.pdf](http://www.purdue.edu/newsroom/health_safety/2011/11130WinterWeather.pdf)

## Laboratory Reports/Homework

All homework is to be in a format that would be consistent with professional engineering practice. All homework is to be submitted on either plain (i.e., unlined paper) or engineering paper with the problem worked only on one side of paper. All the sheets should contain the students' name, assignment number, division number (of the enrolled division) and the problem number. In addition it is anticipated that the problem will contain a clear description of the problem including what are the problem givens, nomenclature, and the unknowns. In addition a sketch of the problem is needed as well as a free body diagram whenever applicable (straight-edges are to be used in constructing these diagrams). The solution is to be worked in an organized manner with relevant calculations and notes as appropriate. The answer is to be placed in a box at the end of the problem containing units. The details of your calculations must be shown for all problems that involve calculations. A result may be graded as completely wrong if given without supporting calculations. Any numerical result or answer that requires a unit is incorrect, and will be counted as such, if that unit is omitted or given incorrectly. Example: 50 is not the same as 50 mph or 50 km/hr. Each problem is expected to begin on a new page. You are expected to understand the concept of significant figures and to use the proper number of significant figures in the final statement of your lab results. Finally, all pages are to be stapled together before submission. Failure to follow these guidelines may result in loss of credit regardless of the correctness of the answer. These are due at the beginning of the appropriate class meeting. No late homework will be accepted.

Lab reports are due one week after you perform the experiment or one week after you get all the data needed for the report. These are due at the beginning of the appropriate class meeting. No late reports will be accepted. Students are expected, even encouraged, to consult with one another on homework assignments and lab write-ups; however all work submitted by the student is expected to be their own effort. If there is reason to believe that work has been copied from another student, university regulations may be invoked as regards punitive action. Furthermore, the Professor reserves the right to assign a failing grade for either the specific work or for the entire course. Solutions to the Homework/Lab Reports will be posted 24 hours after the assignment is submitted. Problems will be graded for correctness or will be checked for completeness, regardless of approach or solution at the discretion of the Instructor.



# CE 331: Civil Engineering Materials II

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School of Civil Engineering, Purdue University

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## Exams

All exams are closed book, closed notes. Relevant formulas will be provided with the exam. Programmable calculators are permitted, however grading will be based solely on the information shown on the exam sheet. For this reason all necessary steps, figures, and calculations are to be shown in order to obtain credit. All work that you submit must be strictly your own. If there is reason to believe that work has been copied or done in collaboration with another student, university regulations may be invoked as regards punitive action. Instances of cheating during exams will result in full loss of credit for that exam. Additional measures including the immediate failure of the course, may be applied at the discretion of the instructor and/or University Staff.

## Make-Up Exams

There will be NO MAKE UP EXAMS in this course. Any student absent from an exam will receive a score of "zero" for the exam, unless the absence was related to a substantive personal or family health emergency. The dates of the exams are indicated on the syllabus. Therefore, all travel plans associated within or outside the university functions shall be made with this policy in mind (This includes the final). Any student missing an exam due to a substantive personal or family health emergency shall provide a written letter from a physician or a recognized individual authenticating the seriousness of the emergency and how it led to the student's absence from the exam. The letter should state the specific reason for the absence and the date and duration of the incident. The letter shall include the name, title, relationship to the student, address, and telephone number of the letters author. In such case, the instructor reserves the right to accept or decline the excuse.

## Grading

Exams (2 exams) 65%  
Laboratory Quizzes and Reports 15%  
Homework and Quizzes 15%  
Participation 5%

In order to pass the course, a 100 actual exam points (out of a total 200 points) is required. Failure to accumulate that minimum number of actual exam points will result in an F grade, regardless of the overall average computed from all completed assignments.

The course is NOT graded on a CURVE. Final letter grades are assigned based on the total number of percentage points accumulated. These percentage points are weighted so that the approximate breakdown looks as follows: As a guide, letter grades will generally be assigned as follows: Total percentage in the 90's- A, 80's- B, 70's- C, 60's- D, below 60's- F; providing that you have accumulated the minimum number of points needed for passing the course (150).

You are welcome to discuss any grade with Dr. Farnam. It is important that this is done within 72 hours of when the graded work is returned. There will be no general review of prior work to find "extra points" toward the end of the semester. You are free to contest laboratory, homework, or exam grades; however this must be done in writing and submitted in person to Dr. Farnam. This written explanation should include the location of the problem you are requesting review for along with a where the error is believed to have occurred. The item in dispute must be submitted within 72 hours following the return of the homework, lab assignment, or lecture.

Good grades are earned by students who 1) attend and participate in class, 2) attend and participate in laboratories, 3) perform the assigned reading, 4) perform the assigned homework, 5) understand the fundamental concepts and objectives presented in class.

## General Information on Academic Integrity

Academic integrity is expected of all students at all times.

Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." [Part 5, Section III-B-2-a, University Regulations] Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of



# CE 331: Civil Engineering Materials II

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School of Civil Engineering, Purdue University

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their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." [University Senate Document 72-18, December 15, 1972]

Information on what constitutes academic integrity may be found in the Purdue's student guide for academic integrity (<http://www.purdue.edu/odos/aboutodos/academicintegrity.php> )

## Use of Copyrighted Materials

Among the materials that may be protected by copyright law are the lectures, notes, and other material presented in class or as part of the course. Always assume the materials presented by an instructor are protected by copyright unless the instructor has stated otherwise. Students enrolled in, and authorized visitors to, Purdue University courses are permitted to take notes, which they may use for individual/group study or for other non-commercial purposes reasonably arising from enrollment in the course or the University generally.

Notes taken in class are, however, generally considered to be "derivative works" of the instructor's presentations and materials, and they are thus subject to the instructor's copyright in such presentations and materials. No individual is permitted to sell or otherwise barter notes, either to other students or to any commercial concern, for a course without the express written permission of the course instructor. To obtain permission to sell or barter notes, the individual wishing to sell or barter the notes must be registered in the course or must be an approved visitor to the class. Course instructors may choose to grant or not grant such permission at their own discretion, and may require a review of the notes prior to their being sold or bartered. If they do grant such permission, they may revoke it at any time, if they so choose.

## Violent Behavior Policy

Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity. See the following website for additional information: [http://www.purdue.edu/policies/pages/facilities\\_lands/i\\_2\\_3.shtml](http://www.purdue.edu/policies/pages/facilities_lands/i_2_3.shtml)

## Students with Disabilities

Purdue University is required to respond to the needs of the students with disabilities as outlined in both the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 through the provision of auxiliary aids and services that allow a student with a disability to fully access and participate in the programs, services, and activities at Purdue University. If you have a disability that requires special academic accommodation, please make an appointment to speak with me within the first three (3) weeks of the semester in order to discuss any adjustments. It is important that we talk about this at the beginning of the semester. It is the student's responsibility to notify the Disability Resource Center (<http://www.purdue.edu/drc>) of an impairment/condition that may require accommodations and/or classroom modifications.

## Emergency Communication

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website (Blackboard) or will be emailed to the course email list. If you have information this can be obtained by contacting the instructors via email. You are expected to read your @purdue.edu email on a frequent basis.



# CE 331: Civil Engineering Materials II

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Week #	Date	Day	Lecture #	Lecture Title
Week 1	August 24, 2015	M	L1, L2	Introduction - Composite I
	August 26, 2015	W	L3	Composite II
	August 28, 2015	F	L4	Composite III
	~	W, R	~	No lab
Week 2	August 31, 2015	M	LP1	Lab Prep: Lab Safety and Fiber Reinforced Composite
	September 2, 2015	W	L5	Fracture Mechanics I
	September 4, 2015	F	LP2	Lab Prep: Particulate Composites and NDT
	~	W, R	Lab 1	Fiber Reinforced Composites
Week 3	September 7, 2015	M		Labor Day - No Class
	September 9, 2015	W	L6	Fracture Mechanics II
	September 11, 2015	F	L7	Fracture Mechanics III
	~	W, R	Lab 2	Particulate Composites and NDT
Week 4	September 14, 2015	M	LP3	Lab Prep: Fracture Toughness Testing
	September 16, 2015	W	L8	Brittle Strengthening/Mechanism
	September 18, 2015	F	L9	Viscosity
	~	W, R	Lab 3	Fracture Toughness Testing
Week 5	September 21, 2015	M	LP4	Lab Prep: Creep in Polymers
	September 23, 2015	W	L10	Viscoelasticity I
	September 25, 2015	F	L11	Viscoelasticity II
	~	W, R	Lab 4	Creep in Polymers
Week 6	September 28, 2015	M	L12	Review and Questions
	September 30, 2015	W	L13	Aggregates I
	October 2, 2015	F	LP5	Lab Prep - Particle Size and Density
	~	W, R	Lab 5	Lab Problem Session
Week 7	October 5, 2015	M	~	Examination - In Class
	October 7, 2015	W	L14	Aggregates II
	October 9, 2015	F	LP6	Lab Prep - Concrete Sample Preparation, Calorimetry
	~	W, R	Lab 6	Particle Size and Density
Week 8	October 12, 2015	M		October Break - No Class
	October 14, 2015	W	L15	Introduction to Concrete
	October 16, 2015	F	L16	Cement and Supplemental Materials
	~	W, R	Lab 7	Concrete Sample Preparation
Week 9	October 19, 2015	M	L17	Hydration and Concrete Structure
	October 21, 2015	W	L18	Concrete Proportions I
	October 23, 2015	F	L19	Concrete Proportions II
	~	W, R	Lab 8	Calorimetry
Week 10	October 26, 2015	M	L20	Concrete - Mechanical Properties
	October 28, 2015	W	L21	Concrete - Early-Age Properties
	October 30, 2015	F	L22	Concrete - Durability
	~	W, R	Lab 9	Concrete Testing
Week 11	November 2, 2015	M	L23	Service-Life Prediction
	November 4, 2015	W	L24	Internal Curing in Concrete
	November 6, 2015	F	L25	Bituminous Materials
	~	W, R	Lab 10	Concrete Problems
Week 12	November 9, 2015	M	LP7	Lab Prep - Asphalt Sample Preparation
	November 11, 2015	W	L26	Hot Mix Asphalt Construction
	November 13, 2015	F	L27	Hot Mix Asphalt Volumetrics
	~	W, R	Lab 11	Asphalt Sample Preparation
Week 13	November 16, 2015	M	L28	Asphalt Concrete Performance I
	November 18, 2015	W	L29	Asphalt Concrete Performance II
	November 20, 2015	F	L30	Invited Speaker
	~	W, R	Lab 12	Asphalt Sample Testing
Week 14	November 23, 2015	M	L31	Chemical Admixtures
	November 25, 2015	W		Thanksgiving - No Class
	November 27, 2015	F		Thanksgiving - No Class
	~	W, R		Thanksgiving - No Class
Week 15	November 30, 2015	M	L32	Masonry
	December 2, 2015	W	L33	Clay and Wood I
	December 4, 2015	F	L34	Wood II
	~	W, R	Lab 13	Lab Tour
Week 16	December 7, 2015	M	L35	Review Session
	December 9, 2015	W	~	Optional Review Session
	December 11, 2015	F	~	Optional Review Session
	~	W, R	~	No Lab
Week 17				Final Exam, As Scheduled by the University