UNIVERSITY OF RHODE ISLAND
Department of Civil and Environmental Engineering

CVE 445 SUSTAINABLE PAVEMENT DESIGN
SUMMER 2017 – SESSION I

Instructor: K. Wayne Lee
Telephone: 401-874-2695
Email: leekw@uri.edu
Class Days/Times: Online Course
Credits: 3
Prerequisites: CVE 347 (Highway Engineering)

CATALOGUE DESCRIPTION:
Pavement types; pavement system components; stresses in the pavement structure. Design factors and criteria, structural design of flexible and rigid pavements for highways and airports, green pavement. (Lec. 3) Pre: CVE347 or permission of instructor.

COURSE OBJECTIVES:
1. Describe the context and scope of pavement design including: history, type of pavements, components, concept, design factors, criteria, approaches and performances
2. Identify the basic principles of pavement design
3. Discuss a basic understanding of sequential process of pavement design
4. Discuss about the significance of AASHO Road Test, Long Term Pavement Performance (LTPP), DataPave, and InfoPave
5. Distinguish empirical and mechanistic approaches
6. Describe highway pavement design procedures of flexible, rigid and composite pavement structures, e.g., AASHTOWare Pavement ME Design
7. Discuss airport highway pavement design procedures of flexible, rigid and composite pavement structures
8. Explore green and sustainable pavement design approaches

COURSE OUTCOMES:
Upon successful completion of this course, students will be able to:

1. Describe history, type of pavements, components and concepts
2. Understand factors, criteria, and approaches of pavement design
3. Describe the basic principles of pavement design and performances
4. Understand sequential process of pavement design
5. Recognize the significance of AASHO Road Test, Long Term Pavement Performance (LTPP), DataPave, and InfoPave
6. Distinguish empirical, mechanistic-empirical and mechanistic approaches
7. Characterize subgrade soils for pavement design
8. Identify and incorporate environmental factors into pavement design
9. Use traffic and load information to design pavement structures
10. Design flexible, rigid and composite highway pavement structures using AASHTOWare Pavement ME Design software
11. Design flexible, rigid and composite airport pavement structures
12. Identify green and sustainable design approaches

**ABET OUTCOMES:**
Outcome 1: An ability to identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics
Outcome 4: An ability to communicate effectively with a range of audiences
Outcome 5: An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

**TEXTBOOKS:**


AASHTOWare Pavement ME Design software


**TECHNOLOGY REQUIREMENTS:**
You will be using the URI Course Management System by Sakai. Computer access to the internet is required in order to successfully navigate this course. Firefox is the recommended browser for Sakai compatibility and can be downloaded free from www.mozilla.com/firefox. You will require additional plug-ins (Adobe Reader, Adobe Flash, Real Player, Quicktime). These are all free downloads. Internet Explorer for Windows, safari as well as Google Chrome are also options. Be sure to turn off pop-up blocker. You will also need the ability to scan your work into pdf documents and upload them on the course site.
SAKAI HELP:
Here is the link for Sakai help: https://sakai.uri.edu/portal/help/main.
In the Sakai menu on the left you will see Sakai Documentation at the bottom of the menu. If you click on it, it will take you to the help pages. You can also call the Help Desk at 401-874-4357.
Remember to use Firefox as your browser as there have been compatibility issues with Internet Explorer and Safari. Firefox works on both PC and Mac platforms.

CLASSROOM PROTOCOL:
For this online course, Sakai is our “classroom.” In the online learning environment, “attendance” is measured by your PRESENCE in the site as well as your CONTRIBUTIONS to the site. The importance of regular log-ins and active participation cannot be overstated. You are expected to contribute in the forum discussions for each Unit as well as the 3 Case Studies and the Group Project.

I will gauge your participation by your regular, on-time forum postings and responses, and timely assignment submissions. If you’ve never taken an online course, “hanging out” on Sakai will take some getting used to, and it will be easy to forget about the course from time to time. I recommend that you check out the Online Learn Orientation at http://web.uri.edu/learningonline/online-learning-orientation/. This short orientation will provide you with an introduction to the important aspects of taking an online course. I further recommend that you get in the habit of daily attendance online to maximize your successful completion of the course. Please refer to the Schedule of Readings, Assignments, Quizzes, Exams at the end of this syllabus and on the Sakai site for details on how and when you will be expected to contribute to the course.

ONLINE LEARNING:
The best way to begin this course is to view the START HERE video, read the syllabus and the other topics listed under START HERE.

This course is divided into 10 units with about two units per week. There is also a “Unit 0” to be completed before the start of the course. This unit reviews some of the background information from Highway Engineering as a refresher in order to bring everyone up to speed with the prerequisite material.

Each of the 10 Units on Sakai contains the learning objectives for that unit/lesson, assigned readings, videos, and links to other important content on the internet, written assignments, quizzes, and discussion activities.
COURSE SCHEDULE AND READING ASSIGNMENTS

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topics</th>
<th>Assignments and/or Quiz</th>
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<tbody>
<tr>
<td>1</td>
<td>Asphalt, concrete and composite pavement, Pavement components</td>
<td>Guide I</td>
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<td>History of pavement design practices</td>
<td>Ref. 3</td>
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<td></td>
<td>AASHO Road Test &amp; AASHTO Interim Guide</td>
<td>Refs 6 &amp; 7</td>
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<td><strong>DESIGN OF FLEXIBLE HIGHWAY PAVEMENTS</strong></td>
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<td></td>
<td>* Design Factors</td>
<td>Guide II</td>
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<td></td>
<td>* Effective Soil Resilient Modulus</td>
<td>Guide II</td>
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<td>* Serviceability Loss due to Roadbed Swelling and Frost Heave</td>
<td>Guide II</td>
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<td>* Required Structural Number</td>
<td>Guide I</td>
</tr>
<tr>
<td>2</td>
<td>* Layer Coefficients</td>
<td>Guide II</td>
</tr>
<tr>
<td></td>
<td>* Drainage Coefficients</td>
<td>Guide II</td>
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<td></td>
<td>* Determination of Layer Thickness</td>
<td>Guide II</td>
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<td></td>
<td>* Climate change</td>
<td>Ref. 31</td>
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<td></td>
<td>* Green and sustainable pavement structures</td>
<td>Refs. 28 &amp; 29</td>
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<td></td>
<td>* Use of asphalt plug on bridge joint</td>
<td>Quiz #1</td>
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<td></td>
<td>* Overview</td>
<td>Module 1-3</td>
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<td>* Design Inputs</td>
<td>Module 3-1</td>
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<td>* Structural Responses</td>
<td>Module 3-2</td>
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<td>* Fatigue Cracking</td>
<td>Module 3-3</td>
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<td>* Rutting</td>
<td>Quiz #2</td>
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<td>4</td>
<td>* Thermal Cracking</td>
<td>Module 3-4</td>
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<td>* Smoothness Consideration</td>
<td>Module 3-5</td>
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<td>* M-E Flexible Pavement Design Procedure</td>
<td>Module 3-6</td>
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<td><strong>AASHTOWare Pavement ME Design</strong></td>
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<td>* Design traffic variables analysis, e.g., traffic spectrum from WIM data</td>
<td>Manual</td>
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<td>* Pavement material input parameters</td>
<td>Chapter 8</td>
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<td>* Environmental factors and considerations</td>
<td>Chapter 10</td>
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<td>Quiz #3</td>
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<tr>
<td>5</td>
<td>* Resistance against Rutting and Permanent Deformation</td>
<td>Manual</td>
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<td></td>
<td>* Resistance against Fatigue Cracking</td>
<td>Chapter 11</td>
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<td></td>
<td>* Analysis against Thermal Cracking</td>
<td>Manual</td>
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<td></td>
<td>* Smoothness and Serviceability Considerations</td>
<td>Chapter 13</td>
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<td>Quiz #4</td>
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6 DESIGN OF RIGID HIGHWAY PAVEMENTS
PCA Method R1 & R2
AASHTO Guide for Design of Rigid Pavement Structures Guide II
Mechanistic-Empirical Design Module 2-1
* Structural Responses Quiz #5

7 * Fatigue Cracking in Joint Plain Concrete Pavement Module 2-2
* Transverse Joint Faulting in JPCP Module 2-3
* Continuously Reinforced Concrete Pavement Quiz #6

8 DESIGN OF FLEXIBLE AIRPORT PAVEMENTS
Corps of Engineers (CBR) Method R3
The Federal Aviation Administration Method AC 150
Term Project Presentation

9 DESIGN OF RIGID AIRPORT PAVEMENTS AC 150
Green pavements R3
Review Session Refs. 29 & 30
Quiz #8

10 Review Session
Term Project Presentation

Note: The details can be modified upon request and agreement.

REFERENCES


8. "Design Procedure For Pavements," Division of Public Works, Rhode Island Department of Transportation (RIDOT), 1990.


ASSIGNMENTS AND GRADING POLICY

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>8 Quizzes on sakai</td>
<td>40%</td>
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<tr>
<td>Participation in discussions and forums</td>
<td>15%</td>
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<tr>
<td>Term project and/or paper</td>
<td>15%</td>
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<tr>
<td>Final Comprehensive Exam on sakai</td>
<td>30%</td>
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<td><strong>TOTAL</strong></td>
<td><strong>100%</strong></td>
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GRADING SCALE:
A (≥92), A- (90-91), B+ (87-89), B (83-86), B- (80-82), C+ (77-79), C (73-76), C- (70-72), D+ (67-69), D (60-66), F (≤60)

DESCRIPTION OF ASSIGNMENTS:
For each unit students will study all reading assignments, online video presentations and other information posted on sakai.

For each unit there will be a Quiz on sakai based on the material covered in the specific unit.

The final exam will be comprehensive. Both the final exam and the 8 quizzes will be timed.

Under the term project and/or paper, each student will conduct a project related to pavement design. A presentation can be done using pp or video through Sakai.

Students are expected to contribute in the Discussion Forums for every Unit and the term Project.

ASSIGNMENTS/QUIZZES/EXAMS NOT SUBMITTED BY THE DEADLINE WILL RECEIVE A GRADE OF ZERO. Please back up your work on a flash drive, email to yourself, and/or store in a cloud. It is a good idea to have a back-up plan in case of computer problems.

ACADEMIC SUPPORT SERVICES

Office of Disability Services

Any student with a documented disability is welcome to contact me early in the semester so that we may work out reasonable accommodations to support your success in this course.

Students should also contact Disability Services for Students, Office of Student Life, 330 Memorial Union, 401-874-2098.
From the University Manual: **6.40.10 and 6.40.11 Accommodations for Qualified Students With Disabilities.**

Students are expected to notify faculty at the onset of the semester if any special considerations are required in the classroom. If any special considerations are required for examinations, it is expected the student will notify the faculty a week before the examination with the appropriate paperwork.

**PROFESSIONAL CONDUCT**

Cheating and plagiarism are serious academic offenses, which are dealt with firmly by the College and University. Scholastic integrity presumes that students are honest in all academic work. **Cheating** is the failure to give credit for work not done independently (i.e., submitting a paper written by someone other than yourself), unauthorized communication during an examination, or the claiming of credit for work not done (i.e., falsifying information). **Plagiarism** is the failure to give credit for another person’s written or oral statement, thereby falsely presuming that such work is originally and solely your own.

If you have any doubt about what constitutes plagiarism consult the URI Student Handbook, and University Manual sections on plagiarism and cheating at [http://web.uri.edu/manual/chapter-8/chapter-8-2/#8.27.10](http://web.uri.edu/manual/chapter-8/chapter-8-2/#8.27.10) (sections 8.27.10-8.27.21)

Students are expected to be honest in all academic work. A student’s name on any written work, quiz or exam shall be regarded as assurance that the work is the result of the student’s own independent thought and study. Work should be stated in the student’s own words, properly attributed to its source. Students have an obligation to know how to quote, paraphrase, summarize, cite and reference the work of others with integrity. The following are examples of academic dishonesty.

- Using material, directly or paraphrasing, from published sources (print or electronic) without appropriate citation;
- Claiming disproportionate credit for work not done independently;
- Unauthorized possession or access to exams;
- Unauthorized communication during exams;
- Unauthorized use of another’s work or preparing work for another student;
- Taking an exam for another student;
- Altering or attempting to alter grades;
- The use of notes or electronic devices to gain an unauthorized advantage during exams;
- Fabricating or falsifying facts, data or references;
- Facilitating or aiding another’s academic dishonesty;
- Submitting the same paper for more than one course without prior approval from the Instructor.