

## Pavement Design and Analysis

<b>Code</b> CE 860	<b>Credit Hours</b> 3-0
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### Course Description

This course has been designed to provide students with the needed knowledge to analyze and design flexible and rigid pavement. In this course students understand the basics of the Mechanistic-Empirical design approach and recognize the advantages and limitations of various design approaches. The concept of load and temperature induced stresses in pavement is also covered. Airport design for flexible and rigid pavement is integrated in this course. Equivalent Standard Axle Loads (ESALs) calculation based on the traffic volumes and loads included their factors are also covered in this course. Pavement drainage design and factors considered in the drainage design are also covered in the syllabus.

### Textbook:

1. Pavement Analysis and Design by Yong H. Huang, 2nd Ed, Pearson Prentice Hall. Ninth impression 2018

### Reference Book:

1. Principles of Pavement Design Yoder, E.J, and Witzcak M.W., New York, John Wiley and Sons, 1975.
2. Pavement Analysis by Ullidtz, Elsevier Publishers, 1987.
3. AASHTO Guide for Design of Pavement Structures Washington, D.C., 1986, 2002.
4. The Asphalt Institute Thickness Design - Asphalt Pavements for Highway and Streets Manual Series No.1 (MS-1), 1991.
5. The Asphalt Institute Thickness Design - Asphalt Pavements for Air Carrier Airports Manual Series No.11 (MS-11), 1987.
6. Thickness Design for Concrete Highway and Street Pavements, Portland Cement Association (PCA), 1995.
7. Thickness Design for Concrete Airport Pavements, Portland Cement Association (PCA), 1995.
8. Airport Pavement Design and Evaluation – Federal Aviation Administration (FAA).

### Prerequisites

Nil

### ASSESSMENT SYSTEM FOR THEORY

Quizzes	10-15%
Assignments	5-10%
Mid Terms	25%
ESE	40-50%
Term Project	10%

## Teaching Plan

Week No	Topics	Learning Outcomes
1	Introduction of Structural Design of Pavements	Course outlines, objectives, teaching plan, assessment methods Load carrying concept of various pavement types. Stress/strain-based pavement design concept. Empirical and mechanistic-empirical design approaches Structural design input parameters
2- 4	Structural Analysis of Flexible Pavements	Stresses in flexible pavements (Boussinesq theory, Layered system concept, Finite element procedure) Critical stresses and strains and design principles to minimize distresses. Sensitivity of flexible pavement response to layer thickness and ratio, modulus and ratio, total load, tire pressure and imprint area values Analysis of flexible pavements using <b>KENLAYER</b>
5-6	Structural analysis of rigid pavements	Distresses in rigid pavements (Westergaard theory, non-load related stresses, combined stresses) Critical loading conditions and design Principles to minimize distresses. Sensitivity of rigid pavement responses to modulus of subgrade reaction, tire pressure, total load, and wheel configuration Analysis of rigid pavements using <b>KENSLAB</b>
7	Characterization of Roadbed Soils and Material Properties	Strength and deformation characterization Modeling and behavior under dynamic cyclic loads Stress dependent behavior models. Fatigue and rutting models
8	Traffic Data Analysis	Tire contact pressure and imprint areas Pavement response to various wheel/axle loads and configurations. Concepts of load equivalency factors (LEF) Estimation of design traffic and forecasting techniques
9	<b>MID SEMESTER EXAM</b>	
10-12	Structural Design Procedure for Flexible Pavements	AASHTO design procedure Asphalt Institute method. Comparison of assumptions, strengths, weaknesses, limitations, and applications of the above procedures FAA method for airport flexible pavement design

13-14	Structural Design Procedure for Rigid Pavements	AASHTO design procedure FAA design procedure PCA design procedures Comparison of assumption, strengths, weaknesses, limitations, and applications of the above procedures
15-16	Environmental and Climatic Consideration	Effects of environmental factors on the pavement design process and the pavement performance Environmental data needed in the structural design of pavements. Moisture related pavement distresses and their mechanisms Influence of drainage on the structural design of pavements
17	Term Project and Presentations	Development of a comprehensive pavement design and evaluation project Application of course concepts to a real-world scenario Group presentations and peer review
18	<b>END SEMESTER EXAM</b>	