Course Outline

Title: Mechanics of Composite Materials

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Prerequisite: Strength of materials I, Material Science

Overview

Mechanics of Composite Materials is a three-credit course, which emphasizes on designing structural elements by using light weight composite materials.
The course is designed to be taken in third or fourth year by undergraduate students of the mechanical engineering department at Iran University of Science and Technology (IUST).

Goal (introduction)

The main goal of this course is to provide students a systematic approach for design and analysis of structures made of composite materials.

Objectives

The objective of this course is to develop a solid understanding of the properties of composite materials, lamination theory, together with the analysis and manufacture of lightweight composite structures in a unified and integrated manner for an undergraduate student. These are fundamental to mechanical, civil and material science engineering and related programs such as mechatronic engineering, naval architecture, aerospace engineering and biomedical engineering as well as manufacturing and industrial design.
Skills Objectives
On successful completion of this course, students should be able to; (a) Understand the use of fibre-reinforced composites in structural applications, and (b) Develop a basic understanding of the use of composite materials, analysis and design of composite

structures and failure analysis of laminated panels.
At the end of this course you will be able to:
Design a composite structure and be able to test and confirm its mechanical properties

Materials

Week	Subject	Table of Contents
1	Review of solid mechanics: stress and strain tensors Review of elasticity: isotropic and orthotropic	Chapter 1, Ref 1
2	Classifications of composite materials Common reinforcements and matrices, interfaces	Chapter 1, Ref 1
3	Industrial applications and manufacturing	Chapter 1, Ref 1and 3
4	Engineering constants of anisotropic materials, Hook's law	Chapter 2, Ref 1and 3
5	Stress and strain transformation of a unidirectional lamina	Chapter 3, Ref 2
6	Stiffness and compliance transformation of a unidirectional lamina	Chapter 3, Ref 2
7	Stress – strain relationship of multidirectional laminates under in plan loading (1)	Chapter 4, Ref 2
8	Stress – strain relationship of multidirectional laminates under in plan loading (2)	Chapter 4, Ref 2
9	tress – strain relationship of multidirectional laminates under flexural loading (1)	Chapter 5, Ref 2
10	Stress – strain relationship of multidirectional laminates under flexural loading (2)	Chapter 5, Ref 2
11	Midterm	----------
12	Failure modes in composite materials	Chapter 9, Ref 3
13	Maximum stress and maximum strain failure theories	Chapter 7, Ref 2
14	Tsai-Wu failure theory	Chapter 7, Ref 2
15	Load-displacement relationship in composite beams	Ref 4

16	Load-displacement relationship in composite plates	Ref 4
17	Presentation a rational design problem (Pressure vessel)	-----

Refrences

1. A.K. Kaw, 1997 "Mechanics of Composite Materials" , CRC Press, **ISBN**: 9780849396564

2. S.W. Tsai, 1980 "Introduction to Composite Materials", TECNOMIC publishing Co., Inc. , **ISBN**- 13: 978-0877622888

3. M.W. Hyer, 2008 " Stress Analysis of Fiber Reinforced Composite Materials" "Destech Pubns Inc; Updated edition , **ISBN**-13: 978-1932078862

4. J.M. Whitney, 1987 "Structural Analysis of Laminated Anisotropic Plates, CRC Press, **ISBN**-13: 978-0877625186

Classroom Methods(policies)

- Attendance is required for all lecture sessions.
- 4-5 sets of homework problems will be assigned during the course. No late homework will be accepted.
- Homework must be written and organized in a professional manner or points will be deducted.
- Students are required to complete a course project and present in the class.

Evaluation

- Homework 10%, Mid exam 20%
- Project 15%, Final exam 55%

Project

Students will be required to complete a group course project as well as some small projects during this course.
Details of the project will be given during the course.

Final project will consist of the following elements:
- Finding an application for which composites are a likely candidate
- develop in depth report which addresses:
- Material selection
- Detailed design of composite architecture
- Finite element modeling with ABAQUS or ANSYS software

Projects will be presented orally and in written form and it should be optimized for the presentation of about 10 minutes. There will be maximum 2 students per group.