



Course Outline

Title: Fatigue Life of Polymeric Composites

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Department: Mechanical Engineering Dep.

Prerequisite: No prerequisite

Overview

Fatigue Life of Polymeric Composites is a three-credit course, which emphasizes on various methods to find the fatigue strength and life of structures made of polymeric composite materials. The course is designed to be taken by second semester graduate students of the mechanical engineering department at Iran University of Science and Technology (IUST).

Goal(introduction)

This course is designed in two sections for graduated students (M.Sc. and Ph.D.) to understand the fatigue response of polymeric composites.

First section, reviews fatigue failure mechanisms in isotropic materials as metals from micromechanical point of view. Then fatigue failure criteria will be studied. In this section, fatigue failure models based on stress, strain and fatigue crack growth will be reviewed in more details. In addition, basics of fatigue test methods are presented in this chapter.

In the second section, first; static and fatigue failure modes will be studied in composite materials. Then, fatigue models in composite materials as, macroscopic failure criteria, residual stiffness, residual strength and progressive fatigue damage models will be studied in more details. Also, fatigue life modeling in laminated composites under variable loading will be studied in this section. Final part of this section is deal with fatigue life molding in some practical engineering cases as, wind turbine blades, adhesive joints and aerospace structures.

Objectives

The primary objective of this course is to understand fatigue failure mechanisms in polymeric composites and be able to design composite structures against fatigue failure.

Skills Objectives

1. Demonstrate knowledge of the physical meanings, principles, and mathematics of fatigue failure in composites.
2. Understand fatigue failure mechanism and be able to select a suitable fatigue failure approach to find out the fatigue life of a real structure subjected to arbitrary loading conditions.
3. Be familiar with applicability limitations of various fatigue failure criteria available in the context of composites materials.

Materials

Week	Subject	Table of Contents
1	Review of fatigue design criteria	
2	Macro/Micro aspects of fatigue of metals	
3	Fatigue life models of metals (1)	Stress-life
4	Fatigue life models of metals (2)	Strain-life
5	Fatigue life models of metals (3)	Strain life
6	Fatigue test methods and equipment's	
7	Fatigue failure mechanisms in composites	
8	Macroscopic fatigue models based on stress-life diagrams	
9	Fatigue life based on constant life diagrams (CLD) (1)	
10	Fatigue life based on constant life diagrams (CLD) (2)	
11	Fatigue models based on residual stiffness	
12	Fatigue models based on residual strength	Harris, Brutman Models
13	Fatigue models based on residual strength	Reifsnider Model
14	Progressive fatigue damage models in composites	Shokrieh Model
15	Fatigue life modeling of composites under variable amplitude loading	
16	Applications and students seminars	

References

1. P. Vassilopoulos, "Fatigue life prediction of composites and composite structures", Woodhead publishing, 2010
2. B. Harris, "Fatigue in composites", Woodhead publishing, 2003
3. R.I. Stephens and etal., "Metal fatigue in engineering, Second edition" , John Wiley & Sons Inc., 2001

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

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| • Homework | 10% | , | Project | 20% |
| • Final exam | 50% | , | Mid exam | 20% |

Project

Students will be required to complete a course project. The course project is a critical literature review of a specific topic fatigue life prediction of composite materials. It is very important in a critical literature review not only to present an overview of the latest work in the literature but to identify opportunities for advancement or improvement. It is the responsibility of each group (two-student max) to generate a topic for the critical literature review. Topics that relate to the student's area of research are acceptable and encouraged.

In order to approve the project title each group has to prepare title and an abstract not less than 200 words and electronically submit to Professor Taheri email by twelve-week of the course.

Project results will be evaluated through a written report (10-15 pages, with sufficient references) and an oral presentation (10 minutes to be given in class at the end of semester)