

ADVANCED COMPOSITES STRUCTURES AND MECHANICS

Objective

To understand the design, analysis and testing of composite materials

1. Introduction

Basic definitions-Classification of Composite Materials based on Matrix Material: Organic Matrix composites Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC); Classification Composite Materials based on Reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites- Properties of typical Composite Materials-Elastic constants for Anisotropic, Orthotropic and Isotropic Materials.

2. Methods of Analysis

Micro mechanics – Analysis of composite Strength and Stiffness- Elasticity approach to determine material properties – Macro Mechanics – Stress-Strain Relations. Types of Laminate Configuration –Finite Element Method Analysis of Composite Structures- Composite Joints.

3. Testing of Composites

Mechanical testing of Composites: Tensile testing- Compressive testing- Intra-laminar shear testing-Inter-laminar shear testing-Fracture testing-Environmental Effects on composites. Governing differential equation for a general laminate- Angle ply and Cross ply laminates. Failure criteria for composites.

4. Applications

Applications related to Aerospace-Automotive- Civil Engineering Structures-Marine Structures- Composites as biomaterials: Orthopedic, Dental and other applications -Case studies.

Textbooks

1. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition – 2007
2. Madhujit Mukhopadhyay. "Mechanics of Composite Materials and Structures", University Press (India) Private Limited 2004.