

Course Name:
Composite Materials

Course Number:
20135

Credit:
3

Course Content (outline):

-Chapter 1: Introduction to Composite Materials

- Course overview and policies
- Definitions and classifications of different types of composites
- Overview of polymer matrix composites
- Advanced composite materials
- Application of FRP composites
- Manufacturing of FRP composites
- Mechanics terminology of composite structure

-Chapter 2: Macromechanical Analysis of a Lamina

- Material symmetries (3D monoclinic and orthotropic)
- Materials symmetries (3D transversely isotropic)
- Thin unidirectional lamina and derivation of engineering constants
- Examples and applications of unidirectional lamina
- Angle lamina introduction
- Derivation of engineering constants for angle lamina
- Examples and applications of angle lamina

-Chapter 3: Micromechanical Analysis of a Lamina

- Introduction of micromechanics
- Fiber and matrix volume fractions
- Rule of mixtures derivation of longitudinal / transverse modulus
- Rule of mixtures derivation of Poisson's ratio and shear modulus
- Semi-empirical models (Halpin-Tsai equations)
- Method of elasticity to derive composite modulus
- Tensile strength of composite lamina as a function of volume fraction
- Compression and shear strengths of composite lamina

-Chapter 4: Macromechanical Analysis of Laminates

- Introduction to laminate design and code for laminate description
- Stresses and strains in laminates (force/moment relationships)

- Procedures for laminate analysis
- Laminate stress analysis example problems

-Chapter 5: Failure, Analysis and Design of Laminates

- Special laminate geometries
- Examples and applications of special laminates
- Failure criterion for laminates
- Design considerations for composite laminates
- Design examples

References:

- The International Handbook of FRP Composites in Civil Engineering, by M. Zoghi.
- Engineering Mechanics of Composite Materials, by Isaac M. Daniel.
- Introduction to Composite Materials, by Hull and Clyne,
- Introduction to Composite Materials Design, by Ever J. Barbero,
- Mechanics of Composite Materials, by R. Jone,
- Fiber-Reinforced Composites: Materials, Manufacturing and Design, by P.K. Mallick,