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.
• 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,