

1. *Course number and name*  
**ENGR 441: Fundamentals of Composite Materials**
2. *Credits and contact hours*  
3 credit hours: two 75-minute lecture sessions/week
3. *Instructor's or course coordinator's name*  
Instructor: Kwok Siong Teh, Associate Professor of Mechanical Engineering  
  
Course coordinator: Kwok Siong Teh, Associate Professor of Mechanical Engineering
4. *Text book, title, author, and year*  
(No textbook)
  - c. *other supplemental materials*  
(none)
5. *Specific course information*
  - g. *brief description of the content of the course (catalog description)*  
Mechanics of long-, short-, and particle-reinforced composites. Stress, strain, and stiffness transformations. Mechanics of a single orthotropic ply. Laminated plate theory. Residual stress, fracture mechanics, delamination, fatigue; environmental effects, and thermomechanical properties. Manufacturing processes. Composites design, sustainability and recycling.
  - h. *prerequisites or co-requisites*  
Math 245: Elementary Differential Equations & Linear Algebra, and  
  
Engr 309: Mechanics of Solids
  - i. *indicate whether a required, elective, or selected elective course in the program*  
Upper Division Technical Elective for Civil Engineering and Mechanical Engineering
6. *Specific goals for the course*
  - g. *specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.*
    - The student will demonstrate an ability to describe and solve problems on atomic arrangements, geometry of imperfections, and atomic diffusion in solids.
    - The student will demonstrate an ability to describe and solve problems on mechanical and electrical behavior of materials.
    - The student will demonstrate an ability to submit homework solutions in proper engineering format.
    - The student will demonstrate an ability to describe and solve problems on the distinguishing properties of metals, plastics and ceramics.

- The student will demonstrate a familiarity with the effects of thermal, mechanical, and chemical treatments on properties.
- The student will demonstrate an ability to experimentally determine mechanical and electrical properties of materials.
- The student will demonstrate an ability to make oral presentations and write a technical report.

*h. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.*

Course addresses ABET Student Outcome(s): a, b, c, d, e, g, h, i, j, k.

*7. Brief list of topics to be covered*

- Introduction to composites: nomenclature, definitions, advantages, applications.
- Fiber Materials (polymer, metal, ceramic, carbon)
- Matrix Materials (polymer, metal, ceramic, carbon)
- Stress-Strain Tensors and Transformation
- Long Fiber-Reinforced Lamina: Mechanical Properties
- Long Fiber-Reinforced Laminate Plate Theory and Design
- Strength Theories
- Manufacturing Processes
- Test Methods
- Aligned and Non-Aligned Short Fiber-Reinforced Composites
- Failure Modes - Fracture, Fatigue, Delamination
- Thermomechanical Properties
- Sandwich Panels
- Particle-Reinforced Composites
- Metal and Ceramic Matrix Composites
- Nanocomposites
- Case Studies and Applications