

1. MME 3314 Composite Materials
2. 3 credits and 3 contact hours per week
3. Darren Cone
4. Composite Materials: Science and Engineering, 3rd edition, Krishna Chawla, Springer (2013) ISBN: 978-0-387-74364-6
5. Specific course information
 - a. Introduction to fiber-reinforced materials. Manufacturing technology for strong fibers and whiskers. Mechanical performance, design, and manufacturing of composite products. Adhesion, interfacial shear, and critical fiber length. Anisotropic plane-stress elasticity; multiaxial strength of anisotropic materials. Classical theory of laminates. Delamination and other performance problems.
 - b. MME2434 and MME2303, with a grade of “C” or better.
 - c. Elective
6. Specific goals for the course
 - a. Learning Outcomes
 - Identify the advantages and disadvantages of composites for particular applications
 - Define the interfacial properties between the reinforcement and matrix components based on the bonding type
 - Calculate the bulk mechanical properties of composites based on shear and bending modes of loading
 - Distinguish between the different fiber material types based on the relationship between fabrication techniques, microstructures and properties
 - Describe the relationships between composite mechanical properties, volume fraction, and geometric arrangement of the constituent materials in isotropic, anisotropic and orthotropic composites
 - Calculate theoretical composite properties using the rule of mixtures and Halpin-Tsai relationships
 - Describe the composite materials selection and design processes.
 - Identify possible composite failure modes and how they influence the factors of safety applied to composite systems
 - b. Student Outcomes
 - Outcome 1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
 - Outcome 3: an ability to communicate effectively with a range of audiences
 - Outcome 4: an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the

impact of engineering solutions in global, economic, environmental, and societal contexts

- Outcome 6: an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- Outcome 7: an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. Brief list of topics to be covered

- Introduction to families of composites, properties and applications
- Physical characteristics of composites: volume fraction, density, heat capacity, etc
- Elastic micromechanics of continuous-fiber composites
- Laminates: mechanics, design and performance
- Reinforcing fibers: manufacturing and properties
- Strength prediction and failure modes
- Polymer-matrix composites (PMC): properties and limitations
- Manufacturing of polymer-matrix composites
- Discontinuous reinforcement: critical length and properties
- Metal-matrix composites (MMC)
- Ceramic-matrix composites (CMC)