MEC 456/556 - Introduction to Engineering Mechanics of Composites

Fall Semester 2018

Credit: 3 credits

Prerequisite: MEC 363 or equivalent course

Lectures: Mondays 4:00 – 6:50PM at Light Engineering Room 152 (LE152)

Instructor: Kedar Kirane (kedar.kirane@stonybrook.edu)

Office Hours: Tue, Thu 1:30 – 3:00PM in Light Engineering 133

Text/Primary Reference Book:

- ❑ *Engineering Mechanics of Composite Materials*, Isaac M. Daniel & Ori Ishai. Oxford Press (2006, second edition) ISBN 978-0-19-515097-1

Other Related Books:

- ❑ *Autar K. Kaw, "Mechanics of Composite Materials," 2nd ed., Taylor and Francis*
- ❑ *Carl T. Herakovich, "Mechanics of Fibrous Composites," Wiley.*
- ❑ *Robert M. Jones, "Mechanics of Composite Materials," Taylor and Francis.*

Grading:

Homework	35%
Mid-Term Exam (mid-late October)	30%
Final Exam (Wednesday December 12, *8.30 pm -11:00 pm*)	35%

Homework assignments will be given about every two weeks. A group project will also be assigned towards the end of the semester which will involve reviewing a published research article and making a class presentation. The homework and exam requirements for MEC556 students will be slightly greater than for MEC456 students.

Course Description:

This course introduces students to the mechanics of fiber reinforced composite materials. It covers a brief history of the development of fiber composites, their properties, advantages, limitations and applications. Most of the course will focus on long (continuous) fiber reinforced composites. It introduces various length-scales at which composites are analyzed, and covers in detail lamina and laminate concepts – mainly the elastic behavior, strength and progressive failure of unidirectional lamina as well as multidirectional laminates. It also introduces the students to various modes of failure in composites and the importance of fracture mechanics.

Course Learning Objectives:
1. Become familiar with the advantages and limitation of fiber composites in comparison with conventional structural materials
2. Be able to use stress-strain linear elastic constitutive relations in structural analysis, including isotropic, anisotropic, orthotropic and transverse isotropic relations
3. Understand coordinate transformation of stress, strain, stiffness and compliance matrices
4. Understand various theoretical methods for predicting effective elastic properties and their relative advantages and limitations
5. Be able to determine the onset of failure in composites using various strength-based failure theories
6. Be able to determine the elastic behavior of multidirectional laminates composed of plies with different orientations
7. Be able to appreciate the shortcomings of strength-based failure theories, and importance of fracture mechanics

Topics:
- *Introduction* - Relevant terminology, advantages & disadvantages of composites, role of constituents (fibers, matrix), synthesis and fabrication techniques, types of composites, degrees of anisotropy

- *UD lamina* – Elastic constitutive relations, relations between mathematical and elastic constants, plane stress constitutive relation, transformation of elastic parameters, effective elastic properties (fiber volume ratio, rule of mixtures)

- *Strength of UD lamina* – Failure mechanisms and failure criterion, failure theories (stress, strain, Tsai Hill, Tsai Wu)

- *Multi-directional laminates* – Macro-mechanical Analysis, Elastic properties, Laminate theory, *(*Cross-Ply, Moment-Curvature, Basic), Stress and Failure analysis

- *Failure and Design of Laminates* - Ply Arrangements, Failure Theories, Failure Criterion

- *Other topics:* Fatigue, Fracture mechanics, Quasi-brittleness, Size Effects, Mechanical testing methods overview, Hygro-thermal effects

DISABILITY SUPPORT SERVICES (DSS) STATEMENT
If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Disability Support Services, ECC (Educational Communications Center) Building, room128, (631) 632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

ACADEMIC INTEGRITY STATEMENT
Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at http://www.stonybrook.edu/uaa/academicjudiciary/

CRITICAL INCIDENT MANAGEMENT
Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures.

CALCULATOR POLICY
Only the following calculators will be permitted to be used on all midterm and final exams in the Department of Mechanical Engineering. There will be no exceptions! This list of calculators is identical to that allowed for the National Council for Examiners for Engineering and Surveying (NCEES) Fundamentals of Engineering (FE) exam that many of you will take in your senior year, as well as Professional Engineering (PE exam) that you may take.

Casio:	All fx-115 models. Any Casio calculator must contain fx-115 in its model name.
Hewlett Packard:	The HP 33s and HP 35s models, but no others.
Texas Instruments:	All TI-30X and TI-36X models. Any Texas Instruments calculator must contain either TI-30X or TI-36X in its model name.

For detail information, follow https://ncees.org/exams/calculator-policy/