MSE 4793 Composite Materials & Processes

Credit hours and contact hours: 3-0-0-3

Instructor: Kyriaki Kalaitzidou

Textbook: Sanjay Mazumdar, *Composites Manufacturing: Materials, Product and Process Engineering*, CRC Press, 1st Edition, 2001.

Specific course information

Catalog description: Basic principles of selecting component materials and manufacturing composites are presented. Polymeric, metallic, and ceramic systems are considered.

Prerequisites: CHEM 1310 – General Chemistry and PHYS 2212 – Introduction Physics II

Course: Selected Elective

Specific goals for the course

Outcomes of instruction:

Outcome 1: The student will develop a knowledge of the manufacturing of composite materials.

1.1 The student will be introduced to the various composite components e.g. reinforcement and matrices.

1.2 The student will employ principles of material selection and design for composite materials.

1.3 The student will demonstrate basic knowledge on the various composite processing techniques.

Outcome 2: The student will develop a working knowledge of the various testing and performance protocols for composite materials.

2.1 The student will demonstrate the ability to test the as synthesized composite materials.

2.2 The student will demonstrate the ability to assess the performance of the composites.

Outcome 3: The student will develop an understanding of the economics of composite materials.

3.1 The student will demonstrate an ability to determine material cost through modeling and case studies.

Student Outcomes:

(1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

(2) An ability to apply engineering design to produce solutions that meet specified needs with consideration for public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
(6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

Topics covered:

1. Materials:
   Reinforcements: glass, carbon, metal, organic and inorganic.
   Matrices: thermoset, thermoplastic, carbon, ceramics and metal.
2. Processing:
   Interface modification, reinforcement forms, manufacturing preforms, and prepregging.
   Continuous processes: Filament winding and pultrusion.
   Batch processes: Autoclave and matched-die/RTM.
   Thermoplastic processes.
3. Testing:
   Density/voids
   C-scan
   Mechanical
4. Performance
5. Economics:
   Process modeling, cost modeling and case studies.

Correlation between Outcomes of Instruction and Student Outcomes:

Outcomes of Instruction	Student Outcomes						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.		X			X		
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration for public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	X	X			X		
3. Analyze mass and heat transfer problems in simple geometries (e.g. 1-D or axisymmetric) for polymeric materials during polymer/fiber processing.	X	X			X		

4. Understand the structural-property relationship and interpret the influence of processing on the structural development during polymer/fiber processing.	X				X		
5. Select suitable polymer/fiber processing techniques and sequences for product realization.	X	X			X		
6. Apply CAD and CAE for solving polymer/fiber engineering problems.	X	X			X	X	X

School of Materials Science and Engineering Student Outcomes:

(1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
(2) An ability to apply engineering design to produce solutions that meet specified needs with consideration for public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
(3) An ability to communicate effectively with a range of audiences.
(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.
(5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
(6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
(7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.