

**PELLISSIPPI STATE COMMUNITY COLLEGE  
MASTER SYLLABUS**

**COMPOSITE MATERIALS & STRUCTURES  
MET 2250**

**Lecture/Lab Hours: 3 / 3**

**Credit Hours: 4**

**Date Revised: Spring 2017**

**Catalog Course Description**

An introduction to the science and technology of composite materials and structures. Topics covered include the anisotropic nature of typical laminated composite materials, polymeric composites, constituent materials, the processes used to manufacture composites, tooling requirements, analysis methods, non-destructive inspection, and repair.

**Prerequisites**

MET 1012

**Co-requisites**

None

**Textbooks and Other Supplies**

*Essentials of Advanced Composite Fabrication and Repair*, Dorworth, Gardiner and Mellema, ASA, current edition

**Week/Topic Basis**

<b>Week</b>	<b>Topic</b>
1-2	Composite Materials Overview
2 - 3	Matrix Technology: thermosets, thermoplastics, other matrix materials
4 - 5	Fiber Reinforcements: fiber types, properties and layups
5 – 6	Composite Design Considerations: matrix dominated properties, fiber dominated properties, composite layup terms and conditions, service life

6 - 7	Manufacturing methods: mold release, vacuum bagging, hand layup, filament winding, prepreg, automated tape laying and fiber placement, pultrusion, compression molding
8	Core materials for sandwich structures
9 - 10	Tooling Requirements
11	Non-destructive and destructive testing for quality assurance
12 - 13	Adhesive bonding and fastening
14	Repair
15	Safety and Health Considerations

### **Engineering Technology General Outcomes (Educational objectives)**

- I. Apply basic engineering theories and concepts creatively to analyze and solve technical problems.
- II. Utilize with a high degree of knowledge and skill equipment, instruments, software, and technical reference materials currently used in industry.
- III. Communicate effectively using developed writing, speaking, and graphics skills.
- IV. Assimilate and practice the concepts and principles of working in a team environment.
- V. Obtain employment within the discipline or matriculate to a four year program in engineering or industrial technology.

### **Engineering Technology Concentration Competencies**

NOTE: At the program level all 6 competencies apply to roman numerals I – V of the Engineering Technology General Outcomes (Educational objectives) listed above.

Students will

- A. Apply the knowledge, techniques, skills, and modern tools for the concentration of study to specifically defined engineering technology activities.
- B. Demonstrate the knowledge of mathematics, science, engineering and technology to engineering technology problems using developed practical knowledge.
- C. Conduct and report the results of standard tests and measurements, and conduct, analyze and interpret experiment or project results.
- D. Function effectively as a member of a technical team.
- E. Identify, analyze and solve specifically defined engineering technology-based problems.
- F. Employ written, oral and visual communication in a technical environment.

## Course Goals

NOTE: Capital letters after course goals reference goals of the Engineering Technology Program.

The course will

1. Enhance the students understanding of how matrix and fibers are combined to create modern composite materials. (A,B,E,F)
2. Contribute to the student's knowledge of basic design considerations needed for manufacturing composite structures. (A,B,E,F)
3. Give the students an overview of the different manufacturing methods that can be used to produce composite materials. (A,B,E,F)
4. Guide the students to demonstrate their understanding of the tooling required to manufacture good quality composite materials. (A,B,E,F)
5. Enhance the students understanding of techniques for inspection and destructive testing which are used for quality assurance. (A, B, C, D, E, F)
6. Demonstrate to the student the importance of techniques for adhesive bonding and repair of composite materials. (A,B,E,F)
7. Reinforce necessary skills in identifying and providing hazard assessment, prevention and control when working with advanced composite materials. (A,B,E,F)

## Expected Student Learning Outcomes

NOTE: Numbers after Expected Student Learning Outcomes reference the course goals listed above.

The student will

- a. Identify which matrix materials are best suited for particular applications. (1, 2)
- b. Analyze and evaluate glass transition temperature and cure cycle information for thermoset and thermoplastic matrix materials. (1, 2)
- c. Classify the fiber type, length and weave for specific composite material applications. (1, 2)
- d. Recall which composite properties are matrix dominated and which are fiber dominated. (1,2)
- e. List and interpret the layup designation and associated ply orientations. (3)
- f. Distinguish between the methods for different types of composite materials production including filament winding, injection molding and vacuum bagging for non-autoclave processing. (3)
- g. Describe the steps required for different manufacturing methods for composite materials. (3)
- h. Discuss advantages and disadvantages of different manufacturing methods for composite materials. (3)
- i. Classify the appropriate core material for different applications. (2, 3)
- j. Describe composite material applications that would benefit from using sandwich structures. (2, 3)

- k. Identify appropriate fiber/matix selections, manufacturing methods and composite structural designs for applications with restrictions such as weight, cost, or service conditions. (1, 2, 3)
- l. Explain the roles of coefficient of thermal expansion and thermal conductivity in tooling for composite materials. (4)
- m. Explain why tests developed for metals and plastics typically cannot be used for composite materials. (5)
- n. Explain and perform destructive tests on sample composite material coupons to find both tensile properties and fiber/matrix and void content. (5)
- o. Identify appropriate non-destructive testing techniques which can be done to inspect composite materials. (5)
- p. Discuss the advantages and disadvantages of mechanical fastening and adhesive bonding for attaching composite materials. (6)
- q. Explain the importance of surface preparation, bondline thickness and adhesive selection for bonding different types of composite materials. (6)
- r. Describe the considerations that must be taken into account for mechanical fastening of composite materials. (6)
- s. Identify the types of damage that can occur in composite materials, how damage can be detected and describe the suitable methods for repair of the structure. (7)
- t. Relate and understand ways to mitigate the health and safety issues that can potentially arise when working with composite materials. (8).

## **Evaluation**

Total evaluation will be based on the following point distribution.

### **Testing Procedures**

#### **Unit Exams**

**50 points**

There will be 4-6 unit exams administered during the course.

#### **Final Exam**

**15 Points**

There will be a comprehensive final exam administered at the end of the course.

#### **Participation**

**5 Points**

Based on instructor observation during the course, each student will be evaluated on participation activities. Evaluation parameters to include active participation in class discussions, response to verbal questions, being prepared, efficient use of lab time and regular attendance.

### **Laboratory Experiences**

#### **Laboratory Projects**

**30 points**

#### **Field Work**

N/A

## **Other Evaluation Methods**

N/A

## **Grading Scale**

Final grade for this course will be based on the following alphabetical/numerical scale.

A	93-100
B+	88-92
B	83-87
C+	79-82
C	74-78
D	65-73
F	Below 65

## **Policies**

### **Attendance Policy**

Pellissippi State expects students to attend all scheduled instructional activities. As a minimum, students in all courses (excluding distance learning courses) must be present for at least 75 percent of their scheduled class and laboratory meetings in order to receive credit for the course. Individual departments/programs/disciplines, with the approval of the vice president of Academic Affairs, may have requirements that are more stringent. In very specific circumstances, an appeal of the policy may be addressed to the head of the department in which the course was taken. If further action is warranted, the appeal may be addressed to the vice president of Academic Affairs.

### **Academic Dishonesty**

Academic misconduct committed either directly or indirectly by an individual or group is subject to disciplinary action. Prohibited activities include but are not limited to the following practices:

- Cheating, including but not limited to unauthorized assistance from material, people, or devices when taking a test, quiz, or examination; writing papers or reports; solving problems; or completing academic assignments.
- Plagiarism, including but not limited to paraphrasing, summarizing, or directly quoting published or unpublished work of another person, including online or computerized services, without proper documentation of the original source.
- Purchasing or otherwise obtaining prewritten essays, research papers, or materials prepared by another person or agency that sells term papers or other academic materials to be presented as one's own work.
- Taking an exam for another student.
- Providing others with information and/or answers regarding exams, quizzes, homework or other classroom assignments unless explicitly authorized by the instructor.

- Any of the above occurring within the Web or distance learning environment.

Please see the Pellissippi State Policies and Procedures Manual, Policy 04:02:00 Academic/Classroom Conduct and Disciplinary Sanctions for the complete policy.

### **Accommodations for Disabilities**

Students that need accommodations because of a disability, have emergency medical information to share, or need special arrangements in case the building must be evacuated should inform the instructor immediately, privately after class or in her or his office. Students must present a current accommodation plan from a staff member in Disability Services (DS) in order to receive accommodations in this course. [Disability Services](http://www.pstcc.edu/sswd/) (<http://www.pstcc.edu/sswd/>) may be contacted via [Disability Services email](#) or by visiting Alexander 130.

### **Other Policies**

#### **Safety and Equipment Abuse**

Repeated safety violations will result in a reduction of final grade, at the instructor's discretion. Flagrant violations which result in equipment damage or personal injury could result in automatic failure of the course