

MASC 564 Syllabus – 2024-S
Prof. Nutt

Course Objective: This course covers the science and technology underlying composites manufacturing processes from the perspectives of process selection, materials efficiency, and sustainability. The scope includes constituent materials, manufacturing challenges, defect control strategies, as well as bases for material and process selection and design, and practical issues of producing composite structures. Students will learn (1) how to analyze, evaluate, and select a manufacturing process appropriate for a given part within various constraints, (2) how to evaluate different processes, (3) how process parameters affect part quality and performance, and (4) how processes can be adjusted to control part quality.

Course Description: This course will cover applied aspects of manufacturing methods for polymer composites. We will rely on a textbook and web articles as the primary sources of content and as a platform for learning. We start by introducing the basic constituent materials – fibers and matrices – commonly used in composites, and the distinguishing characteristics of these materials that justifies selection for different applications. The task of combining these materials and curing the matrix comprises composite manufacturing, and there are dozens of approaches, each with limitations and advantages. We cover prepregs (VBO and conventional), liquid molding techniques (RTM, VARTM and infusion), compression molding, automated tape layup (ATL), filament winding, and pultrusion. Attention is devoted briefly mechanics and analysis of composites, the principles and concepts being generic to all fiber-reinforced materials. In addition to manufacturing techniques, we introduce the basic processes and phenomena involved, such as fluid flow through permeable media, dynamic viscosity, gas removal, and cure kinetics. We also introduce technical issues and scientific phenomena associated with the manufacture of sandwich structures. The final portion of the course is devoted to engineering issues, such as joining and repair, diagnostic techniques, and design.

Reading List. The textbook for the course is Structural Composite Materials, by F.C. Campbell. Additional background texts are listed below, but much of the material will be gleaned from lectures.

Manufacturing of Polymer Composites, B.T. Astrom, Chapman & Hall
Manufacturing of Polymer Composites, vol 6, American Society for Composites, ed. by A.C. Loos
Manufacturing Processes for Advanced Composites, Elsevier, F.C. Campbell
Processing of Composites, Hanser, ed by R.S. Dave and A.C. Loos
Principles of the Manufacturing of Composites, DEStech, S.V. Hoa

Examinations/ Grading

Midterm Exam – 40%

Final Exam – 43%

HW's – 20%

Exams will be closed-book, closed-notes.

No photos allowed in class

Schedule of Lectures - MASC 564

Week	Date	Topic
1	1/9	Fibers and Interfaces
	1/11	Polymer Matrices
2	1/16	Composite Manufacturing Methods – Overview
	1/18	Prepreg fundamentals
3	1/23	Prepreg fundamentals
	1/25	OoA prepregs/VBO processing
4	1/30	OoA prepregs/VBO processing
	2/1	Automated tape layup/fiber placement - 1
5	2/6	Automated tape layup/fiber placement – 2
	2/8	Liquid molding techniques – RTM 1
6	2/13	Liquid molding techniques – RTM 2
	2/15	Liquid molding techniques – Vacuum Infusion 1
7	2/20	Liquid molding techniques - Vacuum Infusion 2
	2/22	LM Challenges and Case Studies
8	2/27	Thermoplastic Composite Fabrication
	2/29	Polymer Processing Science – cure, flow, defects
9	3/5	Cure Kinetics 1
	3/7	Midterm
	3/12	SPRING BREAK
	3/14	SPRING BREAK

Week	Date	Topic	Chapter
	3/12	SPRING BREAK	
	3/14	SPRING BREAK	
10	3/19	Cure Kinetics 2	
	3/21	Sandwich structure manufacturing - 1	Ch 9
11	3/26	Sandwich structure manufacturing - 2	
	3/28	Composite Joining - bonding	Ch 8
12	4/2	Composite Joining - fasteners	Ch 17
	4/4	Tooling	Ch 4
13	4/9	Composite Repair	Ch 19
	4/11	Machining and Assembly	Ch 11
14	4/16	Non-destructive Inspection (NDI)	Ch 12
	4/18	Composite Mechanical Properties	Ch 14
15	4/23	Structural Analysis	Ch 16
	4/25	Ceramic Composites	
	5/8	FINAL EXAM – 2-4pm	

Class meets Tu, Th @12-1:40 in VHE 217