

## 课程大纲 COURSE SYLLABUS

1.	<b>课程代码/名称 Course Code/Title</b>	MAE5020/复合材料力学 Mechanics of Composite Materials
2.	<b>课程性质 Compulsory/Elective</b>	核心课程 core course
3.	<b>课程学分/学时 Course Credit/Hours</b>	3/48
4.	<b>授课语言 Teaching Language</b>	英文 English
5.	<b>授课教师 Instructor(s)</b>	待定
6.	<b>是否面向本科生开放 Open to undergraduates or not</b>	是 Yes
7.	<b>先修要求 Pre-requisites</b>	MA102B 高等数学（下）A Calculus II A
8.	<b>教学目标 Course Objectives</b>	
	<p>复合材料力学是力学与航空航天工程系的专业课，是为培养复合材料与工程专业高质量专门人才服务的。通过本课程的学习，使学生了解和掌握现代复合材料的力学性能及其在工程中的应用。学会根据结构的受力分析，正确地设计和选取复合材料，达到优化结构性能的目的。要求学生掌握复合材料的宏观性能和微观结构之间的关系，了解复合材料的各种破坏机理及破坏准则，并能正确地应用于复合材料层合板的弯曲、屈曲和振动分析中去。该课程是对一般弹性力学和振动力学等课程的延续和拓宽，是学生掌握现代力学知识和进行结构设计的必修课程。</p> <p>Mechanics of composite materials is a specialized course in mechanics and aerospace engineering. It is a course for training high quality specialists of composite materials and engineering. Through the study of this course, students can understand and grasp the mechanical properties of modern composite materials and their applications in engineering, and learn to design and select composite materials according to the stress analysis of the structure, thus optimizing the performance of the structure. Students are required to master the relationship between the macroscopic properties and microstructure of the composites, understand the various composites failure mechanisms and failure criteria, and apply those knowledge into the bending, buckling and vibration analysis of laminate correctly. This course is a continuation and extension of general elasticity and vibration mechanics, and is a required course for students to master modern mechanical knowledge and to carry out structural design.</p>	
9.	<b>教学方法 Teaching Methods</b>	
	讲授 lecture	
10.	<b>教学内容 Course Contents</b>	
	<b>Section 1</b>	绪论 Introduction （3 学时/3 credit hours） 发展历史和现状，复合材料的分类、应用及发展前景。 History and status of composites, classification of composites, application.
	<b>Section 2</b>	复合材料的制备工艺 Composite Manufacturing Processes （3 学时/3 credit hours） 复合材料的分类，制备方法，及航空航天的应用。 Classification of composites, manufacturing process and application in aerospace engineering.
	<b>Section 3</b>	各向异性弹性力学基础 Foundation of Anisotropic Elastic Mechanics （3 学时/3 credit hours）

	各向异性弹性力学基本方程，各向异性弹性体的应力应变关系。 Foundation of anisotropic elastic mechanics, stress-strain relation for anisotropic material.
<b>Section 4</b>	单层板的宏观力学分析 Macromechanical Analysis of a Lamina (3 学时/3 credit hours) 平面应力下单层板的应力应变关系，任意方向的应力应变关系，单层板的强度和强度理论。 Stress-strain relation of unidirectional lamina in a plane stress, stress-strain relation for angle lamina Strength of lamina composites, strength theory of orthogonal anisotropic lamina.
<b>Section 5</b>	层合板刚度的宏观力学分析 Macromechanical Analysis of Laminate stiffness (3 学时/3 credit hours) 层合板的刚度和柔度，层合板的刚度计算，刚度理论。 Stiffness and compliance of laminate, stiffness calculation and stiffness theory of laminate.
<b>Section 6</b>	层合板强度的宏观力学分析 Macromechanical Analysis of Laminate Strength (3 学时/3 credit hours) 层合板的强度，层合板的应力分析，强度分析。 Strength of laminate, stress analysis, strength analysis of laminate.
<b>Section 7</b>	湿热效应 Hygrothermal Effect (3 学时/3 credit hours) 单层板的湿热变形，单层板的应力应变分析，层合板的刚度和强度分析。 Hygrothermal effect of lamina, stress-strain analysis of lamina, stiffness and strength analysis of laminate.
<b>Section 8</b>	期中考试 Mid-term exam (3 学时/3 credit hours)
<b>Section 9</b>	层合板的弯曲、屈曲与振动 Bending, buckling and vibration of laminate (3 学时/3 credit hours) 层合板的弯曲，层合平板的屈曲，层合平板的振动。 Bending, buckling and vibration of laminate.
<b>Section 10</b>	若干专题 Some Special Topics (3 学时/3 credit hours) 混杂复合材料的力学分析，复合材料的疲劳，断裂。 Mechanical analysis of hybrid composites, fatigue and fracture of composites.
<b>Section 11</b>	复合材料有效性质和均质化方法 Effective Properties and Homogenization Methods of Composites (3 学时/3 credit hours) 尺度和代表单元，细观过渡方法。 Meso scale and representative elements, meso transition method.
<b>Section 12</b>	单层板的细观力学分析 Micromechanical Analysis of a Lamina (3 学时/3 credit hours) 刚度分析，强度分析，短纤维复合材料的细观力学分析，热膨胀的力学分析。 Stiffness analysis, strength analysis, micromechanical analysis of short fiber reinforced composites, and mechanical analysis of thermal expansion.
<b>Section 13</b>	复合材料的单夹杂问题 Single Inclusion Problem of composite (3 学时/3 credit hours) 弹性问题，椭球型夹杂，本征应变，夹杂的能量。 Elastic problem, ellipsoidal inclusions, intrinsic strains, and the energy of inclusions.
<b>Section 14</b>	复合材料线性有效模量预测的近似方法 Predicting Linear Effective Modulus of Composite (3 学时/3 credit hours) 稀疏方法，自洽方法，微分法等。 Sparse method, self-consistent method, differential method and so on.
<b>Section 15</b>	复合材料的计算研究方法 Computational Methods for Composite (3 学时/3 credit hours) 代表体积单元，载荷边界条件。 Representative volume element, load boundary condition.
<b>Section 16</b>	复习课 Review (3 学时/3 credit hours)

11.	<b>课程考核 Course Assessment</b>
	<p>1. 考查 no exam</p> <p>2. 课堂表现 Class Performance 10%</p> <p>课程项目 Projects 30%</p> <p>平时作业 Assignments 20%</p> <p>期末报告 Final Presentation 40%</p> <p>3. There is no difference between undergraduate and graduate students.</p>
12.	<b>教材及其它参考资料 Textbook and Supplementary Readings</b>
	<p>《复合材料力学》，R.M.琼斯著,上海科学技术出版社，1975</p> <p>《复合材料力学概论》，陈建桥著，科学出版社，2008</p> <p>《复合材料力学》，沈观林编，清华大学出版社，2013</p>