

课程大纲 COURSE SYLLABUS

1.	课程代码/名称 Course Code/Title	先进复合材料原理与应用 Fundamental and Applications of Advanced Composite Materials
2.	课程性质 Compulsory/Elective	专业选修课 Elective
3.	课程学分/学时 Course Credit/Hours	3/48
4.	授课语言 Teaching Language	双语授课，英文课件 (Taught in both Chinese and English, with English teaching materials)
5.	授课教师 Instructor(s)	白家鸣 Bai Jiaming
6.	是否面向本科生开放 Open undergraduates or not	是 Yes
7.	先修要求 Pre-requisites	本科生：大学物理 B(下) General Physics

8.	教学目标 Course Objectives	
	<p>This module will introduce and develop the concepts and techniques for Advanced Composite Materials. The module will emphasise on:</p> <ul style="list-style-type: none"> • The definition, classification, basic properties and design principles and applications of various types of composite materials, especially for polymer matrix composites (PMCs). • The microstructural characteristics, physical properties, manufacturing processes and application areas of different kinds of reinforcements and matrix materials, participants should acknowledge the definition and interfacial effect of the interface in the composite materials, including interfacial structures, characteristics and the effects on the properties of composites. • Upon completion, participants should be able to apply the execution of concept and skills acquired in the areas of Advanced Composite Materials, design principles, microstructure-property correlations in the composites and the optimization of the preparation processes. <p>本课程将介绍先进复合材料的基础概念，工艺及应用，教学目标主要包括：</p> <ul style="list-style-type: none"> • 复合材料的定义及分类，各种复合材料的基本性能及设计原理; • 不同增强体和基体类型的复合材料的微观结构特性和物理性能，制造工艺和应用领域，了解复合材料中的界面效应，包括界面结构和特性，以及对复合材料产生的性能影响; • 课程完成后，学生能够充分了解及应用复合材料的设计原理，结构-性能关系，优化制备工艺。 	

9.	教学方法 Teaching Methods
	<p>(1) 广泛得使用多媒体工具； (2) 教学中多引入实例； (3) 多与学生进行互动，讨论</p> <p>(1) Apply Multimedia methods widely and wisely; (2) case studies from industries during teaching (3) interact intensively with students.</p>
10.	教学内容 Course Contents
Section 1	<p>先进复合材料概括 Overview of Advanced Composite Materials (ACM)</p> <ul style="list-style-type: none"> - What is ACM - Classification of ACM - Industry - applications - Current situation and prospects
Section 2	<p>先进复合材料分类 ACM classification</p> <ul style="list-style-type: none"> - Reinforcement <ul style="list-style-type: none"> • Fiberglass; • Carbon/Boron fiber; • Ceramic fiber; - Matrix <ul style="list-style-type: none"> • polymer • Metal • Ceramics • Carbon/Carbon
Section 3	<p>聚合物基复合材料 Polymer Matrix Composites</p> <ul style="list-style-type: none"> - Reinforcement <ul style="list-style-type: none"> • Fiberglass • Carbon fibers • High modulus organic fibers • Other reinforced fibers - Matrix <ul style="list-style-type: none"> • Basic properties • Resin matrix for composites • High performance resin matrix • Resin matrix for corrosion-resistant composites - Polymeric interface <ul style="list-style-type: none"> • Formation and function mechanism

	<ul style="list-style-type: none"> • Failure mechanism • Surface treatment of fibers • Interfacial properties of PMCs
Section 4	<p>聚合物基复合材料工艺 Polymer Matrix Composites Processing</p> <ul style="list-style-type: none"> - Moulding techniques <ul style="list-style-type: none"> • Hand lay-up molding • Bag moulding • Filament winding • Compression molding • Resin transfer molding - Mould and auxiliary materials - Solidification process
Section 5	<p>聚合物基复合材料性能 Properties of PMCs</p> <ul style="list-style-type: none"> - Basic mechanical properties <ul style="list-style-type: none"> • Tensile properties • Compressive properties • Bending properties of composites - Other mechanical properties <ul style="list-style-type: none"> • Impact, fatigue, creep deformation, environmental influence and rupture of composites • Basic mechanical properties of interlayer structure of composite materials - The high frequency dielectric property of composite material and radar cover <ul style="list-style-type: none"> • High frequency dielectric properties • Radar cover
Section 6	<p>聚合物基复合材料的其他性能 Other Properties of PMCs</p> <ul style="list-style-type: none"> • Thermophysical properties • Heat resistance • Chemical resistance • Abrasive resistance • Flame resistance
Section 7	<p>金属基复合材料 Metal Matrix Composites (MMCs)</p> <ul style="list-style-type: none"> - Introduction <ul style="list-style-type: none"> • Development • Classification • Characteristics - Matrix <ul style="list-style-type: none"> • Selection Principle • Category - Manufacturing Methods <ul style="list-style-type: none"> • Solid-state method • Liquid method

	<ul style="list-style-type: none"> • In-situ composite technique <ul style="list-style-type: none"> - Interface <ul style="list-style-type: none"> • Interfacial structure and reaction • Impact on the properties of MMCs • Interface optimization • Properties and application
Section 8	<p>陶瓷基复合材料 Ceramic Matrix Composites (CMCs)</p> <ul style="list-style-type: none"> - Whisker reinforced ceramics <ul style="list-style-type: none"> • Mechanism • Influence factors • Preparation techniques • Properties and application - Fiber reinforced CMCs <ul style="list-style-type: none"> • Mechanical properties and reinforcement mechanism • Preparation techniques • Interface control - Bionic structure CMCs <ul style="list-style-type: none"> • Design and preparation
Section 9	<p>碳/碳复合材料 Carbon/Carbon Composites</p> <ul style="list-style-type: none"> - Development and characteristics - Preparation technique - Properties <ul style="list-style-type: none"> • Mechanical properties • Thermophysical properties • Biocompatibility
Section 10	<p>航空航天领域的复合材料应用 Composites for Aerospace Application</p> <ul style="list-style-type: none"> • Introduction • Shielding and stealth composites • Magnetic induction composites • Photosensitive composite materials • Thermal and mechanical composites • Sound and wave absorbing composites
Section 11	<p>电学和电子领域的复合材料应用 Composites for Electric and Electronic Application</p> <ul style="list-style-type: none"> • Introduction • Electrical contact composites • Conductive composites • Piezoelectric composites • Superconductive composites
Section 12	<p>新型复合材料应用 Application of Advanced Composite Materials</p> <ul style="list-style-type: none"> • Nanocomposite materials

	<ul style="list-style-type: none"> • Intelligent composites • Smart composites • Gradient composites • Biocomposites • Special functional composites
Note:	<p>Lectures slots could be swapped around</p> <p>* Possible invited lecturer</p>
11.	课程考核 Course Assessment
	<p>出勤 10%+平时作业 50%+期末课题 40%</p> <p>Attendance 10%, coursework 50%, Final project 40%</p>
12.	教材及其它参考资料 Textbook and Supplementary Readings
	<p>教材:</p> <ul style="list-style-type: none"> - Composite Materials: Science and Engineering, Krishan Kumar Chawla, Springer, 2013 <p>参考资料:</p> <ul style="list-style-type: none"> - 复合材料, 尹洪峰, 魏剑, 2010, 冶金工业出版社 - 聚合物基复合材料设计与加工, 梁基照, 2011, 机械工业出版社 - 先进复合材料的制造工艺, Flake C. Campbell, 2016, 上海交通大学出版社