

## 研究生课程教学大纲 (Syllabus)

课程代码 Course Code	MSE8303	*学时 Teaching Hours	32	*学分 Credits	2
*课程名称 Course Name	(中文) 材料加工过程的虚拟制造技术				
	(English) Virtual manufacturing Technology in Material Processing				
*授课语言 Instruction Language	中文				
	Chinese				
*开课院系 School	材料科学与工程学院				
	School of Materials Science and Engineering				
*授课对象 Students	硕士、博士 (包括硕博连读)				
	Master's degree, doctor's degree (including successive master-doctor program )				
先修课程 Prerequisite	材料力学或弹性力学、数值计算				
	Mechanics of materials, mechanics of elasticity, numerical calculation				
授课教师 Instructors	姓名 Name	职称 Title	单位 Department	联系方式 E-mail	
	陆皓	教授	材料学院	luhao@sjtu.edu.cn	
*课程简介 (中文) Course Description	<p>本课程介绍了材料加工过程的建模和数值分析的基本方法，包括材料加工热过程、应力应变、相变组织转变和蠕变的数值模拟，以及用于建模优化的数值反演、人工智能算法。教学目的是使学生掌握数值模拟的知识和技能：</p> <ol style="list-style-type: none"> <li>1) 了解材料加工建模的方法；</li> <li>2) 获得参数优化的知识；</li> <li>3) 获得材料加工过程温度、应力、变形、损伤等数值分析的知识；</li> <li>4) 实际工程案例的学习；</li> <li>5) 获得开展数值计算的科研技能。</li> </ol>				
*课程简介 (English) Course Description	<p>This course introduces the fundamental methodologies on materials processes modelling and numerical analysis. It covers topics of programing and simulation of heat transfer, stress and strain, phase transition, and creep in materials process. The algorithms of reverse method, and artificial intelligence are also introduced to assist the optimization of the modelling. It strength the knowledge and skill of materials processes modelling and analysis.</p> <p>This course_aims to achieve the following objectives:</p> <ol style="list-style-type: none"> <li>1.To understand the methodology of materials processes modelling.</li> <li>2.To gain fundamental knowledge of parameters optimization.</li> <li>3.To gain fundamental knowledge of numerical analysis of temperature, stress, distortion, microstructure and damage in materials process.</li> <li>4. To be exposed to industrial practices of engineering projects involves above phenomena.</li> <li>5. To gain skills in research with numerical simulation.</li> </ol>				

	教学内容 Content	授课学时 Hours	教学方式 Format	授课教师 Instructor
*教学安排 Schedules	1、绪论： 1.1 虚拟工程； 1.2 模型与建模方法； 1.3 数值分析算法； 1.4 举例	2	课堂	
	2、热过程计算： 2.1 差分法； 2.2 有限元法； 2.3 热过程计算要点； 2.4 程序结构特点及实现	4	课堂/练习	
	3、热力过程计算： 3.1 应力变形； 3.2 弹性理论及热应变； 3.3 固有应变理论； 3.4 热弹塑性理论； 3.5 固态相变计算； 3.6 混合组织力学性能计算和测试方法； 3.7 方法比较	12	课堂/讨论/练习	
	4、粘弹塑性理论及应用： 4.1 蠕变理论； 4.2 温度、应力计算； 4.3 注意的问题； 4.4 局部焊后热处理评定方法	4	课堂	
	5、数值反演及 AI 技术（4 学时）： 5.1 数值反演； 5.2 模型参数优化	4	课堂/讨论	
	6 工程案例专题	4	课堂	
	7 大作业讨论	2	讨论	
*考核方式 Grading Policy	1、 计算和综述大作业； 2、 大作业讨论。			
*教材或参考资料 Textbooks & References	1、《焊接数值模拟技术及其应用》，汪建华， 上海交通大学出版社， 2003 10。			
备注 Notes				

	教学内容 Content	授课学时 Hours	教学方式 Format	授课教师 Instructor
*教学安排 (English) Schedules	1、Introduction: 1.1 Virtual engineering; 1.2 Models and modeling methods; 1.3 Numerical analysis algorithm ; 1.4 Application Example	2	Class teaching	
	2、Thermal process calculation: 2.1 Finite difference method; 2.2 Finite element method; 2.3 Thermal process calculation; 2.4 Program structure features and implementation	4	Class teaching /practice	
	3、Thermodynamic process calculation: 3.1 Stress deformation; 3.2 Theory of elasticity and thermal strain; 3.3 Inherent strain theory; 3.4 Thermal elastoplasticity theory; 3.5 Solid Phase Transformation calculation; 3.6 Hybrid methods for calculating and testing the mechanical properties of tissues; 3.7 Comparison of various calculation methods	12	Class teaching /Discussion /practice	
	4、Theory and application of viscoelastoplasticity: 4.1 Creep theory; 4.2 Temperature and stress calculation; 4.3 Problems in the application of theory ; 4.4 Evaluation method for local post - weld heat treatment	4	Class teaching	
	5、Numerical inversion and AI technology (4hours): 5.1 Numerical inversion; 5.2 Optimization of model parameters	4	Class teaching / Discussion	
	6、Project cases	4	Class teaching	
	7、Assignment discussion	2	Discussion	
*考核方式 (English) Grading Policy	1、 Calculate and review assignments. 2、 Assignment discussion.			
*教材或参考资料 (English) Textbooks & References	1、 Welding numerical simulation technology and application, Jianhua Wang, Shanghai Jiao Tong University Press, 2003-10			
备注 Notes				

