

课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	课程名称 Course Title	制造工程认知实践 Awareness Practice of Manufacturing Engineering				
2.	授课院系 Originating Department	机械与能源工程系 Department of Mechanical and Energy Engineering				
3.	课程编号 Course Code	ME103				
4.	课程学分 Credit Value	3				
5.	课程类别 Course Type	通识选修课程 General Education (GE) Elective Courses				
6.	授课学期 Semester	春季 Spring / 夏季 Summer / 秋季 Fall				
7.	授课语言 Teaching Language	英文 English				
8.	授课教师、所属学系、联系方式 (如属团队授课, 请列明其他授课教师) Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	路冬 机械与能源工程系 13732970595 lud@sustech.edu.cn				
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	曾千里/机械与能源工程系/zengql@sustech.edu.cn 黄渊建/机械与能源工程系/huangyj@sustech.edu.cn				
10.	选课人数限额(可不填) Maximum Enrolment (Optional)					
11.	授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other (Please specify)	总学时 Total
	学时数 Credit Hours	16		64		80

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	无/None
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	《机械制造基础》，《先进制造实践》，《精密加工技术》
14. 其它要求修读本课程的学系 Cross-listing Dept.	

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

通过本课程的课堂教学，使学生了解材料从毛坯到成品（零件,机械装置）所经历的制造过程；了解材料成型（铸造、锻造、焊接）、金属切削和先进制造技术的基本原理、工艺、设备、特点和用途。通过本课程实践环节的教学，使学生获得与制造技术相关的各种工具、量具和设备的感性知识，初步掌握数控车床、数控铣床、和加工中心等的实际操作技能。

Through class teaching, students can understand the manufacturing process from raw material to products (parts, mechanical devices); Learn the basic principles, processes, equipment, features and uses of material forming (casting, forging, welding), metal cutting and advanced manufacturing techniques. By practices/experiments, the students can obtain the perceptual knowledge about the process, the tools, the measure instrument and the equipment of the technologies and can master the operation skills of the equipment (such as CNC lathe, CNC milling machine, CNC machine centers so on) at the elementary level.

16. 预达学习成果 Learning Outcomes

- (1). 学生了解制造技术的原理、特点和用途；
 - (2). 学生能够初步具备根据毛坯的技术要求，选择合理的材料成形工艺（例如铸造、锻造和焊接）和根据零件的技术要求，选择合理的切削加工工艺（例如车、铣削、磨削等）的能力；
 - (3). 能够识别各种工艺方法涉及的设备种类并能够掌握数控车床、数控铣床、和加工中心等的初步实操能力；
 - (4). 能够初步掌握简单零件数控程序的手动编程和较复杂零件的 CAM 编程技术；
 - (5). 学会简单零件的工艺规程制定。
- (1). The students can understand mechanism, features and applications of the manufacturing technologies.
 - (2). The students can select correctly the process of blank forming (such as casting, forging, welding and so on) and the machining process of parts (such as CNC turning, CNC milling, CNC machine centres and so on) according to the technical requirements at the elementary level.
 - (3). The students can distinguish types of the equipment and can operate the machines such as CNC turning, CNC milling, CNC machine centres.
 - (4). The students can programme the NC program of the parts with simple form by manual work and the parts with complex form by CAM.
 - (5). The students can formulate the process program of parts with simple structure.

17. 课程内容及教学日历（如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）
Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)



理论课教学内容、学时分配及教学要求:			
课次	课程内容	教学要求 Objectives	学时(h)
1	引言, 材料及其成型方法 Introduction, materials and forming technology of materials	<ul style="list-style-type: none"> • 熟悉材料的分类; • 熟悉材料的成型方法, 包括铸造、锻造、焊接及金属加工等。 ➢ Familiar with the classification of materials; ➢ Familiar with the forming technology of materials, including casting, forging, welding and metal cutting processing. 	2
2	金属切削基本原理 Basic principle of metal cutting	<ul style="list-style-type: none"> • 熟悉切屑的形成原理及分类; • 熟悉切削过程中的切削力、切削热; • 熟悉刀具的寿命及刀具磨损的评价方法; • 掌握表面质量的概念及材料切削加工性的概念。 ➢ Familiar with the formation principle and classification of chips; ➢ Familiar with cutting force and cutting heat during cutting; ➢ Familiar with tool life and tool wear evaluation methods; ➢ Master the concept of surface quality and the concept of material machinability. 	2
3	数控加工技术 CNC machining technology	<ul style="list-style-type: none"> • 熟悉数控加工的基本原理; • 熟悉数控机床(加工中心)的分类; • 掌握加工经济性概念。 ➢ Familiar with the basic principles of CNC machining; ➢ Familiar with the classification of CNC machine tools (machining centers); ➢ Master the concept of machining economics. 	2
4	加工机床与刀具 Machining tools and cutting tools	<ul style="list-style-type: none"> • 熟悉车床的加工原理及车刀的选择方法; • 熟悉铣床的加工原理及铣刀的选择方法; • 熟悉钻床的加工原理及刀具的选择方法; • 熟悉齿轮的加工原理及刀具的选择方法。 ➢ Familiar with the machining principle of lathe and the selection method of turning tools; ➢ Familiar with the machining principle of milling machine and the selection method of millers; ➢ Familiar with the machining principle of drilling machine and the selection method of drills; ➢ Familiar with the machining principle of gears and the selection of cutting tools. 	2
5	互换性与测量技术 Interchangeability and measurement technology	<ul style="list-style-type: none"> • 熟悉互换性与标准化的概念; • 熟悉几何精度设计的概念及原则; • 熟悉表面粗糙度设计的概念及原则。 ➢ Familiar with the concept of interchangeability and standardization; ➢ Familiar with the concepts and principles of geometric precision design; ➢ Familiar with the concepts and principles of surface roughness design. 	2
6	先进制造技术 Advanced Manufacturing Technology	<ul style="list-style-type: none"> • 熟悉先进制造技术的概念; • 熟悉各种先进制造方法(包括化学加工、电化学加工、电火花加工、线切割、激光加工、电子束加工、水射流加工等)的特点及其应用范围。 ➢ Familiar with the concept of advanced manufacturing technology; ➢ Familiar with the characteristics of various advanced manufacturing methods (including chemical machining, electrochemical machining, electrical-discharge machining, wire electrical-discharge machining, laser-beam machining, electron-beam machining, water-jet machining, etc.) and their application. 	2

7	数字化制造 Digital manufacturing	<ul style="list-style-type: none"> 熟悉数字化制造的概念； 熟悉几何仿真的概念及其应用； 熟悉物理仿真的概念及其应用。 <ul style="list-style-type: none"> Familiar with the concept of digital manufacturing technology; Familiar with the concept of geometric simulation and its application; Familiar with the concept of physical simulation and its application. 	2
8	智能制造 Smart manufacturing	<ul style="list-style-type: none"> 熟悉智能制造的概念； 熟悉智能制造的关键技术； 熟悉物理仿真的概念及其应用。 <ul style="list-style-type: none"> Familiar with the concept of digital manufacturing technology; Familiar with the concept of geometric simulation and its application; Familiar with the concept of physical simulation and its application. 	2

实验教学内容、学时分配及教学要求:

课次	课程内容	教学要求 Objectives	学时 (h)
1	个人便携式数控机床 (PPCNC) 操作入门	<ul style="list-style-type: none"> 了解 PPCNC 的硬件知识, 熟练使用机床上的电源开关按钮、急停按钮和调速旋钮; 学会使用 PPCNC 的附件 (如对刀器、专用扳手、螺帽、索嘴等); 熟习 PPCNC 操控软件界面, 学会操作机床, 含机床工作台连续移动和步进移动、让机床主轴转动和停止转动、机床超行程诊断; 掌握正确装夹工件毛坯和安装刀具的方法; 掌握 PPCNC 手动试切对刀的操作步骤 (含 X 轴、Y 轴的对刀和 Z 轴的对刀); 学习如何加载程序试运行机床。 <ul style="list-style-type: none"> Understand the hardware knowledge of PPCNC, and skilfully use the power switch button, emergency stop button and speed control knob on the machine; Learn to use PPCNC accessories (such as tool holders, special wrenches, nuts, nozzles, etc.); Familiar with PPCNC control software interface, learn to operate machine tools, including machine tool table continuous movement and step movement, let machine tool spindle rotate and stop rotation, machine tool overtravel diagnosis; Master the correct method of clamping workpiece blanks and installing tools; Master the operation steps of the PPCNC manual trial cutting tool (including the X-axis, Y-axis tool setting and Z-axis tool setting); Learn how to load a program to test the machine. 	4
2	“雕刻文字”刀路的创建及加工 Creation and processing of the "engraving text" tool path	<ul style="list-style-type: none"> 熟习 Edgecam 软件的操作界面。 掌握 Edgecam 软件中几何创建 (如创建矩形、创建文字)、编辑 (如比例、移动、旋转) 等命令。 学会在 Edgecam 软件中新建工序及创建、加载刀具等基本操作。 掌握 Edgecam 雕刻加工刀路的创建方法。 学会在 Edgecam 中生成 NC 程序代码。 学会将 Edgecam 中生成的雕刻刀路 NC 程序代码载入机床进行加工。 <ul style="list-style-type: none"> Familiar with the interface of the Edgecam software; Master geometric creation in Edgecam software (such as creating rectangles, creating text), editing (such as scaling, moving, rotating), etc.; Learn to create new operations in Edgecam software 	4

		<p>and create basic operations such as loading and loading tools;</p> <ul style="list-style-type: none"> ➤ Master the creation method of Edgecam engraving tool path; ➤ Learn to generate NC program code in Edgecam; ➤ Learn to load the tool NC program code of engraving generated in Edgecam into the machine processing. 	
3	“五星红旗”刀路的创建及加工 Creation and processing of the "five-star red flag" tool path	<ul style="list-style-type: none"> • 掌握 Edgecam 软件中载入三维零件模型 iges、step、stl 等常用格式的方法; • 学会 Edgecam 中改变视图显示方向及改变机床显示、刀具显示、夹具显示、零件渲染等显示模式的方法; • 掌握合理布局零件加工范围及正确定位零件加工原点的方法; • 掌握 Edgecam 铣加工特征栏目中提取封闭轮廓线作为轮廓特征的方法; • 掌握 Edgecam 中粗加工、等粗糙度加工刀路的创建方法。 ➤ Master the methods of loading 3D part models iges, steps, stl, etc. in Edgecam software ➤ Learn how to change the display orientation of the view and change the display mode of machine display, tool display, fixture display, part rendering, etc. in Edgecam; ➤ Master the method of arranging the processing range of parts and correctly locating the origin of parts; ➤ Master the method of extracting closed contours as contour features in the Edgecam milling feature column; ➤ Master the method of creating roughing and other roughness machining tools path in Edgecam. 	4
4	“风扇”刀路的创建及加工 Creation and processing of "fan" tool path	<ul style="list-style-type: none"> • 熟悉打开和关闭 Edgecam 软件中的层。 • 学会灵活运用软件中的层操作，便于选取所需特征，生成正确的刀路。 • 掌握设置零件毛坯的方法，并合理设置风扇叶片的毛坯。 • 掌握 Edgecam 中平面铣切加工刀路的创建方法。 • 掌握 Edgecam 中清根铣刀路的创建方法。 • 掌握 Edgecam 中雕刻加工中，投影加工刀路创建的方法。 ➤ Familiar with opening and closing layers in Edgecam software; ➤ Learn to use the layer operations in the software to easily select the desired features and generate the correct toolpath; ➤ Master the method of setting the part blank and set the blank of the fan blade reasonably; ➤ Master the method of creating a plane milling tool path in Edgecam; ➤ Master the method of creating the root milling cutter in Edgecam; ➤ Master the method of creating a tool path in the engraving and projection process in Edgecam. 	4
5	“心心相印”刀路的创建及加工 The creation and processing of the "heart and soul" tool path	<ul style="list-style-type: none"> • 掌握将 iges 格式的文件作为实体导入 Edgecam 软件中的方法。 • 了解粗加工方式创建凹心及凸心加工刀路时毛坯类型选取的差异。 • 掌握 Edgecam 软件创建粗加工刀路时，不同毛坯类型所对应加工刀路的异同。 • 掌握 Edgecam 中轮廓铣刀路的创建，了解轮廓铣刀路的意义。 • 凸心轮廓铣精修刀路创建中，学会正确选取补偿方式及补偿地址，结合前面所学的 PPCNC 机床操作知识，实 	4

		<p>现凹、凸心配合的精修加工。</p> <ul style="list-style-type: none"> ➤ Master the method of importing files in the iges format into the Edgcam software as entities; ➤ Understand the difference in blank type selection when roughing and creating a concave and convex machining path; ➤ Master the similarities and differences of machining paths for different blank types when Edgcam software creates roughing tool path; ➤ Master the creation of contour milling tool path in Edgcam to understand the meaning of contour milling tool path; ➤ In the creation of the convex contour milling and finishing tool path, learn to correctly select the compensation method and compensation address, and combine the previous PPCNC machine tool operation knowledge to realize the intensive processing of concave and convex core coordination. 	
6	“飞行员头像”刀路的创建及加工 Creation and processing of the "pilot avatar" tool path	<ul style="list-style-type: none"> • 掌握 Edgcam 软件中控制加工深度及加工范围的方法。 • 了解粗加工和等粗糙度加工（精加工）的异同。 • 掌握 Edgcam 三轴模式加工空间立体的方法。 • 掌握 Edgcam 中残料精加工刀路的创建方法。 ➤ Master the method of controlling machining depth and machining range in Edgcam software; ➤ Understand the similarities and differences between roughing and equal roughness machining (finishing); ➤ Master the method of processing space stereo in Edgcam triaxial mode; ➤ Master the method of creating the residual machining path in Edgcam. 	4
7	制造工程参观实习 Visiting internship of manufacturing engineering	<ul style="list-style-type: none"> • 调研所参观展会/企业的基本情况; • 了解常用零件的制造和加工方法; • 了解国内外主要的先进制造技术; ➤ Understand the basic situation of the exhibition/enterprise; ➤ Understand how to manufacture and process common parts; ➤ Understand major advanced manufacturing technologies at home and abroad. 	4
8-9	钳工实践 Practice for fitter	<ul style="list-style-type: none"> • 了解钳工在零件加工、产品装配和设备维修中的作用。 • 掌握钳工基本工艺（如划线、锯削、挫削、钻孔、攻螺纹等）的操作方法。 • 了解钳工常用工具、设备及量具的使用方法。 • 了解直线度、平面度、平行度、垂直度等形位公差的含义及其误差的测量方法。 ➤ Understand the role of fitters in part processing, product assembly and equipment repair; ➤ Master the basic methods of the fitter (such as scribing, sawing, frustration, drilling, tapping, etc.); ➤ Learn how to use common tools, equipment and gauges for fitters; ➤ Understand the meaning of the geometric tolerances such as straightness, flatness, parallelism, and perpendicularity, and how to measure the error. 	8
10-12	数控车削实践 Practice for CNC turning	<ul style="list-style-type: none"> • 了解数控车床的工作原理、特点及应用范围; • 熟悉数控车床的控制面板及相关按键功能; • 掌握工件的正确安装和测量的方法; • 熟练掌握试切对刀的方法; • 熟悉数车编程的基本指令和复合循环指令; • 掌握数车手工编程方法。 ➤ Understand the working principle, characteristics and application range of CNC lathes; 	10

		<ul style="list-style-type: none"> ➤ Familiar with the control panel of the CNC lathe and related button functions; ➤ Master the correct installation and measurement of the workpiece; ➤ Proficiency in the method of trial cutting; ➤ Familiar with basic instructions for CNC lathe programming and composite cycle commands; ➤ Master the manual programming method of CNC lathe. 	
12-14	数控铣削实践 Practice for CNC turning	<ul style="list-style-type: none"> • 了解数控铣床的工作原理、特点及应用范围。 • 熟悉数控铣床的控制面板及相关按键功能。 • 掌握铣刀及工件定位装夹、找正的方法。 • 熟悉数铣编程的基本指令，掌握数铣编程方法。 • 学会使用 Edgcam 软件编制复杂零件的数铣加工程序。 • 学会使用量具对零件进行加工质量评估、分析的方法。 ➤ Understand the working principle, characteristics and application range of CNC milling machine; ➤ Familiar with the control panel of CNC milling machine and related button functions; ➤ Master the method of miller and workpiece positioning and clamping; ➤ Familiar with the basic instructions of CNC milling programming, master the programming method of CNC milling; ➤ Learn to use the Edgcam software to program a tool path for complex parts; ➤ Learn how to use the gage to evaluate and analyze the quality of the part. 	10
15	电火花线切割加工实践 Practice for WEDM	<ul style="list-style-type: none"> • 了解电火花线切割加工的工作原理与应用范围。 • 掌握电火花线切割机程序编制的基本工艺和方法，掌握简单零件的程序编制方法。 • 掌握凸模类零件的加工方法，能够正确设置电火花线切割机床的相关参数。 ➤ Understand the working principle and application range of WEDM; ➤ Master the basic processes and methods of WEDM programming and master the method of programming of simple parts; ➤ Master the processing method of the punch type parts, and correctly set the relevant parameters of the WEDM machine. 	4
16	自选作品加工 Practice for optional work	<ul style="list-style-type: none"> • 学习常见机械制图软件，熟悉常见机械零件的工艺结构，了解其在制图软件中的表达方式。 • 提高动手能力和创造能力，训练创新思维。 • 提高使用 Edgcam 软件编制数控加工程序的能力。 • 增加动手操作机会，提高数控机床操作技能水平。 ➤ Learn common mechanical drawing software, familiar with the process structure of common mechanical parts, and understand how to express in the drawing software; ➤ Improve hands-on and creative skills and train innovative thinking ability; ➤ Improve the ability to program CNC machining programs using Edgcam software; ➤ Increase hands-on opportunities and improve the skill level for operation CNC machine tools. 	4

18. 教材及其它参考资料 Textbook and Supplementary Readings

- [1] 林友希等 主编, 认识制造, 清华大学出版社, 2013 年 2 月第一版.
 [2] Serope Kalpakjian, Steven R.Schmid, MANUFACTURING ENGINEERING AND TECHNOLOGY (7th edition), Pearson Publications, October 2013.
 [3] 夏巨谟, 张启勋主编, 材料成形工艺, 机械工业出版社 2015 年 1 月第二版.
 [4] 冯之敬主编, 机械制造工程原理, 清华大学出版社, 2015 年 5 月第三版.
 [5] 周世全等主编, 机械制造工艺基础, 华中科技大学出版社, 2010 年 10 月第三版.

课程评估 ASSESSMENT

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		10		
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects		70		
平时作业 Assignments				
期中考试 Mid-Term Test				
期末考试 Final Exam	2h	20		开卷考试 (open book examination)
期末报告 Final Presentation				
其它 (可根据需要 改写以上评估方 式) Others (The above may be modified as necessary)				

20. 记分方式 GRADING SYSTEM

- A. 十三级等级制 Letter Grading
 B. 二级记分制 (通过/不通过) Pass/Fail Grading

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
 This Course has been approved by the following person or committee of authority