

## 机器人引论 (ME232 ) 课程大纲

- 1、2020 春季学期——2022 春季学期 (2)
- 2、2023 秋季学期起 (7)

# 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 <b>Course Title</b>	机器人引论 <b>Prolegomenon to Robotics</b>
2.	授课院系 <b>Originating Department</b>	机械与能源工程系 Department of Mechanical and Energy Engineering
3.	课程编号 <b>Course Code</b>	ME232
4.	课程学分 <b>Credit Value</b>	3
5.	课程类别 <b>Course Type</b>	通识选修课程 General Education (GE) Elective Courses
6.	授课学期 <b>Semester</b>	春季 Spring (2020-2022 春季学期)
7.	授课语言 <b>Teaching Language</b>	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) <b>Instructor(s), Affiliation &amp; Contact</b> (For team teaching, please list all instructors)	王峥 教授 机械与能源工程系 wangz@sustech.edu.cn Prof Wang Zheng, Dept. Mechanical and Energy Engineering, wangz@sustech.edu.cn

9.	实验员/助教、所属学系、联系方式 <b>Tutor/TA(s), Contact</b>	待公布 To be announced				
10.	选课人数限额(可不填) <b>Maximum Enrolment (Optional)</b>					
11.	授课方式 <b>Delivery Method</b>	讲授 <b>Lectures</b>	习题/辅导/讨论 <b>Tutorials</b>	实验/实习 <b>Lab/Practical</b>	其它(请具体注明) <b>Other (Please specify)</b>	总学时 <b>Total</b>
	学时数 <b>Credit Hours</b>	32	16			48
12.	先修课程、其它学习要求 <b>Pre-requisites or Other Academic Requirements</b>	无 None				
13.	后续课程、其它学习规划 <b>Courses for which this course is a pre-requisite</b>					
14.	其它要求修读本课程的学系 <b>Cross-listing Dept.</b>					

### 教学大纲及教学日历 SYLLABUS

#### 15. 教学目标 Course Objectives

本课程通过探讨机器人领域的一系列基础本源的核心话题，藉由技术与人文相结合的视角，来探讨机器人和人工智能的涵义，与人和生物的区别与联系，以及对社会，经济，文化等多方面的影响。通过提供具体的环境和场景，使学生设身处地的思考机器人技术的发展和可能带来的一系列衍生问题。本课程由三个部分相结合构成，第一部分着重于机器人的历史与本源特征，第二部分着重于机器人的前沿与技术核心，第三部分着重于机器人的伦理与影响。

This course discusses a series of core subjects in the field of robotics on a fundamental and original level, from the definition of robots and artificial intelligence, to their similarities and distinctions with humans and animals, and to the social, economic, and cultural impacts. Students are posed with a concrete scenario, within which the potential impacts and concerns of the development and application of robotics technology will be discussed. The course comprises of three segments: 1) history and original characteristics of robotics, 2) frontiers and core technologies of robotics, 3) ethics and impacts or robots.

#### 16. 预达学习成果 Learning Outcomes

1. 阅读和了解经典文学作品中对于机器人的描述，并认识其进步性与局限性
  2. 理解和掌握机器人与人工智能的涵义，分类，特点，并能够有针对性的进行讨论
  3. 深入理解机器人发展带来的影响，并能够形成独立的观点
  4. 针对机器人发展和应用相关的具体问题，能够使用课程所学进行活学活用，完成调查研究并进行汇报
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1. Read and understand the description of robots in classic literature, know the advantages and limitations.
  2. Understand and obtain knowledge of the concept, classification, characteristics of robots and artificial intelligence, and form specific arguments.
  3. Understand thoroughly the impacts of robots, and form independent opinions.
  4. Apply learned knowledge from the course regarding specific topics on robotic development and application, conduct research and perform report.

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.)**

Topic	Hours	Contents
1. Introduction to Robotics	6	<ul style="list-style-type: none"> <li>➤ Introduction to Robots</li> <li>➤ Definition of robots</li> </ul> <p>The introduction to robotics, technology, and general perceptions. Providing an evolving boundary of the definition of robots against general machines or intelligence.</p>
2. Portrayal of Robots	8	<ul style="list-style-type: none"> <li>➤ Robot portraits</li> <li>➤ Similarity and distinctions between robots and human/animals</li> <li>➤ Frontiers of robotics</li> </ul> <p>The detailed survey of insights on what comprises of robots, in-depth discussion of the differences between robots, machines in general, and live animals. Also a broad overview of state-of-the-art advances in the robotics research field.</p>
3. History of Robots	8	<ul style="list-style-type: none"> <li>➤ Robots in literature</li> </ul>

		<ul style="list-style-type: none"> <li>➤ Robots in films</li> <li>➤ Robots chronicle</li> </ul> <p>From the very beginning of the robotics concept in pre-WWI era, to the most recent IoT generation, discuss on the role of robots in the history from a general public point of view.</p>
4. Intelligence	10	<ul style="list-style-type: none"> <li>➤ Artificial intelligence introduction</li> <li>➤ Strong vs weak AI</li> <li>➤ Technology and applications</li> </ul> <p>The core and extension of intelligence, comparison of strong and weak AI, and case studies showcasing the highlights of machine intelligence's limitations and strength.</p>
5. Impacts of robots	12	<ul style="list-style-type: none"> <li>➤ Social impacts</li> <li>➤ Ethical impacts</li> <li>➤ Economic impacts</li> </ul> <p>The general impacts and specific highlights, covering social impacts with western view and oriental views compared, ethical impacts from educational, relational, to the evolution of robots from a tool to an intelligent device, and to economic impacts where robotic technology contributes to employment, technical growth, and the general aspects.</p>
6. Group presentations	4	<ul style="list-style-type: none"> <li>➤ Group presentations</li> </ul> <p>Final group presentation of the group project.</p>

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

Isaac Asimov "I. Robot" 5 <sup>th</sup> Edition.
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**课程评估 ASSESSMENT**

19. 评估形式 Type Assessment	评估时间 of Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance				
课堂表现				

<b>Class Performance</b>				
小测验 <b>Quiz</b>				
课程项目 <b>Projects</b>	40			
平时作业 <b>Assignments</b>	20			
期中考试 <b>Mid-Term Test</b>				
期末考试 <b>Final Exam</b>				
期末报告 <b>Final Presentation</b>	40			
其它 (可根据需要 改写以上评估方式) <b>Others (The above may be modified as necessary)</b>				

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**

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# 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 <b>Course Title</b>	机器人引论 <b>Prolegomenon to Robotics</b>
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4.	课程学分 <b>Credit Value</b>	3
5.	课程类别 <b>Course Type</b>	通识选修课程 <b>General Education (GE) Elective Courses</b>
6.	授课学期 <b>Semester</b>	秋季 <b>Fall</b> (2023 秋季学期起)
7.	授课语言 <b>Teaching Language</b>	中英双语 <b>English &amp; Chinese</b>
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) <b>Instructor(s), Affiliation &amp; Contact</b> (For team teaching, please list all instructors)	冯慧娟 机械与能源工程系 fenghj@sustech.edu.cn Huijuan Feng Department of Mechanical and Energy Engineering fenghj@sustech.edu.cn

9.	实验员/助教、所属学系、联系方式 <b>Tutor/TA(s), Contact</b>	待公布 To be announced				
10.	选课人数限额(可不填) <b>Maximum Enrolment (Optional)</b>					
11.	授课方式 <b>Delivery Method</b>	讲授 <b>Lectures</b>	习题/辅导/讨论 <b>Tutorials</b>	实验/实习 <b>Lab/Practical</b>	其它(请具体注明) <b>Other (Please specify)</b>	总学时 <b>Total</b>
	学时数 <b>Credit Hours</b>	36	12			48
12.	先修课程、其它学习要求 <b>Pre-requisites or Other Academic Requirements</b>	无 N/A				
13.	后续课程、其它学习规划 <b>Courses for which this course is a pre-requisite</b>	无 N/A				
14.	其它要求修读本课程的学系 <b>Cross-listing Dept.</b>	无 N/A				

### 教学大纲及教学日历 SYLLABUS

#### 15. 教学目标 Course Objectives

本课程通过探讨机器人的基本概念、主要技术及其应用，结合多种典型机器人的发展简史，使学生掌握机器人的基础知识，了解当前机器人技术的最新成果和机器人领域的未来发展方向。本课程主要讲授的内容包括两个部分，第一部分着重于介绍机器人的基础知识，包括机器人系统的组成、分类与发展、机器人运动学、机器人动力学、机器人控制与机器人智能控制等；第二部分着重于介绍典型机器人及其前沿技术核心。

This course discusses a series of basic concepts, main techniques and their applications in the field of robotics, combining with the historical development of several typical robots. Students are expected to master the fundamental knowledge of robotics, understand the latest achievements of robot technology, and grasp the vision of future development direction in the field of robotics. The course comprises of two segments: 1) fundamentals of robotics, including the composition, classification and development of robotic systems, robot kinematics, robot dynamics, robot control and robot intelligent control; 2) typical robots and their frontiers and core technologies.

#### 16. 预达学习成果 Learning Outcomes



<p>1. 了解机器人技术发展简史以及典型机器人作业系统的组成、功能、技术特点和发展前沿</p> <p>2. 掌握机器人学基本概念，了解机器人运动学及动力学的基础知识，以及机器人轨迹规划、运动控制和柔顺控制的基本方法</p> <p>3. 理解和掌握机器人与人工智能的涵义、分类与特点，并能够有针对性的进行讨论</p> <p>4. 针对机器人发展和应用相关的具体问题，能够使用课程所学进行活学活用，完成调查研究并进行汇报</p>
<p>1. Understand the development history of robot technology, and composition, functions, characteristics, and development frontier of typical robotic systems</p> <p>2. Master the basic concepts of robotics, understand fundamentals of robot kinematics, dynamics, and methods of robot trajectory planning, motion control and compliance control.</p> <p>3. Understand and obtain knowledge of the concept, classification, characteristics of robots and artificial intelligence, and form specific argument</p> <p>4. Apply learned knowledge from the course regarding specific topics on robotic development and application, conduct research and perform report.</p>

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.)**

主题	学时	内容
1. 机器人概述	6	a) 机器人起源及伦理问题; b) 机器人的定义及分类; c) 机器人发展的重要阶段; d) 机器人及其作业系统; e) 机器人学涉及的理论及方法。
2. 机器人的发展历史	6	a) 古代机器人; b) 文学及电影中的机器人; c) 机器人发展大事纪。 从第一次世界大战前机器人概念的开始，到最近的物联网，从公众角度讨论机器人在历史中的作用。
3. 机器人的构造	8	a) 机器人的“大脑”--控制系统; b) 机器人的“眼睛”--传感系统; c) 机器人的“心血管”--驱动系统; d) 机器人的“手脚”--执行系统。
4. 机器人学基础	8	a) 机器人运动学; b) 机器人动力学; c) 机器人控制; d) 机器人智能控制。
5. 典型机器人	16	a) 工业机器人; b) 军事机器人; c) 农业机器人; d) 服务机器人; e) 医疗机器人; f) 仿生机器人; g) 空中机器人; h) 空间机器人。
6. 小组报告	4	小组项目报告展示

Topic	Hours	Contents
1. Introduction to Robotics	6	a) The origin and ethical issues of robots; b) Definition and classification of robots; c) Important stages in the development of robots; d) Robots and their operating systems; e) Theories and methods involved in robotics.
2. History of Robots	6	a) Ancient robots; b) Robots in literature and films; c) Robots chronicle.  From the very beginning of the robotics concept in pre-WWI era, to the most recent IoT generation, discuss on the role of robots in the history from a general public point of view.
3. Components of Robots	8	a) The "brain" of robots - control systems; b) The "eyes" of robots - sensing systems; c) The "cardiovascular" of robots - driving systems; d) The "hands and feet" of robots - execution systems.
4. Fundamentals of Robotics	8	a) Robot kinematics; b) Robot dynamics; c) Robot control; d) Intelligent control of robots.
5. Typical Robots	16	a) Industrial robots; b) Military robots; c) Agricultural robot; d) Service robots; e) Medical robots; f) Biomimetic robots; g) Aerial robots; h) Space robots.
6. Group Presentation	4	Final group presentation of the group project

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

- [1] 张涛. 《机器人引论》 第2版. 机械工业出版社, 2016.
- [2] 徐文福. 《机器人学: 基础理论与应用实践》. 哈尔滨工业大学出版社, 2020.
- [3] 熊有伦. 机器人学: 建模、控制与视觉. 华中科技大学出版社. 2018.
- [4] Isaac Asimov, *I. Robot*, 5<sup>th</sup> Edition, Harper Collins Publishers, 2018.
- [5] John J. Craig, *Introduction to Robotics: Mechanics and Control*, 3<sup>rd</sup> Edition, Pearson Prentice Hall, 2005.

**课程评估 ASSESSMENT**

19. 评估形式 Type Assessment	评估时间 of Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

课堂表现 <b>Class Performance</b>				
小测验 <b>Quiz</b>				
课程项目 <b>Projects</b>		40		
平时作业 <b>Assignments</b>		20		
期中考试 <b>Mid-Term Test</b>				
期末考试 <b>Final Exam</b>				
期末报告 <b>Final Presentation</b>		40		
其它（可根据需要 改写以上评估方式） <b>Others (The above may be modified as necessary)</b>				

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

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