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# Advanced Robotics Design and Integration Syllabus

## 1. Basic Course Information

Course Name:	Advanced Robotics Design and Integration、高阶机器人设计与集成		
Course Level:	Undergraduate	Credit/Contact Hour:	64
Major	CS	Teaching Language:	English
Prerequisite:	CS183 Introduction to Robotics OR CS172 Computer Vision I OR CS284 Simultaneous Localization and Mapping OR CS283 Robotics OR EE160 Introduction to Control OR EE114 Introduction to Embedded Systems OR EE123 Microelectronic Systems		
School/Institute:	SIST	Course Code:	SI160

## 2. Course Introduction

Robotics and Automation are very interdisciplinary and engineering heavy disciplines that can typically only be undertaken in a team. Successful projects need several months and require a group of motivated students to handle the heavy hands-on workload. Therefore, the ShanghaiTech Automation and Robotics Center (STAR Center) offers the Advanced Robotics Design and Integration course. This is a fully packed course for the Fall semester of your senior year, in which you develop an impressive automation or robotics solution. The course is demanding on your initiative and time commitment, but in return offers unique opportunities. We expect that students selecting this course have already formed one or two teams of 4 to 10 students before the course starts – or latest within the first few days. Under the guidance of the instructors and the TAs, the team will, during the course of the semester, conceptualize, design and develop an automation or robotics system. The course is open to CS and EE students that have previously or in this semester taken at least one of the prerequisite courses.

The project topic is selected by the students and typically is not a research topic of the instructors, though instructors will make suggestions early on! The project team is expected to self-organize their

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work – the instructors will give some lectures, provide advice and resources and give feedback and grade the performance.

Taking this course, you will:

- Develop an automation or robotics system, with an emphasis on software;
- Be provided with the necessary resources, including hardware, tools and (access to) a lab for your project;
- Potentially collaborate with or get sponsored by an industry partner (encouraged, but depends on the project idea).
- Gain experience in team work and project planning

The following concepts regarding the project are outlined here, but of course not enforced:

- It is suggested, that your Bachelor thesis is developed from one aspect of this project. That does NOT mean that the course instructors have to be your bachelor advisor – the advisor could be professors working on related areas. The big advantage is that you can do a complex and scientifically interesting project by utilizing a system for which the major engineering tasks have already been solved in the Advanced Robotics Design and Integration course. In turn, there will of course be continued efforts flowing into the development of the system, which also increases the chances for success and impact of the project.
- When selecting this course, it is expected that you take at most 2 other major courses this semester, because this course is time intensive and should lead you towards your bachelor thesis.

It is strongly encouraged to visit the course website at <https://star-center.shanghaitech.edu.cn/project> and learn about this course before selecting it.

This course is offered twice in the semester, running in parallel, being taught by Prof. Laurent Kneip and Prof. Sören Schwertfeger. Certain parts of both courses are taught jointly (e.g. some of the short courses), while each course will advise one or two projects. The add/drop period is to be used by the students to sort themselves to the projects. The grading in both courses will follow the same standards.

### **3. Learning Goal**

- Cognitive competence:
  - Hands-on robotics development
  - Hardware skills including mechanical & electrical design, 3D printing, etc.
  - Software skills including algorithms and AI for robotics
  - System integration skills and robot experimentation
- Comprehensive qualities:
  - Project Management
  - Teamwork, conflict management & leadership
  - Automation and Robotics knowledge & skills

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#### 4. Instructional Pedagogy

- Base camp for brainstorming about project idea
- Short courses that teach fundamental skills
- Weekly project meetings with rotating roles
- Writing of project reports, giving of project presentations

#### 5. Course Structure

##### Course Structure by Chapter

Part	Description	Contact Hours	Week
Team finding	Ideally: Teams 4-10 students form BEFORE the first week AND discuss possible project ideas with the Professors	/	0
Base Camp	Introduction by the Professors; Brainstorming of the project ideas Ideally: Whole day event (e.g. on weekend)	10	1
Short Courses	Project Management; Startups, Finance & VC; Hardware Design; Project specific lectures	12	2 – 4 but also later if needed
Project Pitch	Development of business plan; writing of project proposal; group presentation	(included below)	3
Iteration I	Project work; weekly meetings with Professors and TAs	24	5-10
Midterm Report	Group progress presentation; Midterm report with progress evaluation; Website running	(included below)	10
Iteration II	Project work; weekly meetings with Professors and TAs	24	11-16
Final Report	Group final presentation; Final report; Website with video	2	17
Roadshow	Presentation of the project to the public	2	18

#### 6. Grading Policy

Half of the grading is measured from the group performance; the other half is an individual component:

- Project proposal with literature review & business plan      group      5%
- Project pitch presentation      group      5%
- Midterm individual report      individual      10%
- Midterm report & website      group      5%
- Final individual report      individual      10%
- Final report & website & video      group      10%

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• Participation (in weekly group meetings & work)	individual	20%
• Meeting moderation + leadership (preparation and execution)	individual	10%
• Prototype performance	group	20%
• Project rollout & demo	group	5%

## 7. Textbooks

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## 8. Academic Integrity

This course highly values academic integrity. Behaviors such as plagiarism and cheating are strictly prohibited.

- Individual parts (especially the reports) have to be written by yourself.
- It is not allowed to copy & paste text from the internet.
- Paraphrasing existing texts is also not allowed – you have to write your own words.
- Citations have to be clearly marked.
- Create images yourself or cite the source!
- It is OK to show your text to other team members, e.g. for proof reading. But they cannot copy your text.
- Sharing of specific graphics or photos is allowed in rare cases – the author of these graphics has to be clearly named!

## 9. Other Information