# NCHU Course Outline

中文

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| Course Name | (中) 奈米科技(0504) | | | | | | |
| | (Eng.) Introduction of Nanotech | | | | | | |
| Offering Dept | General Education Center | | | | | | |
| Course Type | Required | Credits | 2 | Teacher | 吳孟真 | | |
| Department | General | Language | English | 英文/EMI | Y | Semester | 2024-SPRING |
| Course Description | This Nanotechnology to Robotics course seeks to introduce fundamental introductory concepts in nanotechnology and robotics for the college undergraduate. The instructor has prepared course lecture slides, and the course requires access to a computer to utilize math software (Matlab) for learning, solving problem sets and exam problems. We also have hands-on Arduino kit project to work through in the course. Through the group project, exam and course lecture, the goal is to expand our view of robotics and find synergies with fundamental science and engineering. These basics are to be applied to technologies such as solar and fuel cells, batteries and self-driving vehicles. | | | | | | |
| Prerequisites | | | | | | self-directed learning in the course | N |

| Relevance of Course Objectives and Core Learning Outcomes(%) | | | Teaching and Assessment Methods for Course Objectives | |
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| Course Objectives | Competency Indicators | Ratio(%) | Teaching Methods | Assessment Methods |
| For the science and non-science major alike, this course introduces fundamental concepts in robotics, nanotechnology and quantum mechanics. We cover vectors, matrices, pendulums, solving differential equations and applying these ideas to understand solar/fuel cells, batteries, and self-driving vehicles. | | | topic Discussion / Production Exercises Discussion Practicum Lecturing | Attendance Oral Presentation Assignment Quiz |

Course Content and Homework/Schedule/Tests Schedule

| Week | Course Content |
|---|---|
| Week 1 | Fundamental Concepts 機楚概念 – “There’s plenty of room at the bottom” (Feynman) and “I, Robot” (Asimov, laws of robotics) |
| Week 2 | Introduction to Robotics 什麼是機器人學 – what are “assistants” and “agents”, what are the vision and auditory mechanisms for robots // Problem Set 1 Due |
| Week 3 | Introduction to Nanotechnology 什麼是納米科技– Microscopy, STM, AFM, Image analysis and filters |
| Week | Optics and Introduction to Quantum Mechanics 光與量子力學 – Waves and particles duality and |

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|---|---|
| 4 | mechanics // Problem Set 2 Due |
| Week 5 | Atoms and Molecules 原分子 – hydrogen atom introduction, Lotus effect, hydrophobic-hydrophilic surfaces, simple pendulum differential equation |
| Week 6 | Atoms and Molecules原分子– Fourier transform infrared spectroscopy, what are good materials for robotics: metals, plastics, polymers, solving the wave equation // Problem Set 3 Due |
| Week 7 | Atoms and Molecules/ Introducing the Stern-Gerlach Experiment and Spin 原分子與電子自旋(斯特恩-革拉赫實驗) – Does spin of the electron matter for robots? Set up and how to solve the double pendulum. |
| Week 8 | Exam |
| Week 9 | Exam work through, Atoms and Molecules – X-rays and photoelectrons X光與光電效應, We also talk about the rubrics for the group presentation and project // Problem Set 4 Due |
| Week 10 | Applied Concepts 應用 : What are Spherical Harmonics, Solar Cells, Thermoelectrics, Self-driving Trains, Cars, Drones 太陽能, 熱電,自動車 |
| Week 11 | Applied Concepts應用: Battery Systems, Fuel Cells 電池 // Problem Set 5 Due |
| Week 12 | Inverted Pendulum and other Concepts. We also begin to build the Arduino Project in class |
| Week 13 | Medical Physics 醫學物理的自動化, and continue Arduino Project build and testing // Problem Set 6 Due |
| Week 14 | Medical Physics 醫學物理的自動化, build, testing and disassembly of Arduino Project // Problem Set 6 Due |
| Week 15 | Student Presentation Preparation - The Presentation should document the Arduino Project build and propose ideas towards new ”assistants”/”agents”. |
| Week 16 | Student Presentation |
| Week 17 | How does Robotics Help Us in these Fundamental Science Areas – what “assistants” and “agents” do we need to build to improve on AI, robotics and new unexplored areas.<br>Flexible Week |
| Week 18 | Flexible Week |

Evaluation

The course grading is based on working through 6 biweekly problem sets (30%), an exam tentatively in week 8 (30%), completing a group project/presentation (30%), and participating in lecture (10%). The problem sets and exam are graded on a scale of maximum 100 points, while the group work is graded based on rubrics categories (Developing, Emerging, Meets Expectations, Exceeds Expectations).

Textbook & other References

1. Modern physics textbooks Arthur Beiser, Kok Wai Cheah. Concepts of Modern Physics. Intl. editions 2019, McGraw-Hill;
2. Introduction to Robotics: Mechanics and Control, John J. Craig, Addison-Wesley Publishing Company, 3rd Edition, 2003
3. Charles P Poole Jr. and Frank J. Owens. “Introduction to Nanotechnology, Wiley 2003.
4. Isaac Asimov. “I, Robot” 2008.

| Teaching Aids & Teacher's Website |
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| phillip-wu.com/science<br>Required software: Matlab for problem solving and graphing. |
| Office Hours |
| Wednesday 11 am Chemistry Building 422 or by appointment. |
| Sustainable Development Goals, SDGs |
| 01.No Poverty 02.Zero Hunger 03.Good Health and Well-Being 04.Quality Education 05.Gender Equality 06.Clean Water and Sanitation 07.Affordable and Clean Energy 08.Decent Work and Economic Growth 09.Industry, Innovation and Infrastructure 10.Reduced Inequalities 11.Sustainable Cities and Communities 12.Responsible Consumption 13.Climate Action 14.Life Below Water 15.Life On Land 16.Peace and Justice 17.Partnerships for the Goals<br>include experience courses：Y |

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