# INTRODUCTION TO ROBOTICS LAB

**Otras actividades/Other activities null SEP-2025 IRL-N-3CSAI.OACT.M.A1**

Area Computer Science

Number of sessions: 15

Academic year: 25-26

Degree course: FIRST

Number of credits: 3.0

Semester: 2º

Category:

Language: English

Professor: **SUZAN T S AWINAT**

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Adjunct Professor | Women in Robotics & STEM

PhD candidate in computer engineering.

Research areas: Pattern recognition, ArabicNLP, genetic programming, evolutionary algorithms, Semantics and Robotics.

## Office Hours

Office hours will be on request. Please contact at:

My Office: T-05.17 , IE Tower.

You can always find me at my office or at the sci-tech labs from 9:00am - 18:00pm unless I have classes.

Or contact me on Teams: suzant@faculty.ie.edu

## SUBJECT DESCRIPTION

The main purpose of this lab hours is to improve students' robotics skills through designing and constructing real robotic projects and increase their interest in learning by providing them with hands-on experience to bring real-world situations of real-life problems.

The Robotics lab is composed of 15 hours practical experiments and laboratory activities. Project Based Learning approach "learn by doing" paradigm will be used for this course, It is an effective teaching technique into robotics course by using real robot projects.

It covers fundamental concepts, practical applications, and hands-on projects to equip students with the skills needed to design, program, and interact with robots.

**Key Topics:**

- History and Evolution of Robotics: Explore the development of robotics from early automation to modern intelligent systems.
- Robotics and AI Integration: Understand how artificial intelligence enhances robotic capabilities.
- Kinematics and Motion: Learn the principles of robot movement and control.
- Sensors and Actuators: Study the components that enable robots to perceive and interact with their environment.
- Programming for Robotics: Gain proficiency in Python and other programming languages used in robotics.
- Humanoid Interaction: Develop interactive behaviors using the Pepper robot.
- Autonomous Systems: Build and program a Raspberry Pi car to navigate autonomously.
- Ethical Considerations: Discuss the ethical implications of robotics and AI in society.

**Hands-On Projects:**

- Pepper Robot Interaction: Program the Pepper robot to perform interactive tasks and respond to human commands.
- Raspberry Pi Car: Assemble and program a Raspberry Pi car to navigate and avoid obstacles autonomously.

## LEARNING OBJECTIVES

- Colaborar eficazmente con herramientas de IA y compañeros humanos para resolver problemas y generar soluciones innovadoras. Por qué: Fomenta el trabajo en equipo y aprovecha la IA para mejorar la productividad grupal.

By the end of this course, students will:

Understand the fundamental principles of robotics and AI.
Be able to design and program robotic systems.
Gain practical experience with humanoid robots and autonomous vehicles.
Develop critical thinking skills regarding the ethical implications of robotics.

This course combines theoretical knowledge with practical experience, preparing students for advanced robotics courses like: Robotics & Automation on their 4th year.

## TEACHING METHODOLOGY

IE University teaching method is defined by its collaborative, active, and applied nature. Students actively participate in the whole process to build their knowledge and sharpen their skills. Professor's main role is to lead and guide students to achieve the learning objectives of the course. This is done by engaging in a diverse range of teaching techniques and different types of learning activities such as the following:

| **Learning Activity** | **Weighting** | **Estimated time a student should dedicate to prepare for and participate in** |
|---|---|---|
| Lectures | 20.0 % | 15.0 hours |

| | | |
|---|---|---|
| Discussions | 8.0 % | 6.0 hours |
| Exercises in class, Asynchronous sessions, Field Work | 20.0 % | 15.0 hours |
| Group work | 40.0 % | 30.0 hours |
| Individual studying | 12.0 % | 9.0 hours |
| TOTAL | 100.0 % | 75.0 hours |

**AI POLICY**

# Critical GenAI use is encouraged

In this course, the use of generative artificial intelligence (GenAI) is encouraged, with the goal of developing an informed critical perspective on potential uses and generated outputs.

However, be aware of the limits of GenAI in its current state of development:

If you provide minimum effort prompts, you will get low quality results. You will need to refine your prompts to get good outcomes. This will take work.
Don't take ChatGPT's or any GenAI's output at face value. Assume it is wrong unless you either know the answer or can cross-check it with another source. You are responsible for any errors or omissions. You will be able to validate the outputs of GenAI for topics you understand.
AI is a tool, but one that you need to acknowledge using. Failure to do so is in violation of academic honesty policies. Acknowledging the use of AI will not impact your grade.

## PROGRAM

**Module 1/4: Foundations of Robotics**

- Introduction to Robotics
- Basics of Robotics and AI
- Robot Kinematics

**Module 2/4: Robotics Components**

- Sensors and Actuators
- Control Systems in Robotics

**Module 3/4: Humanoid Robots Interaction**

- Introduction to Pepper Robot
- Natural Language Processing (NLP) for Robots

**Module 4/4: Raspberry Pi Car Project**

- Building a Raspberry Pi Car - Part 1
- Building a Raspberry Pi Car - Part 2
- Advanced Programming for Raspberry Pi Car
- Autonomous Navigation
- Testing and Debugging
- Competition Preparation

## SESSION 1 (LIVE IN-PERSON)

Module 1/4: Foundations of Robotics

**Introduction to Robotics**

- History and evolution of robotics
- Types of robots and their applications
- Course overview and project introduction

## SESSION 2 (LIVE IN-PERSON)

Module 1/4: Foundations of Robotics

**Basics of Robotics and AI**

- Fundamental concepts in robotics
- Basics of AI and machine learning in robotics

## SESSION 3 (LIVE IN-PERSON)

Module 1/4: Foundations of Robotics

**Robot Kinematics**

- Forward and inverse kinematics
- Degrees of freedom and robot motion

## SESSION 4 (LIVE IN-PERSON)

Module 2/4: Robotics Components

**Sensors and Actuators**

- Types of sensors and their roles
- Actuators in robotics

## SESSION 5 (LIVE IN-PERSON)

Module 2/4: Robotics Components

**Control Systems in Robotics**

- Introduction to control systems
- Robot Drive Systems: Drives, Motors, and Gearboxs.

## SESSION 6 (LIVE IN-PERSON)

Module 3/4: Humanoid Robots Interaction

**Introduction to Pepper Robot**

- Overview of Pepper robot’s hardware and software
- Basic programming using Choregraphe

## SESSION 7 (LIVE IN-PERSON)

Module 3/4: Humanoid Robots Interaction

**Natural Language Processing (NLP) for Robots**

- Implementing NLP for human-robot interaction
- Designing conversational behaviors for Pepper using NLP

## SESSION 8 (LIVE IN-PERSON)

**Midterm**

## SESSION 9 (LIVE IN-PERSON)

Module 4/4: Raspberry Pi Car Project

**Building a Raspberry Pi Car - Part 1**

- Introduction to Raspberry Pi and its components
- Setting up the Raspberry Pi environment

## SESSION 10 (LIVE IN-PERSON)

Module 4/4: Raspberry Pi Car Project

**Building a Raspberry Pi Car - Part 2**

- Connecting sensors and actuators to Raspberry Pi
- Basic programming for car control

## SESSION 11 (LIVE IN-PERSON)

Module 4/4: Raspberry Pi Car Project

**Advanced Programming for Raspberry Pi Car**

## SESSION 12 (LIVE IN-PERSON)

Module 4/4: Raspberry Pi Car Project

**Autonomous Navigation**

## SESSION 13 (LIVE IN-PERSON)

Module 4/4: Raspberry Pi Car Project

**Testing and Debugging**

## SESSION 14 (LIVE IN-PERSON)

Module 4/4: Raspberry Pi Car Project

**Competition Preparation**

## SESSION 15 (LIVE IN-PERSON)

**Competition :)**

## EVALUATION CRITERIA

Assessment in this *Introduction to Robotics* course is designed to reflect the balance between theoretical understanding, handson experimentation, technical communication, and active engagement that robotics demands. Across the four modules, ranging from foundational concepts to humanoid interaction and a full Raspberry Pi autonomous vehicle project, students will be evaluated through criteria that support both conceptual mastery and practical application.

Evaluation Criteria

The final grade is distributed across the following components, each aligned with the course modules:

**Workgroup Experiments**: Throughout the course, especially in Modules 2, 3, and 4, students will collaborate on robotics experiments involving sensors, actuators, control systems, humanoid robot interaction, and the Raspberry Pi car project. This component evaluates teamwork, applied problemsolving, and the ability to translate theory into functioning robotic systems.

**Class Participation**: Robotics is inherently interactive. Participation during lectures, discussions, and lab sessions is essential for understanding foundational topics such as robot kinematics, AI basics, and NLP for robots. This criterion rewards consistent engagement, curiosity, and contribution to the learning environment.

**Intermediate Tests**: Periodic assessments will measure comprehension of key concepts introduced in Modules 1–3, including kinematics, control theory, and humanrobot interaction. These tests ensure students are building the necessary theoretical foundation before advancing to the final project.

**Report Writing**: Students will document their experimental work and project development, particularly during the Raspberry Pi car build and autonomous navigation phases. This component evaluates clarity, structure, and the ability to communicate technical processes and results effectively.

Together, these components total **100%** of the course grade and are designed to support a progressive learning journey from robotics fundamentals to full system integration and autonomous behavior.

| criteria | percentage | Learning Objectives | Comments |
|---|---|---|---|
| Class Participation | 10 % | | |
| Workgroup Experiments | 50 % | | |
| Intermediate tests | 20 % | | |
| Report Writing | 20 % | | Documentation |

** RE-SIT / RE-TAKE POLICY **

**CLASS PARTICIPATION**

The rating of the class participation is based on two aspects, the presence and contributions to class discussions. Contributions on class discussions will focus on quality, not quantity of the contribution, so that students who participate often do not necessarily receive a better rating than those who participate less frequently. Therefore, students are encouraged to start contributing to the discussions since the beginning of the course.

**INDIVIDUAL AND WORKGROUP EXPERIMENTS**

You are also expected to complete several labs individually or with your group and present their results in multimedia form. These practices will give you the opportunity to reflect on what you have learnt in class and apply it to some practical problems. More details of the labs will be provided by the start of the course.

## BIBLIOGRAPHY

### Compulsory

- John J. Craig. (2004). *Introduction to Robotics: Mechanics and Control.* 3rd Edition. Pearson. ISBN 9780201543612 (Digital)

Provides readers with real-world practicality with underlying theory presented. With one half of the material from traditional mechanical engineering material, one fourth control theoretical material, and one fourth computer science, the book covers rigid-body transformations, forward and inverse positional kinematics, velocities and Jacobians of linkages, dynamics, linear control, non-linear control, force control methodologies, mechanical design aspects and programming of robots.

- Diwakar Vaish. (2018). *Python Robotics Projects.* 1st. packt. ISBN 9781788832922 (Digital)

In this book, you will learn the basics of robotics using Raspberry Pi as our hardware and Python as our programming language.

https://subscription.packtpub.com/book/iot-and-hardware/9781788832922/pref

## BEHAVIOR RULES

Please, check the University's Code of Conduct here. The Program Director may provide further indications.

## ATTENDANCE POLICY

Please, check the University's Attendance Policy here. The Program Director may provide further indications.

## ETHICAL POLICY

Please, check the University's Ethics Code here. The Program Director may provide further indications.