New Jersey Institute of Technology

IE 449 Industrial Robotics
Mechanical and Industrial Engineering
Instructor: Prof. Bo Shen bo.shen@njit.edu
Office: 327 Mechanical Engineering Center

PROGRAM EDUCATIONAL OBJECTIVES

I. Program graduates use the fundamental principles and major areas of Industrial Engineering in their professional practice.
II. Program graduates are life-long learners, pursuing graduate education, and professional growth in Industrial Engineering and related fields.
III. Program graduates pursue diverse career paths and advance in a variety of industries.

STUDENT OUTCOMES

(1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
(2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social and economic factors
(3) An ability to communicate effectively with a range of audiences
(4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental, and social contexts
(5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
(6) An ability to conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions
(7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

IE 449 OUTCOMES OF INSTRUCTION

The students will:

1. Learn to jog the robot (1).
2. Learn to create, modify, and execute a robot program (1).
3. Learn to design and install sensors (1).
4. Learn to use machine learning with sensor data (1).
5. Apply Engineering Ethics to actual industrial robot operations, automation, and machine intelligence (4).

COURSE DESCRIPTION

This course provides a comprehensive description of the concepts of manufacturing systems, manufacturing metrics and economics with a variety of examples on them. The objective of this course is to teach students the basics of robot systems and to give hands-on experience with robots that are used in current production environments as well as machine intelligence. The lab experiments of the course focus on two fundamental objectives: 1) Programming and troubleshooting techniques necessary to run industrial robots; 2) Sensor data collection and data

analytics/machine learning. Moreover, during the class students will gain exposure to quantitative methodologies and algorithms to analyze automated manufacturing systems.

This is a heavily focused lab class, and these labs will be done on-campus. The syllabus is organized in 3 learning modules.

TEACHING ASSISTANT

Jinghao Cao (Lead TA) jc2687@njit.edu
Marco Marena mm243@njit.edu
Chenyang Li cl237@njit.edu

CANVAS

The course will make extensive use of the Canvas system to optimize student-instructor communication. All course materials including lecture slides and homework etc. will be distributed through Canvas. All submission of homework and other assignments will also be through Canvas. To access the system please go to https://canvas.njit.edu, you will need a valid UCID to login.

COURSE MATERIAL

Textbook: Automation, Production Systems and Computer-Integrated Manufacturing, 5th Edition, by Mikell P. Groover, Pearson.

ISBN-10: 0-13-460546-2
ISBN-13: 978-0-13-460546-3

Provided Material on Canvas: PowerPoint Slides, Videos, Reading Material

GRADING

Based in individual and team performance as follows:

- 15% Homework #1
- 15% Homework #2
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- 20% Midterm Exam
- 20% Final Project

- 15% Robotics Lab Assignments
- 15% Sensor & Machine Intelligence Lab Assignments

Letter grades will be assigned based on the following criteria as a percentage of total points (subject to change):

Table 1: Letter Grade Point Distribution

Score Range	Grade
[88,100]	A
[81,88)	B+

[74,81)	B
[67,74)	C+
[60,67)	C
[53,60)	D
[0,53)	F

LAB TEAMS & TEAM PROJECT

The course involves several experiments that are to be completed by all students. All experiments and the project will be completed in **teams of 3 students**. Please select your teams to match your skills. During the lab class the corresponding experiment will be demonstrated by the instructor and the course TA.

WEEKS	*TOPIC*
Learning Module 1: Overview of Manufacturing, Automation and Control Technologies	
Week 1 1/27/2025	Introduction to the Syllabus CH1 – Introduction
Week 2 2/3/2025	CH2 – Manufacturing Operations Introduction to Robotics Equipment & Safety Guidelines CH3 – Manufacturing Metrics and Economics Introduction to PLC Equipment & Safety Guidelines
Week 3 2/10/2025	CH3 – Manufacturing Metrics and Economics (Continued) CH4 – Introduction to Automation
Week 4 2/17/2025	CH5 – Industrial Control Systems
HW #1	
Learning Module 2: Industrial Robotics	
Week 5 2/24/2025	CH8 – Industrial Robotics **Robotics Lab Assignment #1**
Week 6 3/3/2025	CH8 – Industrial Robotics (Continued) – Robot Accuracy and Repeatability **Robotics Lab Assignment #2**
HW #1 Due	
Week 7 3/10/2025	Midterm Exam Review **Robotics Lab Assignment #3**
Week 8 3/17/2025	**No-class Spring Break**

Week 9 3/24/2025	**Midterm Exam** Guest Lecture
Learning Module 3: Sensors & Machine Intelligence	
Week 10 3/31/2025	Introduction to Sensor-based Machine Intelligence-Smart Manufacturing **Sensors & Machine Intelligence Lab # 1**
HW #2	
Week 11 4/7/2025	Introduction to Machine Learning **Basic Python Programming Lab**
Week 12 4/14/2025	Industrial Machine Learning **Machine Learning with Python Lab #1**
Week 13 4/21/2025	Industrial Machine Learning (Continued) **Sensors & Machine Intelligence Lab #2**
HW #2 Due	
Week 14 4/28/2025	Industrial Machine Learning (Continued) **Machine Learning with Python Lab #2**
Week 15 5/5/2025	Industrial Machine Learning (Continued) **Sensors & Machine Intelligence Lab #3**

STATEMENT ON ACADEMIC INTEGRITY

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: https://www5.njit.edu/policies/sites/policies/files/NJIT-University-Policy-on-Academic-Integrity.pdf

Plagiarism is taken seriously and will be dealt with according to university policy. Students must adhere at all times to the NJIT's Code of Academic Integrity.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

If you have a disability or a special need for which you are or may be requesting accommodations, please contact both me and the Office of Accessibility Resources and Services as early as possible in the semester. You must submit appropriate documentation to the instructor before accommodations can be granted. The office will review your concerns and determine, with you, what accommodations are necessary and appropriate for you. All information and documentation of your disability is confidential and will not be released by the office without your written permission.

COURSE EVALUATION

Students will be provided an opportunity to evaluate instruction in this course through Canvas using the University's standard procedures, which are administered by the Office of Institutional Effectiveness.

Instructor may also provide additional informal surveys within the course to receive students' feedback and comments regarding the class. Feel free to provide your constructive feedback to the instructor regarding the class.

SPECIAL NOTE

NJIT's Perspective on AI Usage in Teaching/Learning: This course expects students to work without artificial intelligence (AI) assistance in order to better develop their skills in this content area. As such, AI usage is not permitted throughout this course under any circumstance.

Student Absences for Religious Observance: NJIT is committed to supporting students observing religious holidays. Students must notify their instructors in writing of any conflicts between course requirements and religious observances, ideally by the end of the second week of classes and no later than two weeks before the anticipated absence. All instructors must include a reminder on the course syllabus about this notification process. All instructors are required to provide academically reasonable accommodations, allowing students to complete missed assignments, exams, quizzes, or other coursework within the term. Instructors are encouraged to consider the NJIT religious holiday calendar and exercise cultural sensitivity when scheduling assessments or major assignments. All instructors must ensure that students are not penalized for properly documented absences and maintain confidentiality regarding religious observances. For questions or additional guidance, please review the policy or contact the Office of Inclusive Excellence at inclussiveexcellence@njit.edu.