

EML 4930 – Smart Manufacturing & Robotics
Section: 4654 (MWF, 4th period, #26337)
Spring 2023 Syllabus

(Modifications to this syllabus may be required during the semester. Any changes to the syllabus will be posted on the course website (e-learning/Canvas) and/or announced in class.)

Meeting Times / Locations

MWF, 4th period, 10:40 am – 11:30 am

Location: MAEA 327

Laboratory: MAEB 325

Instructor

Dr. Gloria J. Wiens

Office Location: MAEB 210

Telephone: 352-392-0806

E-mail address: gwiens@ufl.edu (*communicate via Canvas*)

Office Hours: MW – 7th period (2:00 pm – 3:00 pm), or by appointment

Teaching Assistants: Dr. Wiens' research team (Jared Flowers, Callia Bast, John Rockholt)

Course Description

Course content is themed around robotics and automation, a technology thread of the Manufacturing USA – Institutes. Contains content related to Industry 4.0/Industry 5.0 – Industrial Revolutions, Industrial Internet of Things, Smart Manufacturing, AI and that this entails. (3 credits)

Course Pre-Requisites / Co-Requisites

Pre-Requisites: EML 2322L (Design and Manufacturing Laboratory)

Recommended but not required Co-Requisites: EML 4312 (Control of Mechanical Engineering Systems), EML 4321 (Manufacturing Engineering)

Course Objectives

End goal of course is to provide students with basic skill level in robots, knowledge of the state-of-the-art and challenges in robotics and automation and to have confidence in their ability to work as a roboteer in industry (or a research lab) and successfully implement robotics. This includes smart manufacturing and how to achieve “integration” of sensors, industrial robot and its controls, inclusion of human-robot behaviors via AI-methods, proactive-n-reactive robot capabilities for ensuring safety and retaining productivity, automation techniques, and cell design/control.

Students will gain knowledge of robotic systems modeling (kinematics, workspace, task planning and controls). Case studies will explore techniques for addressing integration challenges of implementing industrial robots into automated/semi-automated manufacturing work cells equipped with advanced sensors, vision, and material handling techniques. Assignments will introduce the students to simulation and software tools (C++/Python, ROS platform, Rviz, MoveIT) for programming an in-lab robot to perform a set of assembly tasks. There are plans for Industry tour(s) and guest lecture(s).

Material and Supply Fees: None

Professional Component (ABET)

This course supports program outcomes enumerated in the Mission Statement of the Department of Mechanical and Aerospace Engineering Assessment Plan. The specific program outcomes supported by this course include:

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	Medium
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, environmental, and economic factors	Low
3. An ability to communicate effectively with a range of audiences	Low
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal 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	High
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	Medium
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	Low

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

Textbooks and Software Required/Recommended

Mikell Groover, “Automation, Production Systems, and Computer-Integrated Manufacturing”, 4th edition, Pearson (2015). [UF-ARES course reserve, 2-hour checkout]

ISBN-10: 0133499618
ISBN-13: 9780133499612
ISBN-ebook: 9780133499711

Mikell Groover, “Automation, Production Systems, and Computer-Integrated Manufacturing”, 5th edition, Pearson (2019, July 13, 2018). [Requested: UF-ARES course reserve, 2-hour checkout]

Ebook ISBN-13: 9780137518579
Hardcover ISBN 10: 0-13-460546-2, ISBN 13: 978-0-13-460546-3

C++ and/or Python (expected basic level, will be using for programming robot control modules)
Matlab/Simulink Software (optional)
SolidWorks Software (optional)

Recommended Reading

www.manufacturingUSA.com

- U.S. Advanced Manufacturing Innovation Institutes, ARM Institute.
- National Network for Manufacturing Innovation (NNMI) Program Strategic Plan
<https://www.manufacturingusa.com/resources/national-network-manufacturing-innovation-nnmi-program-strategic-plan>

- Deloitte Report, “The smart factory”, R. Burke *et al.*, August 31, 2017,
https://www2.deloitte.com/insights/us/en/focus/industry-4-0/smart-factory-connected-manufacturing.html?id=us:2ps:3gl:lookagainfy18:eng:greendot:::na:lb6Kqxn:1077435550:239919832936:b:Brand_Digital_Transformation::br
- The Fourth Industrial Revolution, Klaus Schwab, Penguin Group, 2017,
<https://www.penguin.co.uk/books/304971/the-fourth-industrial-revolution/>
- A Roadmap for US Robotics: From Internet to Robotics, 2020 edition, September 9, 2020,
<https://cra.org/ccc/visioning/robotics-roadmap/>
- ASME Government Relations listing roadmaps/ position papers/white papers:
<https://www.asme.org/government-relations/capitol-update/2020-updated-u-s-robotics-roadmap-released>
- NASA policy & strategy (7/2022), objectives (9/2022), and technology roadmaps (2015/2020):
https://csp.aerospace.org/sites/default/files/2022-07/Cavaciuti-Davis-Heying_ISAM_20220715.pdf, <https://www.nasa.gov/sites/default/files/atoms/files/m2m-objectives-exec-summary.pdf> and <https://www.nasa.gov/offices/oct/taxonomy/index.html>

Course Outline:

See schedule available on course website for assignments and handout.

- Technology Landscape: Industry 4.0/Industry 5.0 – Industrial Revolutions, and Beyond
 - o Industry Internet of Things (IIoT)
 - o Digital Thread/Tools: MTConnect, digital twin, OEM software, big data, cybersecurity, ...
 - o Systems Engineering – Functional Architecture
- Automation / Robotics / Human-Machine Interface / Sensors / Controls
 - o Robotic systems modeling (kinematics, workspace, task planning and controls)
 - o Simulation and Hands-on task planning
 - o Cobots – human-robot interactions and proactive-n-reactive behaviors
- Design of Intelligent manufacturing facilities (e.g., robotics workspace, supply chain)
 - o Integration – sensors, industrial robot and its controls, inclusion of human-robot behaviors via AI-methods, proactive-n-reactive robot capabilities for ensuring safety and retaining productivity, automation techniques, and cell design/control
- Case Study(ies) / Guest Speaker(s) / Industry Tour(s)
- Tutorials and Hands-on implementation: In-lab robot programming, simulation and testing

Important Dates

Midterm Exam: Friday, March 24, 2023 (In-Class). Location: MAEA 327

Holidays

January 16, 2023 – MLK Day

March 11 - 19, 2023 – Spring Break

Attendance Policy, Class Expectations and Make-Up Policy

While attendance is not strictly monitored, it is extremely important and expected that students attend class regularly. Participation does count as part of your grade. If you miss a lecture, you are responsible for finding out from a classmate what we did in class. Select material will be made available online, but not all content covered during lecture will necessarily be available online. Furthermore, students will be held responsible for knowledge of all scheduling and policy announcements made in class and on course website. Excused absences must be consistent with university policies in the undergraduate catalog

(<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

You are expected to take a sincere interest in learning the classroom material. Keeping with this expectation, you are expected to show up on time for class. Please turn off all cell phones prior to the start of class. If you are a distraction in class, you will be asked to leave.

Assessment Methods and Grading

Students will be evaluated from their grades on the following, which are weighted as follows.

- 70% Homework/Surveys/Quizzes – including Case Studies, In-Lab assignments and projects, Industry tours & Class Participation (*in-class activities, guest speakers, group discussions, student presentations, peer reviews*)
- 30% Midterm

Grading Scale

93.4 – 100	A	86.7 – 89.9	B+	76.7 – 79.9	C+	66.7 – 69.9	D+	0 – 59.9	E
90.0 – 93.3	A-	83.4 – 86.6	B	73.4 – 76.6	C	63.4 – 66.6	D		
		80.0 – 83.3	B-	70.0 – 73.3	C-	60.0 – 63.3	D-		

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Make-up Exam Policy

Only under extreme extenuating circumstances will make-up exam be considered and not without a documented excused absence (e.g., documented extreme medical emergency).

Students Requiring Accommodations:

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the Disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester. NOTE: Any requests must be made 5 university working days prior to the date for which accommodation is being requested.

Course Evaluation:

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in

preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third-party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use:

All faculty, staff and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy:

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Students with disabilities have an equal right to use and benefit from resources at the George A. Smathers Libraries, including (but not limited to) Course Reserves materials. To ensure this right, students with disabilities:

- *Have the responsibility to identify themselves as needing appropriate, reasonable accommodations for their disabilities*
- *Have the responsibility for making their needs known in a timely manner*
- *Have the same obligation as any library user to comply with library policies and procedures*

The George A. Smathers Libraries Course Reserves Unit will work with patrons needing assistance or accommodations to access course reserves materials. Please contact the Course Reserves Unit at 352-273-2520, or email at eres@uflib.ufl.edu for information or assistance. We also encourage students to contact and register with the [University of Florida Disability Resource Center](#) at 352-392-8565 or at accessuf@dso.ufl.edu.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>
<https://care.dso.ufl.edu>.

On-Line Students Complaints: <https://distance.ufl.edu/state-authorization-status/#student-complaint>.

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS): Student Health Care Center, 392-1161.