

## **CDA 4630: Embedded Systems**

**Sections:** 30109

**Class Periods:** Tuesday 3:00 – 4:55 pm and Thursday 4:05 – 4:55 pm

**Location:** MCCC 0100

**Academic Term:** Spring 2024

### ***Instructor:***

Name: Prabhat Mishra

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Office Hours: Wednesday 3:00 – 5:00 pm in MH 4002

### ***Teaching Assistants:***

Name: Hansika Weerasena

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Office Hours: Monday 3:00 – 5:00 pm in TBD

Name: Uma Saisree Avula

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Office Hours: None

### ***Course Description***

Design of efficient and trustworthy embedded and cyber-physical systems consisting of hardware, software, firmware, sensors, and actuators. It covers fundamental issues related to modeling and specification, design space exploration, hardware-software partitioning, synthesis and compilation, real-time operating systems, and application-specific optimizations targeting area, power, performance, temperature, energy, and security. 3 credits.

### ***Course Pre-Requisites / Co-Requisites***

CDA 3101

### ***Course Objectives***

Embedded systems run the computing devices hidden inside a vast array of everyday products and appliances such as cell phones, toys, handheld PDAs, cameras, and microwave ovens. Cars are full of them, as are airplanes, satellites, and advanced military and medical equipments. As applications grow increasingly complex, so do the complexities of the embedded computing devices. The goal of this course is to develop a comprehensive understanding of the technologies behind the embedded systems design. The students develop an appreciation of the existing capabilities and limitations of various steps in overall design methodology including system level specification, design space exploration, hardware-software partitioning, application-specific optimizations, and functional validation of embedded systems.

***Materials and Supply Fees:*** None

***Required Textbooks and Software:*** None

***Recommended Materials:*** None

- Embedded System Design
- Peter Marwedel, Springer, 2021
- ISBN: 978-3319560434
- Free Download: <https://link.springer.com/content/pdf/10.1007/978-3-030-60910-8.pdf>

## Course Schedule

<b>Week</b>	<b>Topics</b>	<b>Assignments and Exams</b>
<b>1</b>	<i>Introduction to Embedded Systems</i>	
<b>2</b>	<i>Modeling and Specification</i>	<i>Homework 1 (Due: Feb 14 at 11:30 pm)</i>
<b>3</b>	<i>Embedded Systems Architecture</i>	
<b>4</b>	<i>Digital-to-Analog and Analog-to-Digital Converters</i>	
<b>5</b>	<i>Sensors and Actuators</i>	<i>Project 1 (Due: Feb 28 at 11:30 pm)</i>
<b>6</b>	<i>System-level Optimizations</i>	
<b>7</b>	<i>Compression and Decompression</i>	<i>Homework 2 (Due: Mar 13 at 11:30 pm)</i>
<b>8</b>	<i>Real-time Operating Systems</i>	
<b>9</b>	<i>Hardware-Software Co-Design</i>	
<b>10</b>	<i>Spring Break</i>	
<b>11</b>	<i>Compilation of Embedded Applications</i>	
<b>12</b>	<i>Control Systems</i>	<i>Midterm (Mar 26 from 3:00 – 4:55 pm)</i>
<b>13</b>	<i>Design Space Exploration</i>	<i>Project 2 (Due: Apr 3 at 11:30 pm)</i>
<b>14</b>	<i>Energy-aware Computing</i>	
<b>15</b>	<i>Validation and Verification</i>	<i>Homework 3 (Due: Apr 17 at 11:30 pm)</i>
<b>16</b>	<i>Embedded Systems Security</i>	
<b>17</b>		<i>Final Exam (May 2 from 8:00 – 10:00 pm)</i>

### **Attendance Policy, Class Expectations, and Make-Up Policy**

The students are expected to attend the lectures (in person) and actively participate in class discussions. There is a 10% score for class participation and pop quizzes. The pop quiz will be conducted during the lecture based on the materials covered in that lecture. You will not know when the pop quiz will be conducted. You will get the full score (10%) in participation if you get 80% in pop quizzes, prorated otherwise. For example, if I take 10 pop quizzes, and you can correctly solve 8 of them, you will get full 10% of the overall score. There is no scope for makeup pop quizzes. Please attend the first lecture (or view the video) and refer to the introduction.pptx in eLearning for further details.

The students are required to submit their homeworks and projects before the deadline through eLearning. Late submissions are allowed (up to 24 hours) with a 20% penalty. No grades for late submissions after 24 hours from the deadline. The students are required to take the midterm and final exams at the scheduled time. There would be no makeup exams except for medical emergencies with appropriate documentation.

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies:

<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

**Regrading Policy:** A student needs to request for regarding for an assignment (homework or project) or exam within a week of when the grade is posted. The associated announcement will indicate the deadline for that assignment or exam. No regarding is allowed after the deadline has passed. The instructor may add points to each student's midterm such that the highest score in the midterm is 100%. For example, if the highest score is 107 out of 120, the midterm score for each student will increase by 13 points. Note that this increase covers various scenarios, including (but not limited to) minor mistakes in grading, lack of clarity in some questions, or level of difficulty in specific questions. Therefore, during regarding of midterm, a student will not gain any points unless the student gains more than the additional points (e.g., 13 in this example). Due to timing constraints between the final exam and the grade submission deadline, there will be no scope for regarding the final exam. However, we will add points to each student's final such that the highest score in the final is 100%. This increase in points is expected to cover any minor mistakes in grading the final exam.

**Zero Tolerance Policy:** You are expected to do your assignment (homework or project) on your own without giving any help to anyone or getting any help from anyone (including ChatGPT or other internet sources). Similarly, you are allowed only one crib sheet during the exams with hand-written notes (on one side of a US letter size paper during the midterm, and on both sides of a US letter size paper during the final). Any violation of the course policies will be treated as academic dishonesty and reported to the Dean of Student's (DSO). In case of minor violation, the student will receive a zero score in that assignment and an additional grade penalty. In case of major violation (e.g., project similarity more than 50% or any cheating during exams), the student will receive a failing grade ("E") in the course.

### ***Evaluation of Grades***

<b>Assignment</b>	<b>Total Points</b>	<b>Percentage of Final Grade</b>
Homeworks (3)	5% each	15%
Pop Quizzes	10%	10%
Projects (2)	10% each	20%
Midterm Exam	25%	25%
Final Exam	30%	30%
		<b>100%</b>

### ***Grading Policy***

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
91 - 100	A	4.00
86 - 90	A-	3.67
81 - 85	B+	3.33
76 - 80	B	3.00
72 - 75	B-	2.67
68 - 71	C+	2.33
64 - 67	C	2.00
60 - 63	C-	1.67
56 - 59	D+	1.33
52 - 55	D	1.00
48 - 51	D-	0.67
0 - 47	E	0.00

More information on UF grading policy may be found at:

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

### ***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.

### ***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.a.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.a.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 or TAs in this class.

### ***Commitment to a Safe and Inclusive Learning Environment***

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University’s core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

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
- HWCOE Human Resources, 352-392-0904, [student-support-hr@eng.ufl.edu](mailto:student-support-hr@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto: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:**

#### 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](mailto: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:** <https://counseling.ufl.edu>, 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](mailto:title-ix@ufl.edu)

#### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

#### Academic Resources

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

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

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

**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/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.