

# Embedded Systems Design

## CSCE 3612, Section 001

### Spring 2023

**Class Timings:** Tuesday and Thursday, 10:00 AM – 11:20 AM, Discovery Park, B142

**Instructor:** Robin Pottathuparambil, Email: [rpottath@unt.edu](mailto:rpottath@unt.edu), Student hours: F263, Tuesday and Thursday 1:00 PM – 3:00 PM or by appointment.

**Teaching Assistants:**

- Venkat Prashanth Meda, Email: [venkatprashanthmeda@my.unt.edu](mailto:venkatprashanthmeda@my.unt.edu), Student hours: F243, Thursday 11:30 AM – 3:50 PM (Labs and Class activities)
- Abdulrahman Alkinani, Email: [abdulrahmanalkinani@my.unt.edu](mailto:abdulrahmanalkinani@my.unt.edu), Student hours: E248 (Cubicle E), Monday and Wednesday 1:00 PM – 3:00 PM (Homework and Quizzes).

**Course Webpage:** All the course related material will be posted on the course webpage which is available through Canvas (<https://unt.instructure.com/>)

**Course Outcomes:**

- Understand the differences between embedded computing systems and general-purpose computing systems, including constraints on performance, energy consumption, memory, and physical dimensions.
- Able to specify embedded systems using UML or other high-level abstract models.
- Able to use modern micro-controllers, including programming and interfacing such micro-controllers.
- Understand the use of DSP processors and other Application Specific processors.
- Understand trade-offs associated with using micro-controllers, DSPs, ASICs, and FPGAs to meet embedded system requirements.

**Program Outcome Mapping:**

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

**Textbook:** *Computers as Components: Principles of Embedded Computing System Design* by Marilyn Wolf, Fifth Edition, ISBN: 9780323851282.

**Catalog Description:** Prerequisite: CSCE 2610, EENG 2710 or ENGR 2720, ENGR 2730. Computer systems as embedded computing elements and micro-controllers. System specification using UML or other high-level abstract models. Issues and constraints on embedded computing systems, including power, performance, memory and size. Use of DSP, ASIC and micro-controllers in a single design.

**Topics:**

- Introduction to Embedded Systems and its design process
- Instruction sets for ARM, PIC, and DSP
- Introduction to CPUs and co-processors
- Computing platforms and its design

- Program design and analysis
- Introduction to processes and operating systems
- System design techniques
- Internet-of-Things (IoT) Systems.

#### Grading:

Quizzes	12%
Homework	12%
Class Activity	5%
Lab assignments	20%
ePortfolio Design	1%
Midterm Exam (03/07/2023)	20%
Comprehensive Final Exam (05/11/2023)	30%

**Quizzes:** There will be six to seven pop quizzes given throughout the semester. The pop quizzes can be given any time during the class. The solution for quizzes will be posted on Canvas. These will be to reward students who consistently attend the class but will be more than just attendance points.

**Homework:** Homework will be in the form of problem sets with a due date **one week** after it is assigned. Homework will be assigned on Tuesdays as per the schedule. **No late homework will be accepted.** Homework must be done individually (you will learn the most from this). The solution for homework will be posted on Canvas. Any evidence of group participation or direct copying from sources like previous year's solutions, textbook, solutions, Wikipedia, websites, and other sources will be interpreted as academic dishonesty. There will be six to seven homework assignments.

**Recitations:** The recitations are on Thursdays starting from 11:30 AM to 3:50 PM and it is only mandatory on the days of presentations and lab demonstrations. The TA will be available during the recitation hours in F243 on Thursdays to help you with the labs or to demonstrate your labs.

**Experiential Learning:** It's a process of learning where you will be learning through hands-on labs and class activities and is designed such a way that you learn through reflection. This is also called as experiential education. To implement this, we will be using Kolb's experiential learning model where you will be given a class activity, or a hands-on lab and you will be asked to reflect on the experience and then this experience is used to do similar activities. The two experiential learning assignments that we will be involved are: In-class activity and hands-on labs.

- **Class Activity:** There will be several class activities during the class session that will reinforce the concepts that we learned in the class. These class activities will be scheduled during the class timing. The solution for class activity will be posted on Canvas.
- **Lab Assignments:** Lab assignments are an integral part of the course and are intended to provide hands-on experience in the application of the concepts discussed in the lecture. Lab assignments will be assigned on Thursdays as per the schedule and with a due date of **two weeks** after it is assigned. There will be five to six lab assignments assigned. Each of the lab assignment will be used to build the next lab. The last lab will be designed with most of the code from previous labs. The solutions for lab assignments will not be posted on Canvas. Lab assignments must be done individually and can be done on your personal machine. Any evidence of group participation will be interpreted as academic dishonesty.
- **ePortfolio:** All students are required to create a foliotek profile page through Canvas. You will be completing a portfolio page with the details of the final lab. You will be provided with a template of the documentation that is needed. This documentation will be then graded for the aspect of

critical thinking. The evaluation will be made available to you so that you can improve your critical thinking skills. A rubric for grading will also be given to you. You need to complete the ePortfolio assignment to receive credit for it.

**Exams:** There will be a midterm exam and a final exam. The exams are closed books and closed internet. Mobiles phones are not permitted and browsing the internet is not allowed. Exams will include material from the modules, the readings, homework, and labs and should be taken individually and not as a team. Final exam will be comprehensive.

- **Midterm Exam:** Tuesday, March 7<sup>th</sup>, 2023, 10:00 AM – 11:20 AM
- **Comprehensive Final Exam:** Thursday, May 11<sup>th</sup>, 2023, 8:00 AM – 10:00 AM.

**Missing Classes, Assignments, or Exams:** Attendance at all exams, quizzes, and class activities is mandatory. Throughout the semester, a student may miss classes, assignments, quizzes, or exams due to many reasons. Most of the reasons will not be accepted as an "excused" absence. Assignments, quizzes, or exams can be made-up only under extraordinary circumstances and only when notification is given to me before the assessment, quiz, or exam is administered. A no-show for an assessment, quiz or exam without prior notification and a verifiable excuse (appropriate official documentation) will result in a grade of zero (0) for that assessment, quiz, or exam.

**COVID-19 Impact on Attendance:** Students are expected to attend class meetings regularly and to abide by the attendance policy established for the course. It is important that you communicate with the professor and the instructional team prior to being absent, so you, the professor, and the instructional team can discuss and mitigate the impact of the absence on your attainment of course learning goals. Please inform the professor and instructional team if you are unable to attend class meetings because you are ill, in mindfulness of the health and safety of everyone in our community.

If you are experiencing any [symptoms of COVID-19](#) please seek medical attention from the Student Health and Wellness Center (940-565-2333 or [askSHWC@unt.edu](mailto:askSHWC@unt.edu)) or your health care provider PRIOR to coming to campus. UNT also requires you to contact the UNT COVID Team at [COVID@unt.edu](mailto:COVID@unt.edu) for guidance on actions to take due to symptoms, pending or positive test results, or potential exposure.

**Statement on Face Covering:** UNT encourages everyone to wear a face covering when indoors, regardless of vaccination status, to protect yourself and others from COVID infection, as recommended by current CDC guidelines. Face covering guidelines could change based on community health conditions.

**Disputing Grades:** If you have a dispute with how an assignment, quiz, or exam is graded, you should get the solution to the assignment, quiz, or exam off the course web site and examine it. If you really believe that your answer is correct (matches the answer given in the solution), contact the grader and discuss it with him. The grader will listen to your concern, and act on it, at their discretion. The solutions for labs will not be posted, so contact the grader for disputing the grade if you have met all the requirements of the labs and you have lost points. Note that instructor or grader addition errors should follow the above procedure. Assignment, quiz, exam, lab, and homework grades are disputable for **one week** from the day the grades were posted on Canvas.

**Syllabus Revisions:** This syllabus may be modified as the course progresses. Notice of such changes will be by email or announcement in class.

**Class Policies:** Please note that portable phones, pagers, and late arrivals are disruptive to the instructor and to your peers. The use of cell phones, beepers, or communication devices is disruptive and is therefore absolutely prohibited during class and exams. Turn off your cell phone while in class and while taking exams. If I catch you using these devices in the class or during the exams, the penalty can range

from a formal warning to an 'F' for the course and you will be asked to leave the class. Except in emergencies, students using such devices must leave the classroom for the remainder of the class period. I know that some of you may wish to take notes directly on your computer and I have no problem with that. If, however, you choose to access your email, search the web, play games, or instant messenger your friends during class, you will have 5% deducted from your final grade for each transgression. If I am late arriving to class, it will be because of circumstances beyond my control. You are expected to remain for 20 minutes past the scheduled class start time while I attempt to communicate my situation and relay instructions.

**Course Policies:** You are expected to spend at least 10 hours per week for this course. Keep all your graded assignments, quizzes, and tests for study and review. You should track your own progress using Canvas and be aware of current grades throughout the term. Graded midterm exam, quizzes, and class activities will be returned after you take the final exam. If you would like to look at the graded assignments, meet me during my office hours or setup an appointment. Final grading will be done as follows. **A:**  $\geq 90\%$ , **B:**  $\geq 80\%$  and  $< 90\%$ , **C:**  $\geq 70\%$  and  $< 80\%$ , **D:**  $\geq 60\%$  and  $< 70\%$  and **F:**  $< 60\%$ . Grades will be curved if necessary. Grades cannot be changed after they have been electronically entered into university's system except for instructor error. Any extenuating circumstances that may adversely affect your grade must be brought to my attention before the final course grades are recorded. To be considered, such circumstances must be unusual, unavoidable, and verifiable.

**Disability Services/Special Needs:** UNT complies with all federal and state laws and regulations regarding discrimination including the Americans with Disability Act of 1990 (ADA). If you have a disability and need a reasonable accommodation for equal access to education or services, please contact the Office of Disability Accommodation. Please initiate this process and inform me during the first two weeks of class.

**Academic Dishonesty:** All the provisions of the University code of academic integrity apply to this course. In addition, it is my understanding and expectation that your signature on any test or assignment means that you neither gave nor received unauthorized aid. For homework and labs, while discussion is allowed, direct copying is not, and students must turn in individual submissions. All students are required to know, observe, and help enforce the UNT Code of Student Academic Integrity. Academic dishonesty will result in disciplinary action according to UNT Policy 06.003. The penalty for a first offense can range from a formal warning to an 'F' for the course. Regardless of the penalty imposed, a record of the offense will be kept in the Office of the Dean of Students.

**Student Perceptions of Teaching (SPOT):** Student feedback is important and an essential part of participation in this course. The student evaluation of instruction is a requirement for all organized classes at UNT. The short SPOT survey will be made available **April 17<sup>th</sup> – May 4<sup>th</sup>** to provide you with an opportunity to evaluate how this course is taught.

**ABET Survey:** Towards the end of the course, the students will be asked to do an ABET exit survey which will help instructors to quantitatively measure whether the students met the course outcomes stated in the course syllabus. This survey will be administered during the last week of classes.

**Tentative Course Schedule:**

<b>Week</b>	<b>Lecture</b>	<b>Assignments Due</b>
01/16 – 01/20	Embedded computing	
01/23 – 01/27	Embedded computing	
01/30 – 02/03	Embedded computing	Homework 1
02/06 – 02/10	Embedded computing	Lab 1
02/13 – 02/17	Instruction set	Homework 2
02/20 – 02/24	Instruction set	Lab 2
02/27 – 03/03	CPUs/Exam Review	Homework 3
03/06 – 03/10	CPUs	Midterm Exam
03/13 – 03/17	Spring Break – No Classes	
03/20 – 03/24	Computing platforms	
03/27 – 03/31	Computing platforms	Lab 3
04/03 – 04/07	Program design and analysis	Homework 4
04/10 – 04/14	Processes and operating systems	Lab 4
04/17 – 04/21	Processes and operating systems	Homework 5
04/24 – 04/28	System design techniques	Lab 5
05/01 – 05/05	Internet-of-Things Systems (IoT)/Exam Review	Homework 6
05/08 – 05/12	No Lecture	Comprehensive Final Exam