Embedded Systems Design
CSCE 3612
Summer 2023

Class Timings: Tuesday and Thursday, 10:00 AM – 11:50 AM,
Instructor: Sayed Khushal Shah, Email: sayed.shah@unt.edu ,
Office Hours: By appointment only

Teaching Assistants: Anand Kumar Bapatla, Email: anandkumarbapatla@my.unt.edu,
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.

Text: *Computers as Components: Principles of Embedded Computing System Design* by Marilyn Wolf, Fourth Edition, ISBN: 978-0-12-805387-4.

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, Automotive and Aerospace Systems, and Embedded Multiprocessors.

Grading:

Quizzes	15%
Homework	10%
Lab assignments	25%
Midterm Exam	20%
Comprehensive Final Exam	30%

Quizzes: There will be two to four quizzes given throughout the semester. The quizzes can be given during the class announced at least two days prior to quiz. These will be to reward students who consistently attend the class but will be more than just attendance points. **These quizzes can be only taken using Respondus LockDown browser.**

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 Wednesdays as per the schedule. **No late homework will be accepted.** Homework must be done individually (you will learn the most from this). 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 four to five homework assignments.

Recitations: The recitations are on Thursdays, and it is only mandatory on the days of lab demonstrations. The TA will be available during the recitation hours 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 an 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: 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.

- **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 Tuesdays as per the schedule and with a due date of one week after it is assigned. There will be four to five lab assignments assigned. Each of the lab assignment will be used to build the next lab. The last lab will be a final project with most of the pieces completed in the previous labs. 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. **These exams require Respondus LockDown browse.** 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:** Total time allowed is 2 hours and will be available on Canvas.
- **Comprehensive Final Exam:** Total time allowed is 2 hours and will be available on Canvas.

Missing Classes/Assignments/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 quiz or exam is administered. A no-show for a quiz or exam without prior notification and a verifiable excuse (appropriate official documentation) result in a grade of 0 for that quiz or exam.

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, and homework grades are disputable for **one week** from the day the grades were assigned 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.

Course Policies: You are expected to spend at least 15 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. 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 **July** to provide you with an opportunity to evaluate how this course is taught.

Tentative Course Schedule:

Week	Lecture	Assignments Due
1	Embedded computing	
2	Embedded computing	Homework 1
3	Instruction set	Lab 1
4	CPUs	Lab 2
5	Computing platforms/Review	Homework 2
6	Program design and analysis	Midterm Exam
7	Processes and operating systems	Lab 3
8	System design techniques/IoT	Homework 3
9	Automotive and Aerospace Systems	Lab 4
10	Embedded Multiprocessors/Review	Homework 4/Final Exam