

## General Information

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### Professor Information



Instructor Atoussa H. Tehrani

Phone (305) 348-4939

Office EC3113

Office Hours By Appointment

Email [hosseini@fiu.edu](mailto:hosseini@fiu.edu)

### Course Description and Purpose

This is an undergraduate-level course which covers the principles of embedded computing systems. The course presents the main elements in the design of embedded systems and how FPGA technology is used for such a design. Since the course is intended to serve students with a background in Computer or Electrical Engineering, prior knowledge of computer design is expected. These include Computer Architecture, Processor, Combinational and Sequential Logic Design. Topics covered include: embedded systems design metrics, FPGA, VHDL, designing custom single-purpose processors and implementing the corresponding VHDL model in FPGA, and programming an ARM general-purpose processors and peripherals for embedded system design.

This course will consist of 6 modules and a project. Module availability is open; however students are expected to complete each module by the due date. Students must take the quizzes to practice the material covered in modules and also prepare themselves for the midterm and the final exam. Students must submit their assignments and their project by the due date and take their midterm and final exams on the dates specified on the course portal. Assignments will be completed individually, students have the option of working in a group for the final project that will be due toward the end of the semester. Submitted assignments will be evaluated within one week of submission. Communication will take place primarily via email and professor announcements. At the end of the course you would have learned how to design a custom single purpose processor and program it into an FPGA board in VHDL. You will also have learned how to program Zybo - Z7 ARM processor and peripherals for embedded system design.

### Course Objectives

Upon completing this course, students will be able to:

1. List and describe different embedded systems related concepts and technologies.
2. Describe the analysis and design of embedded processing system using the field programmable gate array (FPGA).
3. Use VHDL hardware description language to implement FPGA designs.
4. Design and implement custom single-purpose processors.
5. Explain and analyze the characteristics of a General-Purpose Processor.
6. Describe the features of different Standard Single Purpose Processors or peripherals.
7. Write basic embedded software applications.
8. Explain and analyze microprocessor interfacing methods and protocols.
9. Design and develop an embedded system to implement the required functionality.

## Major & Curriculum Objectives Targeted

### Relationship of course to program 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, environmental, and economic factors.
3. an ability to communicate effectively with a range of audiences.
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 develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

## Teaching Methodology

This is a fully online course in which all of the instructional materials and activities are delivered through Canvas, and/or other internet-based media. Some exams may require the use of an approved proctoring center. Should you have any questions, please contact the professor.

## Important Information

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### Policies

Please review the [FIU's Policies and Netiquette](#) webpage. The policies webpage contains essential information regarding guidelines relevant to all courses at FIU, as well as additional information about acceptable netiquette for online courses.

As a member of the FIU community you are expected to be knowledgeable about the behavioral expectations set forth in the [FIU Student Code of Conduct](#).

## Technical Requirements and Skills

One of the greatest barriers to taking an online course is a lack of basic computer literacy. By computer literacy we mean being able to manage and organize computer files efficiently, and learning to use your computer's operating system and software quickly and easily. Keep in mind that this is not a computer literacy course; but students enrolled in online courses are expected to have moderate proficiency using a computer. Please go to the "[What's Required](#)" webpage to find out more information on this subject.

Privacy Policy Statements for partners and Vendors

- [Canvas](#)
- [Microsoft](#)
- [Adobe](#)
- [Google](#)
- [ProctorU](#)
- [HonorLock \(PDF\)](#)
- [Turnitin](#)
- [NBC Learn](#)
- [OpenStax](#)
- [Adobe Connect](#)
- [Respondus LockDown Browser](#)
- [Zoom](#)

This course utilizes the following tools:

1. The course assignments and project are developed based on “Zybo-Z7 FPGA Development Board”.
2. Student will borrow the FPGA Board and associated Pmods from the ECE department. **Students must return the FPGA board and associated Pmods to the ECE department at the end of the semester.**
3. The board does not come with a cable, a USB Cable, Type A to Type Micro-B is needed. If you do not have one, order a good quality cable from Amazon or other vendors.

Please visit our [Technical Requirements](#) webpage for additional information.

## Accessibility and Accommodation

The Disability Resource Center collaborates with students, faculty, staff, and community members to create diverse learning environments that are usable, equitable, inclusive and sustainable. The DRC provides FIU students with disabilities the necessary support to

successfully complete their education and participate in activities available to all students. If you have a diagnosed disability and plan to utilize academic accommodations, please contact the Center at 305-348-3532 or visit them at the Graham Center GC 190.

For additional assistance please contact FIU's [Disability Resource Center](#).

Web Accessibility Statements for Partners and Vendors

- [Canvas](#)
- [Microsoft](#)
- [Adobe](#)
- [Google](#)
- [ProctorU](#)
- [HonorLock](#)
- [OpenStax](#)
- [Turnitin](#)
- [NBC Learn](#)
- [Adobe Connect](#)
- [Respondus LockDown Browser](#)
- [Zoom](#)

Please visit our [ADA Compliance](#) webpage for additional information about accessibility involving the tools used in this course.

## Academic Misconduct Statement

Florida International University is a community dedicated to generating and imparting knowledge through excellent teaching and research, the rigorous and respectful exchange of ideas and community service. All students should respect the right of others to have an equitable opportunity to learn and honestly to demonstrate the quality of their learning. Therefore, all students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the educational mission of the University. All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the Academic Misconduct procedures and sanctions, as outlined in the Student Handbook.

Academic Misconduct includes: **Cheating** – The unauthorized use of books, notes, aids, electronic sources; or assistance from another person with respect to examinations, course assignments, field service reports, class recitations; or the unauthorized possession of examination papers or course materials, whether originally authorized or not. **Plagiarism** – The use and appropriation of another's work without any indication of the source and the representation of such work as the student's own. Any student who fails to give credit for ideas, expressions or materials taken from another source, including internet sources, is responsible for plagiarism.

Learn more about the [academic integrity policies and procedures](#) as well as [student resources](#) that can help you prepare for a successful semester.

## Panthers Care & Counseling and Psychological Services (CAPS)

If you are looking for help for yourself or a fellow classmate, Panthers Care encourages you to express any concerns you may come across as it relates to any personal behavior concerns or worries you have, for the classmate's well-being or yours; you are encouraged to share your concerns with [FIU's Panthers Care website](#).


[Counseling and Psychological Services \(CAPS\)](#) offers free and confidential help for anxiety, depression, stress, and other concerns that life brings. Professional counselors are available for same-day appointments. Don't wait to call 305-348-2277 to set up a time to talk or visit the online self-help portal.

## Course Prerequisites

This course has a prerequisite(s). Review the [Course Catalog](#) webpage for prerequisites information.

- EEL4709C

## Textbook and Course Materials

	<p>Embedded System Design Frank Vahid, Tony D. Givargis Wiley, Oct-2001 Oct-2001 ISBN-10: 0471386782 ISBN-13: 0471386782 Notes Recommended Bookstore Info</p>
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This book introduces a modern approach to embedded system design, presenting software design and hardware design in a unified manner. It covers trends and challenges, introduces the design and use of single-purpose processors ("hardware") and general-purpose processors ("software"), describes memories and buses, illustrates hardware/software tradeoffs using a digital camera example, and discusses advanced computation models, controls systems, chip technologies, and modern design tools. For courses found in EE, CS and other engineering departments.



Digital Design  
Peter J. Ashenden  
Elsevier, Dec-2007  
Dec-2007  
ISBN-10: 9780123695284  
ISBN-13: 9780123695284  
Notes  
Recommended  
Bookstore Info

Digital Design: An Embedded Systems Approach Using VHDL provides a foundation in digital design for students in computer engineering, electrical engineering and computer science courses. It takes an up-to-date and modern approach of presenting digital logic design as an activity in a larger systems design context. Rather than focus on aspects of digital design that have little relevance in a realistic design context, this book concentrates on modern and evolving knowledge and design skills. Hardware description language (HDL)-based design and verification is emphasized--VHDL examples are used extensively throughout. By treating digital logic as part of embedded systems design, this book provides an understanding of the hardware needed in the analysis and design of systems comprising both hardware and software components. Includes a Web site with links to vendor tools, labs and tutorials. . Presents digital logic design as an activity in a larger systems design context. . Features extensive use of VHDL examples to demonstrate HDL (hardware description language) usage at the abstract behavioural level and register transfer level, as well as for low-level verification and verification environments. . Includes worked examples throughout to enhance the reader's understanding and retention of the material. . Companion Web site includes links to tools for FPGA design from Synplicity, Mentor Graphics, and Xilinx, VHDL source code for all the examples in the book, lecture slides, laboratory projects, and solutions to exercises.

## Course Materials

This course utilizes the following tools:

1. The course assignments and project are developed based on "[Zybo - Z7 FPGA development board](#)".
2. Student will borrow the FPGA Board and associated Pmods from the ECE department. **Students must return the FPGA board and associated Pmods to the ECE department at the end of the semester.**
3. The board does not come with a cable, a USB Cable, Type A to Type Micro-B is needed. If you do not have one, order a good quality cable from Amazon or other vendors.

## Expectations of This Course

This is an online course, which means most (if not all) of the course work will be conducted online. Expectations for performance in an online course are the same for a traditional course. In fact, online courses require a degree of self-motivation, self-discipline, and technology skills which can make these courses more demanding for some students.

**Students are expected to:**

- Log in to the course at least once a week
- Respond to messages within three days
- Submit assignments by the corresponding deadline
- Participate in learner-content and learner-instructor interactions. Further learner-learner interaction is not appropriate for this course.

**The instructor will:**

- Log in to the course daily.
- Respond to messages within one day
- Grade assignments within five days of the assignment deadline

## Course Detail

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### Course Communication

Communication in this course will take place via the Canvas Inbox. Check out the [Canvas Conversations Tutorial](#) or [Canvas Guide](#) to learn how to communicate with your instructor and peers using Announcements, Discussions, and the Inbox. I will respond to all correspondences within *one day*.

### Discussion Forums

Keep in mind that your discussion forum postings will likely be seen by other members of the course. Care should be taken when determining what to post.

**Open Forum:**

- Students may post general concerns related to the class
- Students cannot post any assignment results/answers or related files  
Available dates (unlimited)
- Forums are not graded, it is another means to help students via peer discussion

**Class Forum Posts:**

- The instructor will post a prompt for students to answer.
- Students may review the posts of peers, but need not comment or respond.
- Five points are earned for completion.

## Assessments

In order to mitigate any issues with your computer and online assessments, it is very important that you take the "Practice Quiz" from each computer you will be using to take your graded quizzes and exams. It is your responsibility to make sure your computer meets the minimum [hardware requirements](#).

All assessments will auto-submit when (1) the timer runs out OR (2) the closing date/time is reached, **whichever happens first**. For example, if a quiz has a closing time of 5:00 pm but the student begins the exam at 4:55 pm, the student will only have 5 minutes to complete the quiz.

Assessments in this course are not compatible with mobile devices and should not be taken through a mobile phone or a tablet. If you need further assistance please contact [FIU Online Support Services](#).

### Quiz Expectations:

- This course includes four multiple-choice quizzes for self-assessment.
- One attempt is allowed. Quiz duration is 30 minutes.
- Quizzes are available Friday - Sunday on the dates posted in Canvas.
- Students will be able to see the results and answers the day after submission due date.

### Exam Expectations:

- This course includes one midterm and one comprehensive final exam.
- Midterm exam covers modules 1, 2, and 3.
- Final exam is cumulative and includes the material covered in all the modules.
- Both midterm and final exam are closed book.
- The **Midterm exam** is scheduled on **Monday 10/10/2022 at 7 pm - 8:00 pm**. Honorlock will be used to proctor the exam.
- If you are not familiar with honorlock take honorlock practice quiz to be prepared for midterm exam.
- The **Final exam** is scheduled on **Monday 11/28/2022 at 7 pm - 8:30 pm**. Honorlock will be used to proctor the exam.
- One attempt is permitted.
- No make up or alternate date is available for midterm and final exam.

## Assignment Expectations

### Assignment Expectations:

- This course requires eight assignments. Assignment 1 covers embedded system introductory concepts. All other assignment require that students write code that will run on an FPGA development board.
- Students must use Xilinx Vivado to compile coding assignments.



- The code and in some cases a video of the code running on the board must be submitted.
- Students may post questions to the general forum.
- Grading criteria is posted in assignment file.
- No group work is permitted.
- Students will be able to see the results five days after submission.

### Final Project Expectations:

- Students will design an embedded system.
- Students must use Zybo - Z7 FPGA development board and Xilinx Vivado to complete assignments. Students will submit coding and demonstrate their design during live Zoom meeting. The coding and details of project design will be submitted in one project report document.
- Grading criteria is posted in assignment file.
- Students have the option of working in a group for their final project.

## Assignments

Assignments	0% of Total
No assignments in this group	
Assignments	32% of Total
Assignment 1 Due Sep 04 2022 at 11:59 pm   4 pts	
Assignment 0 Due Sep 04 2022 at 11:59 pm	
Assignment 2 Due Sep 11 2022 at 11:59 pm   4 pts	
Assignment 3 Due Sep 18 2022 at 11:59 pm   4 pts	
Assignment 4 Due Oct 09 2022 at 11:59 pm   4 pts	
Assignment 5 Due Oct 23 2022 at 11:59 pm   4 pts	

**Assignment 6**

**Due** Nov 06 2022 at 11:59 pm | 4 pts

**Assignment 7**

**Due** Nov 13 2022 at 11:59 pm | 4 pts

**Assignment 8**

**Due** Nov 20 2022 at 11:59 pm | 4 pts

**Quizzes**

8% of  
Total

**Quiz 4**

**Due** Nov 06 2022 at 11:59 pm | 2 pts

**Quiz 2**

**Due** Sep 18 2022 at 11:59 pm | 2 pts

**Quiz 1**

**Due** Sep 04 2022 at 11:59 pm | 2 pts

**Quiz 3**

**Due** Oct 09 2022 at 11:59 pm | 2 pts

**Midterm Exam**

14% of  
Total

**Midterm Exam**

**Due** Oct 10 2022 at 8:00 pm | 12 pts

**Final Exam**

25% of  
Total

**Final Exam**

**Due** Nov 28 2022 at 8:30 pm | 25 pts

**Final Project**

23% of  
Total

**Final Project Proposal**

**Due** Oct 30 2022 at 11:59 pm | 1 pts

**Final Project Report**

**Due** Dec 03 2022 at 11:59 pm | 22 pts

**Zoom Video Conference**

Zoom is a video conference tool that you can use to interact with your professor and fellow students by sharing screens, chatting, broadcasting live video/audio, and taking part in other interactive online activities. We will be utilizing this tool to conduct meetings as requested.

### [Zoom Test Meeting Room](#)

Use this link to access the Zoom Test Meeting Room. This meeting room is available to test out the software before joining an actual session.

Reference the provided links to access Zoom student tutorials to learn about the tool, how to access your meeting room, and share your screen.

- [Download Zoom.](#)
- [Login to Zoom through Desktop Application](#)
- [Enable and Test Audio & Webcam.](#)
- [Schedule a meeting](#) or [Join a Zoom meeting.](#)
- [Invite others to join meeting.](#)
- [Chat \(Professors\) - Students look at attendees section for instructions.](#)
- [Share My Screen.](#)
- [Record a Local Zoom meeting.](#)
- [Host Control in Meetings.](#)
- [Getting Started with iOS.](#)
- [Getting Started with Android.](#)

## Grading

Course Requirements	Number of Items	Points for Each	Total Points Available	Weight
Assignments	8	4	32	32%
Quizzes	4	2	8	8%
Midterm	1	12	12	12%
Final Project	1	23	23	23%
Final Exam	1	25	25	25%
<b>Total</b>	<b>9</b>	<b>N/A</b>	<b>100</b>	<b>100%</b>

## Grading Range

Letter	Range (%)	Letter	Range (%)	Letter	Range (%)
A	95 or above	B	83 - 86	C	70 - 76
A-	90 - 94	B-	80 - 82	D	60 - 69
B+	87-89	C+	77 - 79	F	59 or less

## Course Calendar

### Modules

#### Module 0 | Getting Started

Getting Started with Canvas

#### Module 1 | Introduction to Embedded Systems | 8/22 - 9/4

Module 1 Outline

Lecture – Introduction to Embedded Computing Systems

Class Forum Post

Assignment 0

Sep 04 | 0 pts

Assignment 1

Sep 04 | 4 pts

Quiz 1

Sep 04 | 2 pts

#### Module 2 | Programming FPGA in VHDL | 9/5 - 9/18

Module 2 Outline

I. Lecture - IC Technologies – FPGA

II. Lecture - VHDL

III. Lecture - VHDL Combinational Basics

IV. Lecture - Zybo Z7

Assignment 2

Sep 11 | 4 pts

Assignment 3

Sep 18 | 4 pts

Quiz 2

Sep 18 | 2 pts

**Module 3 | Design and Implementation of a Controller in VHDL | 9/19 - 10/9**

Module 3 Outline

I. Lecture - Numeric Basics

II. Lecture - Sequential Basics

III. Lecture - Controller Design

IV. Controller Example

Assignment 4

Oct 09 | 4 pts

Quiz 3

Oct 09 | 2 pts

**Midterm Exam 10/10**

MidtermExamStudyGuide.pdf

Midterm Exam

Oct 10 | 12 pts

**Module 4 | Design and Implementation of Custom Single Purpose Processor  
in VHDL 10/10 - 10/23**

Module 4 Outline

I. Lecture - Custom Single-Purpose Processor Design

II. Single-Purpose Processor Example

Assignment 5  
Oct 23 | 4 pts

**Module 5 | General-Purpose Processors and Microcontrollers | 10/17- 11/6**

Module 5 Outline

I. Lecture - General Purpose Processors

II. Lecture - Vitis Demonstration

Quiz 4  
Nov 06 | 2 pts

Assignment 6  
Nov 06 | 4 pts

**Module 6 | Peripherals 11/7- 11/27**

Module 6 Outline

Lecture - Peripherals

Assignment 8 Demo

Assignment 7  
Nov 13 | 4 pts

Assignment 8  
Nov 20 | 4 pts

**Final Exam 11/28**

FinalExamStudyGuide.docx

Final Exam  
Nov 28 | 25 pts

**Final Project 6/21 - 7/29**

Final Project Proposal  
Oct 30 | 1 pts

Final Project Report  
Dec 03 | 22 pts

**Student Resources**

FIU Resources

Technical Support

Policies