Ve373 Design of Microprocessor Based Systems

Summer 2018

Instructor: Gang Zheng, Ph.D.
Office: JI New Building 400E
Contact: gzheng@sjtu.edu.cn
Office Hours: W 12:00 – 2:00pm / Th 10:00am – 12:00pm, or by appointment
Classroom: D409
Class Time: T/Th 4:00 – 5:40pm, F 12:10 – 1:50pm (even weeks only)
TA: Ms. LYU Zhengyang, wendylyu@sjtu.edu.cn

Course Description:
This course is designed to cover different aspects of microprocessor-based system, and consists of both lecture and laboratory sessions. Topics include microprocessor memory map, software development, simulation, debugging and testing; hardware and software interfacing; principles of interrupts; peripheral configuration and control for Timers, UART, ADC, PWM, I^2C, and other external devices. Experiments with specially designed laboratory facilities will help students to develop skills for embedded software development using assembly and C programming languages.

Credits: 4

Prerequisites*:* Ve270 and Ve370 or instructor permission

Course Objectives:
1) To teach students PIC microprocessor architecture and various peripherals
2) To teach students how the hardware and software components of a microprocessor-based system work together to implement system level features.
3) To teach students the operating principles of, and provide hands-on experience with, common microprocessor peripherals such as UARTs, timers, and ADC.
4) To provide practical experience in applied digital logic design and embedded C programming.
5) To expose students to the tools and techniques used by practicing engineers to design, implement, and debug microprocessor-based systems.

Course Outcomes:
1) Be able to implement a complete microprocessor-based system using the components provided in the lab, including input and output peripheral devices, and simple but complete control software.
2) Given a digital device and its reference manual, be able to write control software in assembly or C programming languages to initialize and perform operations on the device.
3) Be able to interface external controllers, such as an LCD controller through, I/O ports
4) Be able to handle timed signals using internal timers and timing management system
5) Be able to handle multiple peripherals using interrupts
6) Understand the importance of, and be able to apply power saving operations in microprocessor-based system designs

7) Understand basic communication techniques used in modern embedded systems, and be able to establish communications between embedded devices using UART, SPI, or I^2C

References:

- PIC32 Documentation (electronic copy available)
- MIPS32 Documentation (electronic copy available)
- Lucio Di Jasio, "*Programming 32-bit Microcontrollers in C, Exploring the PIC32*", by Elsevier, 2008, ISBN: 978-0-7506-8709-6 (shared copy in JI library)

Course Policies:

- **Honor Code:** All students in the class are bound by the Honor Code of the Joint Institute (http://umji.sjtu.edu.cn/academics/academic-integrity/honor-code/). You may not seek to gain an unfair advantage over your fellow students; you may not consult, look at, or possess the unpublished work of another without their permission; and you must appropriately acknowledge your use of another's work.
- Test: The test procedure will be announced prior to the tests. Anyone violating the testing procedure will be given an 'F' for the test.
- Attendance: Attendance will be randomly taken. 5% will be deducted from the final grade for each absence starting from the 4th one**.**
- Participation: Active participation in course meetings is expected for all students. With each submitted assignment, students should be prepared to explain their solutions to the class.
- Submission: Homework assignments are due on the specified date before the class begins. **No late homework assignments will be accepted**. However, the instructor reserves the right to waive the penalty for emergencies (e.g. hospitalization) or arrangement made with the instructor 24 hours prior to the due date. **Late submission of the lab source files and peer evaluation reports will result in 0 point for the corresponding parts of a lab. No lab grade will be given until all the files are submitted.**
- Lab Demonstration: Students should successfully demonstrate a working circuit to the TAs before your lab session ends. **Late lab demonstration is acceptable with 20% deduction for every day extended beyond your lab session.**
- Individual Assignments: Students are encouraged to discuss course topics and homework assignments with each other. However, all submissions must represent your own work. Duplicated submission is absolutely not allowed and will trigger an honor code violation investigation.
- Group Assignments: Some assignments will be team efforts. The work submitted must reflect the work of the team. The grade for a group assignment will be shared among the entire team equally, unless specified differently.

Course Outline: (*Tentative and subject to change*)

Week	Dates	Topics
1	5/15	Course introduction, introduction to embedded systems
	5/17	PIC MCU architecture
2	5/22	PIC MCU architecture
	5/24	Embedded programming
	5/25	Embedded programming
3	5/29	Embedded programming (Lab 1, 1 week)

	5/31	Embedded software tools
4	6/5	Timers
	6/7	Timers (Lab 2, 1 week)
	6/8	Interrupts
5	6/12	Interrupts, LCD controller (Lab 3, 1 week)
	6/14	Power-saving operations, input capture
6	6/19	Output compare, PWM
	6/21	Output compare, PWM (Lab 4, 1 week)
	6/22	Analog to digital converter (ADC)
7	6/26	Analog to digital converter (ADC)
	6/28	UART (Lab 5, 1 week)
8	7/3	SPI and I^2C
	7/5	CAN
	7/6	DMA (Lab 6, 1 week)
9	7/10	RTOS
	7/12	**Final Exam** (*Lab 7, 1 week*)
10	7/17	Project proposal
	7/19	Project proposal
	7/20	Project coverage
11	7/24	Final Project coverage (in lab)
	7/26	Final Project coverage (in lab)
12	7/31	Final Project coverage (in lab)
	8/2	Final Project coverage (in lab)
	8/3	Final Project coverage (in lab)
13	TBD	**Final Project Demonstration**

Grading Policy:

Homework*	10%
Laboratory**	35%
Final Exam	30%
Final Project**	25%
Total	**100%**

*Individual assignments
**Group assignments
Note: final letter grades will be curved.