San José State University
Department of Computer and Software Engineering
CMPE240, Advanced Microcomputer Design, 1, Fall, 2023

Course and Contact Information

Instructor(s): Harry Li
Office Location: Engineering Building, Room 267A
Telephone: (650) 400-1116
Email: hua.li@sjsu.edu
Office Hours: M.W. 3:00-4:00 pm
Class Days/Time: Mondays, Wednesdays, 1:30-2:45 pm
Classroom: Engineering Building, Room 331
Prerequisites: CmpE 180D for non CMPE or non EE undergraduate major. Students who do not provide documentation of having satisfied the class prerequisite requirements by the second class meeting will be dropped from the class.

Course Description

Architecture of a computing system including system bus, memory subsystems and peripherals. Uni-directional and bidirectional bus architectures, SRAM and FLASH memories and their interfaces with the system bus. Design of Graphics Processing Engines, interrupt controller, transmitter receiver, timers, display adapter, and other system peripherals and bus interfaces.

Course Format

Faculty Web Page and MYSJSU Messaging (Delete if not applicable)

Copies of the course materials such as the syllabus, major assignment handouts, etc. can be found on line at SJSU CANVAS, the same material is also provided online, see URL below:
https://github.com/hualili/CMPE240-Adv-Microprocessors/tree/master/2018F Office hours zoom link: Join Zoom Meeting https://us04web.zoom.us/j/9841607683?pwd=UlA3aEk1TnV4bjNLQk5CQkw0dDk4UT09 Meeting ID: 984 160 7683 Passcode: 121092

Course Learning Outcomes (CLO)

Upon successful completion of this course, students will be able to:

1. design a system bus.
2. understand memory sub-systems and design their interface with a system bus.
3. design system peripherals and interface them to the system bus.
4. understand the overall system functionality .

Required Texts/Readings

Textbook

- NXP LPC17xx datasheets;

- LPC1768/1769 CPU Module schematics;
- Dave Jaggar, ARM Architectural Reference Manual, Prentice Hall, ISBN 0-13-736299-4;
- Reference: ARM11 data sheets and on-line web materials on line https://github.com/hualili/ , or at the SJSU CANVAS provided copyright permitted;
- (Optional) Nvidia Jetson NANO datasheet and user menu (online from Nvidia developer website);
- (Optional) RISC-V tutorial (the link to be given in the lecture) and FPGA verilog implementation guide (the link to be given in the lecture).

Other Readings

1. The reference material for ARM CPU hardware features, application notes, class handouts and lab assignments and reports, please see Professor Li's lecture notes, PPT, sample C code etc on line https://github.com/hualili/CMPE240-Adv-Microprocessors ;
2. Professor Li's book materials, ARM Microprocessor Systems (in preparation for publication) https://github.com/hualili/CMPE240-Adv-Microprocessors .

Other technology requirements / equipment / material

32Bit RISC Prototype/Development Board.

Course Requirements and Assignments

1. All the submissions (Homework, Projects, Quiz, Exams) must be made to SJSU CANVAS, no email submission is accepted;
2. No late submission (Homework, Projects, Quiz, Exams) will be accepted. For special case of late submission, 25% mark reduction will be given;
3. Attendance to the class is required.
Explain how course requirements, reading materials, learning activities, and assignments contribute to or are aligned with course learning outcomes. Include information about general expectations, roles and responsibilities of the students, due dates and assignment weights.

SJSU classes are designed such that in order to be successful, it is expected that students will spend a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on. More details about student workload can be found in University Policy S12-3 at http://www.sjsu.edu/senate/docs/S12-3.pdf.

NOTE that University policy F69-24 at http://www.sjsu.edu/senate/docs/F69-24.pdf states that "Students should attend all meetings of their classes, not only because they are responsible for material discussed therein, but because active participation is frequently essential to insure maximum benefit for all members of the class. Attendance per se shall not be used as a criterion for grading."

The University Syllabus policy:
- University Syllabus Policy S16-9

University Policy S16-9, requires that: "Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practice. Other course structures will have equivalent workload expectations as described in the syllabus."

Final Examination or Evaluation

Final examination is a comprehensive exam and it is close-book, close-note. Per the University policy S17-1 "Faculty members are required to have a culminating activity for their courses, which can include a final examination, a final research paper or project, a final creative work or performance, a final portfolio of work, or other appropriate assignment."

Grading Information

Quiz, Homework, Projects   30%
Midterm Examination   30%
Final Examination   40%

- University Attendance and Participation Policy F15-12
- University Grading System Policy F18-5

Determination of Grades
- The course grade will be determined by the accumulative scores made from quiz, homework, projects, midterm exam, final exam.
- No extra credit options.
- No late homework will be accepted.

Grade	Points	Percentage
A plus	960 to 1000	96 to 100%
A	930 to 959	93 to 95%
A minus	900 to 929	90 to 92%
B plus	860 to 899	86 to 89 %
B	830 to 859	83 to 85%
B minus	800 to 829	80 to 82%
C plus	760 to 799	76 to 79%
C	730 to 759	73 to 75%
C minus	700 to 729	70 to 72%
D plus	660 to 699	66 to 69%
D	630 to 659	63 to 65%
D minus	600 to 629	60 to 62%

Option 1. Target CPU Module Board
NXP LPC 11C24 ARM CPU Module (recommended as the replacement for LPC1769 for this course), NXP LPC1769 ARM CPU Module (towards the end of life by and around 2024).

Option 2. Other CPU Module Boards
Nvidia Jetson NANO board as a target platform in addition to NXP LPC platform.
https://www.google.com/search?channel=fs&client=ubuntu&q=nvidia+jetson+nano+2gb+developer+kit

Open source architecture RISC-V FPGA board with Verilog Implementation of IP core and RTOS software tools, in additional to NXP LPC platform.
https://riscv.org/wp-content/uploads/2017/02/riscv_fosdem17.pdf

Prototype Board
Using wire wrapping board is required. Note, using prebuild PCB board as a LCD display board to couple with the target CPU module board is permitted.

Classroom Protocol

Class participation and attendance are required, please arrive on time, you can bring your laptop to the class if needed. No late homework/project will be accepted. For uncontrollable exceptional situations, late penalty will apply. Exams must be completed on time and submitted to SJSU Canvas.

University Policies

Per University Policy S16-9 ,relevant university policy concerning all courses, such as student responsibilities, academic integrity, accommodations, dropping and adding, consent for recording of class, etc. and available student services (e.g. learning assistance, counseling, and other resources) are listed on Syllabus Information web page (https://www.sjsu.edu/curriculum/courses/syllabus-info.php). Make sure to visit this page to review and be aware of these university policies and resources.

General Expectations, Rights and Responsibilities of the Student

As members of the academic community, students accept both the rights and responsibilities incumbent upon all members of the institution. Students are encouraged to familiarize themselves with SJSU's policies and practices pertaining to the procedures to follow if and when questions or concerns about a class arises. See University Policy S90–5 at http://www.sjsu.edu/senate/docs/S90-5.pdf. More detailed information on a variety of related topics is available in the SJSU catalog, at http://info.sjsu.edu/web-dbgen/narr/catalog/rec-12234.12506.html. In general, it is recommended that students begin by seeking clarification or discussing concerns with their instructor. If such conversation is not possible, or if it does not serve to address the issue, it is recommended that the student contact the Department Chair as a next step.

Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester's Catalog Policies section at http://info.sjsu.edu/static/catalog/policies.html. Add/drop deadlines can be found on the current academic year calendars document on the Academic Calendars webpage at http://www.sjsu.edu/provost/services/academic_calendars/. The Late Drop Policy is available at http://www.sjsu.edu/aars/policies/latedrops/policy/. Students should be aware of the current deadlines and penalties for dropping classes.

Information about the latest changes and news is available at the Advising Hub at http://www.sjsu.edu/advising/.

Consent for Recording of Class and Public Sharing of Instructor Material

University Policy S12-7, http://www.sjsu.edu/senate/docs/S12-7.pdf, requires students to obtain instructor's permission to record the course and the following items to be included in the syllabus:

- "Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor's permission to make audio or video recordings in this class. Such permission allows the recordings to be used for your private, study purposes only. The recordings are the intellectual property of the instructor; you have not been given any rights to reproduce or distribute the material."

- It is suggested that the greensheet include the instructor's process for granting permission, whether in writing or orally and whether for the whole semester or on a class by class basis.
  - In classes where active participation of students or guests may be on the recording, permission of those students or guests should be obtained as well.
- "Course material developed by the instructor is the intellectual property of the instructor and cannot be shared publicly without his/her approval. You may not publicly share or upload instructor generated material for this course such as exam questions, lecture notes, or homework solutions without instructor consent."

Academic integrity

Your commitment, as a student, to learning is evidenced by your enrollment at San Jose State University. The University Academic Integrity Policy S07-2 at http://www.sjsu.edu/senate/docs/S07-2.pdf requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The Student Conduct and Ethical Development website is available at http://www.sjsu.edu/studentconduct/.

Campus Policy in Compliance with the American Disabilities Act

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 at http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf requires that students with disabilities requesting accommodations must register with the Accessible Education Center (AEC) at http://www.sjsu.edu/aec to establish a record of their disability.

Accommodation to Students' Religious Holidays

San José State University shall provide accommodation on any graded class work or activities for students wishing to observe religious holidays when such observances require students to be absent from class. It is the responsibility of the student to inform the instructor, in writing, about such holidays before the add deadline at the start of each semester. If such holidays occur before the add deadline, the student must notify the instructor, in writing, at least three days before the date that he/she will be absent. It is the responsibility of the instructor to make every reasonable effort to honor the student request without penalty, and of the student to make up the work missed. See University Policy S14-7 at http://www.sjsu.edu/senate/docs/S14-7.pdf.

Student Technology Resources

Computer labs for student use are available in the Academic Success Center at http://www.sjsu.edu/at/asc/ located on the 1st floor of Clark Hall and in the Associated Students Lab on the 2nd floor of the Student Union. Additional computer labs may be available in your department/college. Computers are also available in the Martin Luther King Library. A wide variety of audio-visual equipment is available for student checkout from Media Services located in IRC 112. These items include DV and HD digital camcorders; digital still cameras; video, slide and overhead projectors; DVD, CD, and audiotape players; sound systems, wireless microphones, projection screens and monitors.

SJSU Peer Connections

Peer Connections, a campus-wide resource for mentoring and tutoring, strives to inspire students to develop their potential as independent learners while they learn to successfully navigate through their university experience. You are encouraged to take advantage of their services which include course-content based tutoring, enhanced study and time management skills, more effective critical thinking strategies, decision making and problem-solving abilities, and campus resource referrals.

In addition to offering small group, individual, and drop-in tutoring for a number of undergraduate courses, consultation with mentors is available on a drop-in or by appointment basis.   Workshops are offered on a wide variety of topics including preparing for the Writing Skills Test (WST), improving your learning and memory, alleviating procrastination, surviving your first semester at SJSU, and other related topics. A computer lab and study space are also available for student use in Room 600 of Student Services Center (SSC).

Peer Connections is located in three locations: SSC, Room 600 (10th Street Garage on the corner of 10th and San Fernando Street), at the 1st floor entrance of Clark Hall, and in the Living Learning Center (LLC) in Campus Village Housing Building B. Visit Peer Connections website at http://peerconnections.sjsu.edu for more information.

SJSU Writing Center

The SJSU Writing Center is located in Clark Hall, Suite 126. All Writing Specialists have gone through a rigorous hiring process, and they are well trained to assist all students at all levels within all disciplines to become better writers. In addition to one-on-one tutoring services, the Writing Center also offers workshops every semester on a variety of writing topics. To make an appointment or to refer to the numerous online resources offered through the Writing Center, visit the Writing Center website at http://www.sjsu.edu/writingcenter. For additional resources and updated information, follow the Writing Center on Twitter and become a fan of the SJSU Writing Center on Facebook. (Note: You need to have a QR Reader to

scan this code.)

SJSU Counseling Services

The SJSU Counseling Services is located on the corner of 7th Street and San Fernando Street, in Room 201, Administration Building. Professional psychologists, social workers, and counselors are available to provide consultations on issues of student mental health, campus climate or psychological and academic issues on an individual, couple, or group basis. To schedule an appointment or learn more information, visit **Counseling Services website** at http://www.sjsu.edu/counseling**.**

CMPE240 Adv. Microcomputer Design, Spring 2023, Course Schedule

The final exam will be held on line, the schedule of the final exam can be found here: https://www.sjsu.edu/classes/final-exam-schedule/ The schedule is subject to change with fair notice and the notice will be made available to the class via email.

Course Schedule

Week/ Lesson/ Module (Delete if not applicable)	Date	Topics, Readings, Assignments, Deadlines *(If appropriate, add extra column(s) to meet your needs.)*	Learning Outcomes (Delete if not applicable)
1	8/21	Organizational Meeting and Introduction, Overview of a RISC Microprocessor System with CPU datasheet.	
2	8/28	Review of the RISC CPU architecture	
3	8/28	CPU core, peripheral controllers	
4	9/4	Bus system, memory controllers as well as graphics engine. IDE Tool debugging capability. NXP Xpresso (IDE: integrated development environment).	
5	9/11	Design a microprocessor system with CPU module.	
6	9/18	I/O peripheral controllers, GPIO and SPI controller for design and building SPI interface. Graphics display and processing engine. 2D Graphics Processing Engine Design and Emulation	
7	9/25	2D Graphics Processing Engine Design and Emulation	
8	10/2	2D Graphics Processing Engine Design and Emulation	
9	10/9	Midterm	
10	10/16	3D vector graphics processing for ARM Cortex Core. LCD Display adapter design. Implementation of LCD display.	
11	10/23	World to viewer transformations, and linear decoration algorithm.	
12	10/30	3D vector graphics processing: Shadows and Diffuse Reflection	
13	11/6	3D vector graphics processing: Decoration Algorithm	
14	1113	3D vector graphics processing: Diffuse Reflection and Bilinear Interpolation	
15	11/20	3D vector graphics processing: DDA for Diffuse Reflection	
16	11/27	Integration of Microcomputer Design with 2D and 3D	

Week/ Lesson/ Module (Delete if not applicable)	Date	Topics, Readings, Assignments, Deadlines (If appropriate, add extra column(s) to meet your needs.)	Learning Outcomes (Delete if not applicable)
		GE (Graphics Engine) , benchmark of the system performance.	
17	12/4	Integration of Microcomputer Design with 2D and 3D and benchmark of the system performance. Dec. 6th, Last Day of Instruction, review, Q&A	
Final Exam	Wednes day, Dec 13:12:15 -2:30 PM	*The schedule of the final exam can be found here: https://www.sjsu.edu/classes/final-exam-schedule/ The schedule is subject to change with fair notice and the notice will be made available to the class via email.*	