Extended syllabus

Course Title	**Embedded Computer Architecture**	Course Number	CSE4011
Credit	**Theory (3.0) Experiment (0.0) Design (0.0)**	Eligible Student	Junior or Senior
Class time	Mon, Wed 16:30~17:45	Venue	

Professor's Picture	Name: Hyuk-Jun Lee	Homepage: http://ecl.sogang.ac.kr
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Ⅰ. Course Description

1. Description

- Study various architectures and fundamental theories of processor, memory system, and IO devices which are core components of the embedded system.
- Study how to analyze performance and cost quantitatively and trade-offs between performance and cost.
- Study the embedded system design methodology by looking at real embedded system examples.

2. Prior learning contents

Introduction to digital logic and circuits (required), Computer Architecture and logic (optional).

3. Course Format(%)

Lecture	Discussion	Experiment/Practice	Field study	individual/T	Others/ Extra
90 %	10 %	%	%	%	%

4. Evaluation(%)

mid-term Exam	final exam	Quiz	Presentation	Project	Assignments	Participation	Others/ Extra
40 %	40 %	%	%	%	15 %	5 %	%

Ⅱ. Course Purpose

Knowledge:

1) Understanding differences between General Purpose Computer and Embedded Computer.
2) Understanding how to evaluate the performance of program given processor, memory, and I/O architecture.
3) Understanding various program optimization techniques at the instruction level.

Skill:

1) Designing skills for embedded systems.
2) Performance and cost analysis skill given hardware architecture.
3) Program optimization skill at the instruction level.

Attitude:

Always considering various trade-offs between cost and performance.

Ⅲ. Course Format

A. This course is based on lectures. The lecture will accompany series of questions by instructors and answers from students. Student participation and inquiries are essential components of classes.

B. Before each lecture, lecture notes and announcements will be posted on cyber campus.

Ⅳ. Course Requirements

1) Homework
- Homeworks will be posted on Cyber Campus. Typically the due date for homework is one week later after the assignment.
- Late submission will be accepted for three days after the due date and subject to 20% penalty per day. After three days, late homework will not be accepted.

2) Grading
- Based on curve
- 15, 40, 40, and 5 percent of total grade will be allocated to Homework, Midterm, Final, Paticipation.
- Midterm and Final exam is Closed Book exam.

Ⅴ. Materials and References

1) Textbook
- Lecture Notes will be posted on cyber campus.

2) References
- Computer Organization and Design, D. Patterson and J. Hennessy, (ARM edition), Elsevier (or Morgan Kaufmann), 2010.
- J.L. Hennessy and D.A. Patterson, Computer Architecture: A Quantitative Approach, 4th edition, Morgan Kaufmann, 2006
- ARM System Developer's Guide, A. Sloss, D. Symes, and C. Wright, Morgan Kaufmann,2004

Ⅵ. Course schedule

1 week	Learning objective	Overview on embedded systems.
	Main learning contents	Introduce embedded systems and their applications. Review on computer architecture and logic.
	Teaching method and materials	Lecture PPT
	preparation must be done by student	Review on computer architecture and logic.
	References	Textbook of 'Computer architecture and logic', Reference materials.
2 week	Learning objective	Review on datapath and pipeline
	Main learning contents	Datapath and Pipeline are important to understand the performance and cost of processor core.
	Teaching method and materials	Lecture PPT
	preparation must be done by student	Review on computer architecture and logic.
	References	Reference materials.
3 week	Learning objective	Understanding about 'Instruction Level Paralleism'.
	Main learning contents	Study how to exploit instruction level parallelism using techniques like code rescheduling and loop unrolling.
	Teaching method and materials	Lecture PPT
	preparation must be done by student	Review on pipeline part on computer architecture and logic.
	References	Reference materials.
4 week	Learning objective	Understand about 'Instruction Level Paralleism'.
	Main learning contents	Application static/dynamic branch prediction for reduce the impact of Control Hazard.
	Teaching method and materials	Lecture PPT
	preparation must be done by student	Review on Control/Data Hazard part on computer architecture and logic.
	References	Reference materials.
5 week	Learning objective	Understand high-performance embedded processors.
	Main learning contents	Learning high-performance embedded processor architectures such as out-of-order execution machines, superscalar machine, VLIW machines..
	Teaching method and materials	Lecture PPT
	preparation must be done by student	Read assigned reference materials.
	References	Reference materials.

6 week	Learning objective	Understand high-performance embedded processors.
	Main learning contents	Learning high-performance embedded processor architectures such as out-of-order execution machines, superscalar machine, VLIW machines..
	Teaching method and materials	Lecture PPT
	preparation must be done by student	Read assigned reference materials.
	References	Reference materials.
7 week	Learning objective	Understand ARM processor architecture and ISA.
	Main learning contents	Understand most popular ARM processor architecture and ISA.
	Teaching method and materials	Lecture PPT
	preparation must be done by student	Review on ARM ISA and architecture.
	References	Reference materials.
8 week	Learning objective	Midterm exam.
	Main learning contents	Midterm exam.
	Teaching method and materials	Midterm exam.
	preparation must be done by student	Midterm exam.
	References	Midterm exam.
9 week	Learning objective	Understand overall memory system in embedded system.
	Main learning contents	Study memory hierarchy like Cache, Main Memory
	Teaching method and materials	Lacture PPT
	preparation must be done by student	Review on Memory hierarchy part on computer architecture and logic.
	References	Reference materials.
10 week	Learning objective	Understand virtual memory systems.
	Main learning contents	Understanding translation between Virtual memory and Physical memory.
	Teaching method and materials	Lacture PPT
	preparation must be done by student	Review on Memory hierarchy part on computer architecture and logic.
	References	Reference materials.

11 week	Learning objective	Understanding Scratchpad Memory and Cache Locking.
	Main learning contents	Introduce Scratchpad Memory and Cache Locking technic.
	Teaching method and materials	Lecture PPT
	preparation must be done by student	Reference on Cache Locking part in ARM processor manual.
	References	Reference materials.
12 week	Learning objective	Understanding storage and I/O devices and I/O operations.
	Main learning contents	Understanding I/O operation.
	Teaching method and materials	Lecture PPT
	preparation must be done by student	Preview on I/O control methods.
	References	Reference materials.
13 week	Learning objective	Understand the flash memory solid-state disk drive
	Main learning contents	Understand flash memory and solid-state disk drive
	Teaching method and materials	Lecture PPT
	preparation must be done by student	
	References	Reference materials.
14 week	Learning objective	Understand the digital camera example.
	Main learning contents	Understand design technique of embedded system using an example of digital camera.
	Teaching method and materials	Lecture PPT
	preparation must be done by student	Preview on DCT(Discrete Cosine Transform) and JPEG, Search about hardware JPEG encoder/decoder.
	References	Reference materials.
15 week	Learning objective	Topics on on-device AI.
	Main learning contents	Understand key components of on-device AI.
	Teaching method and materials	Lecture PPT
	preparation must be done by student	Background material reading.
	References	Reference materials.

16 week	Learning objective	Final exam.
	Main learning contents	Final exam.
	Teaching method and materials	Final exam.
	preparation must be done by student	Final exam.
	References	Final exam.

Ⅶ. Course Policy

1) Strictly observe FA (failure of class based on absence) law.

2) Cheating in the homeworks and exams will result in failure of the course.

Ⅷ. Special Accommodations

1) In cases you want to request special accommodations to take courses and exams due to a temporary or permanent physical, sensory, psychological/emotional or learning disability, contact instructor.

2) Require in-depth hardware knowledge on 'Computer Architecture and Logic' and 'Introduction to digital logic and circuits'. In case you did not take two course before, highly recommend to reconsider taking this course.

3) Students feel free to ask questions before and after the class and during office hours.