Knight Foundation School of Computing and Information Sciences

Course Title: Structured Computer Organization **Date:** 2/12/2018

Course Number: CDA 4101

Number of Credits: 3

Subject Area: Computer Organization	**Subject Area Coordinator:** Dong Chen **email:** dochen@cs.fiu.edu
Catalog Description: Covers the levels of organization in a computer: Design of memory, buses, ALU, CPU; design of microprogram. Covers virtual memory, I/O, multiple processes, CISC, RISC and parallel architectures.	
Textbook: Structured Computer Organization, 6th Edition, Andrew S. Tanenbaum Prentice Hall (ISBN: 0-13-291652-5)	
References: Computer Organization and Design: The Hardware/Software Interface, 3rd Edition David A. Patterson, John L. Hennessy Morgan Kaufmann (ISBN: 0123706068)	
Prerequisites Courses: CDA 3103, COP 3337 and MAD 2104 or COT 3100	
Corequisites Courses: None	

Type: Required for CS Major

Prerequisites Topics:

- Digital logic and Boolean algebra
- Machine level representation of data
- Assembly level machine organization
- Fundamental data structures

Course Outcomes:

1. Master the design of advanced combinational circuits
2. Master the design of memory and the ALU.
3. Master control unit design and RISC architectures
4. Be familiar with cache architectures, branch predictions, scheduling of multiple instruction issue and flow control
5. Be exposed to parallel architectures, including configurations, shared-memory, message passing, and taxonomy.

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Relationship between Course Outcomes and Program Outcomes

BS in CS: Program Outcomes	Course Outcomes
a) Demonstrate proficiency in the foundation areas of Computer Science including mathematics, discrete structures, logic and the theory of algorithms	1
b) Demonstrate proficiency in various areas of Computer Science including data structures and algorithms, concepts of programming languages and computer systems.	1, 2, 3, 4, 5
c) Demonstrate proficiency in problem solving and application of software engineering techniques	1
d) Demonstrate mastery of at least one modern programming language and proficiency in at least one other.	
e) Demonstrate understanding of the social and ethical concerns of the practicing computer scientist.	
f) Demonstrate the ability to work cooperatively in teams.	
g) Demonstrate effective communication skills.	

Assessment Plan for the Course & how Data in the Course are used to assess Program Outcomes

Student and Instructor Course Outcome Surveys are administered at the conclusion of each offering, and are evaluated as described in the School's Assessment Plan: https://abet.cs.fiu.edu/csassessment/

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Outline

Topic	Number of Lecture Hours	Outcome
• Introduction to architecture o Hierarchy of virtual machines o von Neumann architecture o CPU instruction execution cycle o Overview of parallel architectures o I/O devices, RAID o Review of basic logic circuit design	6	1,3,4
• Digital logic: Design of o Multiplexer, demultiplexer, encoder, decoder o Arithmetic Logic Unit, Shifter o Latch, flip-flop, register, memory organization o Bus protocols, arbitration, DMA o Data path, control unit o Microprogram	14	1,3
• Performance enhancement o Instruction prefetch o Pipelining, pipeline hazards o Cache architecture o Branch prediction o Dynamic scheduling of instructions o Speculative execution	9	2
• Instruction set architecture o CISC vs RISC o RISC Register file o Expanding opcode o Stack addressing mode o Flow control	7	3,4
• Advanced architecture o Taxonomy of parallel architectures o Exposure to shared memory	3	4,5

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Course Outcomes Emphasized in Laboratory Projects / Assignments

	Outcome	Number of Weeks
1	Microprogram design Outcomes: 1,3	3
2	Complex microprogram design Outcomes: 1,3	3

Oral and Written Communication

No significant coverage

Written Reports		Oral Presentations	
Number Required	Approx. Number of pages	Number Required	Approx. Time for each
0	0	0	0

Social and Ethical Implications of Computing Topics

No significant coverage

Topic	Class time	student performance measures

Approximate number of credit hours devoted to fundamental CS topics

Fundamental CS Area	Core Hours	Advanced Hours
Algorithms:		
Software Design:		
Computer Organization and Architecture:	**3.0**	
Data Structures:		
Concepts of Programming Languages		

Theoretical Contents

Topic	Class time
Boolean algebra	1.0

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Problem Analysis Experiences

1. Instruction set analysis

Solution Design Experiences

1. Digital circuit design
2. Microprogram design

The Coverage of Knowledge Units within Computer Science Body of Knowledge[1]

Knowledge Unit	Topic	Lecture Hours
AR4	Storage systems, coding, data integrity, memory organization, latency, cycle time, cache memories	6
AR5	I/O fundamentals, external storage, RAID architectures, bus protocols, bus arbitration, DMA	6
AR6	Implementation of simple datapath, control unit, pipelining, instruction level parallelism	14
AR7	SIMD, MIMD, VLIW, interconnection networks, shared memory systems, cache coherence	5
AR8	Superscalar, superpipe lining, branch prediction, prefetching, speculative execution, multiple instruction issue	8

[1]See https://www.acm.org/binaries/content/assets/education/cs2013_web_final.pdf for a description of Computer Science Knowledge units