FIRST SEMESTER 2020 – 2021

17-08-2020

COURSE HANDOUT (PART II)

In addition to Part I (General Handout for all courses appended to the timetable) this handout gives further details regarding the course.

Course No   : **CS F342**
Course Title   : **Computer Architecture**
Instructor-in-charge : **Dr. Suvadip Batabyal**
Instructors   : Dr. Rajib R. Maiti, Dr. Nikumani Choudhury
TAs   : Mr. Gourish Goudar, Mr. Chillara Anil Kumar, Mr. Praturi V. K. Deepak

1. Scope and Objective of the Course:

The scope of this course is to cover various aspects of Computer Architecture, which is a specification detailing how a set of software and hardware technology standards interact to form a computer system or platform. Performance issues with respect to computer system design and the compatible technologies would be discussed.

The main objective of this course is to give the students exposure to
- Processor performance criteria, performance benchmarks
- CPU design - instruction set architecture, instruction execution
- Single and Multicycle implementation, ILP, Pipeline design, Hazards
- Methods of overcoming hazards, Branch prediction
- Memory subsystems including cache optimization

2. Text Book:

T1. Patterson, D.A. & J.L. Hennessy, Computer Organization and Design: MIPS Edition, Elsevier, 5th edition., 2013.

3. Reference Books:

(i)Hamacher et. al, Computer Organisation, McGraw Hill, 5th ed., 2002.

(ii)J.L. Hennessy & D.A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kauffmann, 5th Ed, 2012.

(iii)W. Stallings, Computer Organisation & Architecture, PHI, 6th ed., 2004.

(iv) Additional material to be put up in CMS

4. Course Plan:

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Lecture No.	Learning Objectives	Topics to be covered	Chapter No.
1 - 2	To understand about the overview of classes of computers	Computer Abstractions and Technology	Ch. 1
3 - 4	To learn about instructions; ISA as well as know about sample ISAs like MIPS	Instructions- language of the computer	Ch.2
5-7		MIPS Architecture & Instruction Set	Ch. 2
8 - 10	To practice arithmetic operations on integers; floating point numbers etc	Arithmetic for computers: floating point arithmetic	Ch 3
11 -16	To understand the basics of processor; learn about data path, control path	Processors: logic design conventions	Ch 4
17 - 18		Role of Performance, pipelining – design issues	Ch 4
19 - 20		Pipelined data path and control	Ch 4
21		Various types of hazards	Ch 4
22		Structural hazards	Ch 4
23		Data Hazards	Ch 4
24-25		Control Hazards	Ch 4
26		Branch prediction techniques	Ch 4
27		Static Branch Prediction	Ch 4
28		Dynamic Branch Prediction	Ch 4
29	To know about the organization of memory hierarchy and learn various optimization techniques at each level	Exploiting memory hierarchy - introduction	Ch 5
30		Cache Memory Organization	Ch 5
31-32		Measuring and improving cache performance, cache optimization	Ch 5
33 - 34		Main Memory and Interleaving	Ch 5
35		Virtual Memory and Virtual Machines	Ch 5
36-39		Performance and memory hierarchies: Cache coherence	Ch 5
40	To understand about storage systems and performance	Storage and other I/O topics	T1 Ch5; R(ii)
41		Dependability, reliability, availability	T1 Ch5; R(ii)
42 - 43		I/O performance measures, Redundant Array of Independent Disks	T1 Ch5; R(ii)

5. Evaluation Scheme:

EC No.	Evaluation Component	Duration (Min)	Weightage (%)	Date & Time	Nature of Component
1	Test-1	30	15	September 10 – September 20 (during scheduled class Hour)	Open Book
2.	Test-2	30	15	October 9-October 20(during scheduled class hour)	Open Book
3.	Test-3	30	15	November 10-November 20 during scheduled class hour)	Open Book
3	Assignment/Project	NA	25	TBA	Open Book
3	Comprehensive	120	30	TBD	Open Book

6. Chamber Consultation Hour: TBA

7. Notices: Notices regarding the course will be put up in CMS.

8. **Makeup Policy:** Makeup for tests and comprehensive exams will be allowed only in genuine cases and with prior permission from the I/C.

9. Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Lab No.	Learning Objectives	Topics to be covered
1-2	Introduction to MIPS; Understanding System calls and arithmetic operations	Installing and launching SPIM (QTSPIM); System Calls and User Input + Add/Sub; manual Disassembly - reversing given MIPS byte code (binary) to assembly; Understanding Pseudo instructions
3	Understanding mul/div operations and FP instructions	FP operations; multiply/divide using HI/LO registers; conversion across numeric datatypes; representing characters
4	Understanding control instructions; loop constructs in MIPS	Code Labels and Jump instructions; Logical operations; shift operations; loops: sentinel control loop & counter control loop; R-I-J type instructions
5	Exploring arrays and strings with MIPS	Array and string manipulation in MIPS; load/store instructions (for integers as well as floating point numbers);
6-7	Understanding function calls and exception handling	basics on function calls; advanced function calls and exception handling in MIPS assembly; recursive function calls
8-9	Representing structures	Dynamic memory allocation using sbrk syscall; structure representation in MIPS
10-11	Exploring sorting techniques using MIPS	Various sorting techniques: bubble sort, merge sort etc.
12	To get hands-on exposure to pipelined execution	Multi-cycle datapath and control path implementation

INSTRUCTOR-IN-CHARGE