COURSE SYLLABUSCS365: Introduction to Computer Organization and Architecture

COURSE DESCRIPTION

|  |  |  |
| --- | --- | --- |
| **Credit points** | 3 credits (45 hrs) | |
| **Level** | Undergraduate | |
| **Instructor** | Pham Ngoc Hung, PhD  Department of Computer Engineering,  School of Information and Communication Technology  Hanoi University of Science and Technology | |
| **Teaching time**  **Location** | 19/2/2024 – 8/6/2024  Hanoi University of Science and Technology | |
| **Prerequisites** | CS310: Foundation of Computer Science | |
| **Recommended background knowledge** | Digital Logic, C programming language | |
| **Subject description** | This course is an introduction to computer architecture for students in  IT-related fields. In this course, students will study:  (1) Computer organization: the arrangement of computer components  (CPU, memory, peripherals (I/O) and system bus) and their relationship.  (2) The instruction set architecture (ISA).  (3) The CPU structure (ALU, registers, decoder), pipelining technique.  (4) Memory and I/O system. | |
| **Objectives & Out-come** | - Basic knowledge of the architecture and operation inside a computer.  - Understanding of the relationship between hardware and software, and  the basic laws for computer performance evaluation.  - Understanding of MIPS instruction set architecture, and the ability to  write MIPS programs to solve computing problems.  - Ability to understand and analyse the design concept of microprocessor  for modern computer architecture.  - Team work and communication skill to discuss and solve assignments | |
| **Assessment/ Evaluation** | Attendance/Attitude | 10% |
| Assignment(s) | 10% |
| Group presentation | 10% |
| Mid-term exam | 30% |
| Final exam | 40% |
| **Prescribed Textbook(s)** | Computer Organization and Design, 4th Edition, Patterson & Hennessy,  MK Pub, 2008. | |

**COURSE CONTENTS & SCHEDULE**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Class No.** | **Contents** | **No. of Hours** | | | **Ref./Resources** | **Assignment(s)** |
| **Lect.** | **Exr.** | **Prc.** |
| 1 | **Course Introduction and Orientation**  **Chapter 1: Introduction**  1.1 Computer Abstraction and Technology  - Computer history  - Computer anatomy  - Computer program  - Hardware and software  1.2 Performance Evaluation and  Benchmarking  - Performance measurement  - Enhancing performance (hardware,  software…) | 3 |  |  | Chapter 1  [Textbook] |  |
| 2 | **Chapter 2: Instruction Set Architecture**  2.1 Overview  2.2 MIPS operands  2.3 MIPS instruction set | 3 |  |  | Chapter 2  [Textbook] |  |
| 3 | 2.3 MIPS instruction set (cont.)  2.4 Basic programming patterns with MIPS  instruction set  2.5 Procedures | 3 |  |  | Chapter 2  [Textbook] |  |
| 4 | Exercise and in-class assignment |  | 3 |  |  | Assignment 1 |
| 5 | **Chapter 3: Computer Arithmetic**  3.1 Integer arithmetic  3.2 Floating point arithmetic | 3 |  |  | Chapter 3  [Textbook] |  |
| 6 | **Chapter 4: CPU**  4.1 Introduction  4.2 Simple CPU implementation | 3 |  |  | Chapter 4  [Textbook] |  |
| 7 | 4.3 Enhancing performance with pipelining  - Overview of pipelining  - MIPS pipeline  - Pipeline performance  - Hazards |  |  |  | Chapter 4  [Textbook] |  |
| 8 | Assignment 1 submission  Practice and in-class assignment |  | 3 |  |  | Assignment 2 |
| 9 | Mid-term exam  Exam solution |  | 3 |  |  |  |
| 10 | **Chapter 5: Memory**  5.1 Memory hierarchy  5.2 Cache  - Overview of cache  - Operation  - Cache performance | 3 |  |  | Chapter 5  [Textbook] |  |
| 11 | 5.2 Cache (cont.)  - Improving cache performance  5.3 Virtual memory  5.4 Virtual machine | 3 |  |  | Chapter 5  [Textbook] |  |
| 12 | **Chapter 6: I/O System**  6.1 Introduction to I/O system  6.2 Storage  6.3 Interfacing with I/O system  6.4 I/O performance | 3 |  |  | Chapter 6  [Textbook] |  |
| 13 | **Chapter 7: Multicore and multiprocessors**  7.1 Introduction  7.2 Shared memory multiprocessors  7.3 Introduction to GPU  Assignment 2 submission  Practice and in-class assignment | 3 |  |  | Chapter 7  [Textbook] | Assignment 3:  Group  presentation |
| 14 | **Group presentation** |  | 3 |  |  |  |
| 15 | **Final exam**  Exam solution |  | 3 |  |  |  |

*Notes:*- *Abbreviation: Lect. (lecture), Exr. (Exercise), Prc. (Practise).*- *Exercises may include assignment, reports, student’s presentation, homework, class exercises... for each class sessions.*

- *Practical mostly refer to Lab-work or outside practice such as field trip.*- *Assignments may include assignments, practical work, reports, exercises ...for each class sessions*

**Reference Literature:**

|  |
| --- |
| [1]. Computer Organization and Design, 4th Edition, Patterson & Hennessy, MK Pub, 2008. |
| [2]. Computer Architecture: From Microprocessors to Supercomputers, Behrooz Parhami, Oxford Univ. Press, New York, 2005. |
| [3]. Computer Architecture and Organization, 7th Edition, William Stallings, Prentice Hall  International, 2006. |