University of Macau
Faculty of Science and Technology
Department of Computer and Information Science
CISB211 Computer Organization
Syllabus
1st Semester 2014/2015
Part A – Course Outline

Compulsory course in Computer Science

Catalog description:
(2-2) 3 credits. Basic concepts of computer organization. Instructions executed by a processor and how to use these instructions in simple assembly language programs. Internal representation of information; arithmetic operations and logic units. Memory hierarchy. Basic processing unit. Input and output devices and their interface with processor and memory.

Course type:
Theoretical

Prerequisites:
- CISB121 Digital Systems

Textbook(s) and other required material:
- Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, *Computer Organization and Embedded Systems*, 6th Edition, McGraw-Hill, 2012.

References:
- Linda Null and Julia Lobur, *The Essentials of Computer Organization and Architecture*, 3rd Edition, Jones and Bartlett, 2010.
- David Patterson and John Hennessy, *Computer Organization & Design: The Hardware/Software Interface*, 4th Edition, Morgan Kaufmann, 2011.

Major prerequisites by topic:
- Boolean algebra.
- Digital circuits.

Course objectives:
- To make students know the basic structure of a computer and the relationship between hardware and software. [a]
- To teach students machine instructions and use the assembly language to understand program execution and data representation in computers. [c, d]
- To teach students logic circuits for arithmetic operations and the IEEE floating-point number representation. [h]
- To provide students with an introduction to memory system, Input/Output operations, and basic processing unit. [j]

Topics covered:
- **Basic structure of computers (3 hours):** Provide an overview of computer hardware and software. Discuss the basic functional units and the ways they are interconnected to form a complete computer system. Introduce the role of system software and basic aspects of performance evaluation. Introduce the history of computer development.
- **Machine instructions and programs (7 hours):** Study the representation and execution of instructions and programs at the assembly and machine level. Discuss the principles of addressing techniques and instruction sequencing. Programming examples are provided to illustrate the basic types of operations implemented by the instruction set of any modern computer, including basic I/O operations, stack, queues, arrays and link lists etc.
- **Input/Output organization (2 hours):** Study three basic approaches to I/O transfers: programmed I/O, interrupts and direct-memory access. Introduce some commonly used bus standards.

- **Software (1 hour):** Introduce the software needed to prepare and run programs.
- **Memory (3 hours):** Study the semiconductor memories. Introduce the caches, virtual-memory systems and secondary storage.
- **Number representation and arithmetic operation (8 hours):** Study the arithmetic unit of a computer. Discuss the logic design for fixed-point add, subtract, multiply, and divide hardware, operating on 2's-complement numbers. Introduce the IEEE floating-point number representation standard and a set of rules for performing the four standard operations.
- **Basic processing unit (4 hours):** Introduce a register-transfer-level treatment of the implementation of instruction fetching and execution in a processor.

Class/laboratory schedule:

Timetabled work in hours per week			No of teaching weeks	Total hours	Total credits	No/Duration of exam papers
Lecture	Tutorial	Practice				
2	2	Nil	14	56	3	1 / 3 hours

Student study effort required:

Class contact:	
Lecture	28 hours
Tutorial	28 hours
Other study effort	
Self-study	28 hours
Homework assignment	10 hours
Total student study effort	94 hours

Student assessment:
Final assessment will be determined on the basis of:
Assignments 20%
Mid-term 30%
Final exam 50%

Course assessment:
The assessment of course objectives will be determined on the basis of:
- Assignments and exams
- Course evaluation

Course outline:

Weeks	Topic	Course work
1, 2	**Basic Structure of Computers** Functional units of computers; Machine instructions and their execution; Number representation; Performance issues in computer systems; The history of computer development	Assignment 1
3, 4	**Machine Instructions and Programs** Addresses, memory locations and operations; Instructions and instruction sequencing; Addressing modes	Assignment 2
5, 6	**Machine Instructions and Programs** Assembly language; Basic I/O operations; Stack and queues; Subroutines; Additional instructions; Encoding of machine instructions; Program examples	Assignment 3
7	**Input/Output Organization** Accessing I/O devices; Interrupt; Direct memory access; Standard I/O interfaces	Assignment 4
8, 9	**The Memory System** Some basic concepts; Semiconductor RAM memories; Read-only memories; Cache memories; virtual memories; secondary storage	Assignment 5

Weeks	Topic	Course work
10-12	**Arithmetic** Addition and subtraction of signed numbers; Multiplication of positive numbers; Signed-operand multiplication; Integer division; Floating-point numbers and operations	Assignment 6
13, 14	**Basic Processing Unit** Some fundamental concepts; Execution of a complete instruction **Review**	Assignment 7

Contribution of course to meet the professional component:
This course provides students the fundamental concepts of computer organization and how computer systems work. An understanding of these concepts is necessary for being computer specialists.

Relationship to CS program objectives and outcomes:
This course primarily contributes to the Computer Science program outcomes that develop student abilities to:
(c) An ability to analyse a problem, and identify and define the computing requirements appropriate to its solution;
(d) An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs with appropriate consideration for public health and safety, social and environmental considerations;

The course secondarily contributes to the Computer Science program outcomes that develop student abilities to:
(a) An ability to apply knowledge of computing and mathematics appropriate to the programme outcomes and to the discipline;
(h) An ability to analyse the local and global impact of computing on individuals, organisations, and society;
(j) An ability to use current techniques, skills, and tools necessary for computing practice with an understanding of the limitations.

Relationship to CS program criteria:

Criterion	DS	PF	AL	AR	OS	NC	PL	HC	GV	IS	IM	SP	SE	CN
Scale: 1 (highest) to 4 (lowest)		4		1	4									

Discrete Structures (DS), Programming Fundamentals (PF), Algorithms and Complexity (AL), Architecture and Organization (AR), Operating Systems (OS), Net-Centric Computing (NC), Programming Languages (PL), Human-Computer Interaction (HC), Graphics and Visual Computing (GV), Intelligent Systems (IS), Information Management (IM), Social and Professional Issues (SP), Software Engineering (SE), Computational Science (CN).

Course content distribution:

Percentage content for			
Mathematics	Science and engineering subjects	Complementary electives	**Total**
0%	100%	0%	100%

Persons who prepared this description:
Dr. Wen Wu, Prof. En Hua Wu

Part B – General Course Information and Policies

1st Semester 2014/2015

Instructor:	Dr. Wen Wu	Office:	E11-4019
Office hour:	by appointment	Phone:	8822 4477
Email:	wenwu@umac.mo		

Time/Venue: Monday 9:00 - 11:00 / E11-G015
Tuesday 17:30 - 19:30 / E11-1028

Grading distribution:

Percentage Grade	Final Grade	Percentage Grade	Final Grade
100 - 93	A	92 - 88	A–
87 - 83	B+	82 - 78	B
77 - 73	B–	72 - 68	C+
67 - 63	C	62 - 58	C–
57 - 53	D+	52 - 50	D
below 50	F		

Comment:
Reading the text is imperative. Students who want to achieve a good result of their study should do exercises of the tutorial courses and all the assignments. Students are encouraged to read and learn any other materials to complement the lectures and text.

Homework policy:
- There will be approximately 7 homework assignments.
- No late homework is accepted.
- No marks will be given in case of copying from others.

Exam:
A mid-term exam will be held during the semester. Both the mid-term and final exams are closed book examinations.

Note:
- Reading the textbook is imperative.
- Check UMMoodle (https://ummoodle.umac.mo/) for announcement, lecture notes, homework and other related resources.
- Cheating is absolutely prohibited by the university. Issues regarding the final exam follow the university rules and policies.

Student Disabilities Support Service:

The University of Macau is committed to providing an equal opportunity in education to persons with disabilities. If you are a student with a physical, visual, hearing, speech, learning or psychological impairment(s) which substantially limit your learning and/or activities of daily living, you are encouraged to communicate with your instructors about your impairment(s) and the accommodations you need in your studies. You are also encouraged to contact the Student Disability Support Service of the Student Counselling and Development Section (SCD), which provides appropriate resources and accommodations to allow each student with a disability to have an equal opportunity in education, university life activities and services at the University of Macau. To learn more about the service, please contact SCD at scd.disability@umac.mo, or 8822 4901 or visit the following website:
http://www.umac.mo/sao/scd/sds/aboutus/en/scd_mission.php

Appendix - Measurement Dimensions and Rubric for Program Outcome (c) and (d)

(c) An ability to analyse a problem, and identify and define the computing requirements appropriate to its solution

Measurement Dimension	Excellent (80-100%)	Average (60-79%)	Poor (<60%)
1. An ability to understand problem and identify the fundamental formulation	Students understand problem correctly and can identify the fundamental formulation	Student understand problem correctly, but have trouble in identifying the fundamental formulation	Students cannot understand problem correctly, and they do not know how to identify the fundamental formulation
2. An ability to choose and properly apply the correct techniques	Students know how to choose and properly apply the correct techniques to solve problem.	Students can choose correct techniques but have trouble in applying these techniques to solve problem.	Students have trouble in choosing the correct techniques to solve problem.

(d) An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs with appropriate consideration for public health and safety, social and environmental considerations

Measurement Dimension	Excellent (80-100%)	Average (60-79%)	Poor (<60%)
1. An ability to design, implement, and evaluate a computer-based system, process, component, or program	Students understand how to properly design, implement and evaluate a computer-based system, process, component, or program	Students understand how to design and implement a computer-based system, process, component, or program, but have trouble in evaluating it.	Students do not know how to design, implement, and evaluate a computer-based system, process, component, or program
2. An ability to understand what needs to be designed and the realistic design constraints regarding public health and safety, social and environmental considerations.	Students understand the design goals and the realistic design constraints regarding public health and safety, social and environmental considerations.	Students understand the design goals; but they are not clear about the realistic design constraints regarding public health and safety, social and environmental considerations.	Students have trouble in understanding what needs to be designed and the realistic design constraints regarding public health and safety, social and environmental considerations.