CS2115: COMPUTER ORGANIZATION

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Computer Organization

Subject Code
CS - Computer Science

Course Number
2115

Academic Unit
Computer Science (CS)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil
Part II Course Details

Abstract
This course aims to introduce digital logic, Boolean algebra and also principles behind the organization of the functional parts of CPU and fundamental components. The course demonstrates computer architecture and programming CISC and RISC microprocessors. It also introduces the basics of assembly language programming.

Course Intended Learning Outcomes (CILOs)

<table>
<thead>
<tr>
<th>CILOs</th>
<th>Weighting (if app.)</th>
<th>DEC-A1</th>
<th>DEC-A2</th>
<th>DEC-A3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe functions of the basic building blocks of a digital system.</td>
<td></td>
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<tr>
<td>2. Identify various architectures and explain the design concepts of computer systems.</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>3. Create the designs of simple digital logic circuits.</td>
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<td>x</td>
<td></td>
<td></td>
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<tr>
<td>4. Apply techniques of assembly language to write simple programs.</td>
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<td>x</td>
<td></td>
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<tr>
<td>5. Explain and critique the basic operations of cache and main memory, I/O operations and interrupt, as well as analyzing the performance of different designs.</td>
<td></td>
<td>x</td>
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<td></td>
</tr>
</tbody>
</table>

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing/constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

<table>
<thead>
<tr>
<th>TLAs</th>
<th>Brief Description</th>
<th>CILO No.</th>
<th>Hours/week (if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lecture</td>
<td>1, 2, 3, 4</td>
<td>3 hours/week</td>
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</table>
## Tutorial

Demonstrate the usage of useful supporting software tools and do exercise and case studies. The students will apply the computer organization concepts and use the supporting software tools to implement to design and analysis problems.  

<table>
<thead>
<tr>
<th>ATs</th>
<th>CILO No.</th>
<th>Weighting (%)</th>
<th>Remarks (e.g. Parameter for GenAI use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coursework</td>
<td>1, 2, 3, 4, 5</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Midterm Exam</td>
<td>1, 2, 3, 4, 5</td>
<td>10</td>
</tr>
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</table>

### Group project

Students will work as a group to apply computer organization concepts to design, implement and validate a CPU and its associated instruction set. The design will be done using circuit simulation software.  

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### Assignment

Students will apply computer organization concepts to solve different programming, analysis and calculation problems that are common in modern operating system design.  

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### Assessment Tasks / Activities (ATs)

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### Continuous Assessment (%)  
30

### Examination (%)  
70

### Examination Duration (Hours)  
2

### Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

### Assessment Rubrics (AR)

#### Assessment Task

**Coursework**

**Criterion**

Assignment may include short factual questions and design exercises regarding the various building blocks of computer. Assignment may include simple circuit design project / exercises. There would be hands-on and case study on circuit design...
during tutorial. Assignment may include mini programming project in assembly language. There would also be hands-on exercises during tutorial.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

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Assessment Task
Midterm Exam

Criterion
The mid-term quiz will include questions assessing the students’ understanding on architectural aspect of computer such as single bus organization.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

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Assessment Task
Final Exam

Criterion
The final exam and mid-term quiz will include questions assessing the students’ understanding on architectural aspect of computer such as single bus organization, I/O, bus, interrupt and peripheral operations.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant
Part III Other Information

Keyword Syllabus


Syllabus

- Number systems
  - Number representation. Binary arithmetic. Conversion between number systems. Floating point numbers and calculations, IEEE floating point.
- Digital logic fundamentals
- Basic computer organization
  - Functional subsystems: CPU, memory, input/output systems.
- CPU organization and operations
  - CPU model, Fetch and execute cycle. Control unit and signal, Interrupt cycle, case study on a typical microprocessor.
- Assembly instruction and assembly language programming
- Processor design
  - Instruction pipelining. Classification of Processors. CISC v.s. RISC
- Memory system
  - Memory bus, memory access. Cache.
- I/O system, bus and interrupt and peripherals
  - Basic model of an I/O system including programmed, Interrupt, DMA.

Reading List

Compulsory Readings

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Additional Readings

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