هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

# Course Specification
(Bachelor)

| | |
|---|---|
| **Course Title** | Computer Architecture II |
| **Course Code:** | CENX 413 |
| **Program:** | B.S. in Computer Engineering |
| **Department:** | Department of Computer Engineering |
| **College:** | College of Computer and Information Sciences |
| **Institution:** | King Saud University |
| **Version:** | *Course Specification Version Number* |
| **Last Revision Date:** | *Pick Revision Date.* |

## Table of Contents

## A. General information about the course:

### 1. Course Identification

| | | | | | |
|---|---|---|---|---|---|
| **1. Credit hours: ( 3 hours )** | | | | | |
| | | | | | |
| **2. Course type** | | | | | |
| **A.** | ☐University | ☐College | ☒ Department | ☐Track | ☐Others |
| **B.** | ☐ Required | | ☒ Elective | | |
| **3. Level/year at which this course is offered: ( 9th or 10th semester, 5th year)** | | | | | |
| **4. Course general Description:** | | | | | |
| **This course focuses on Fundamentals of computer architecture, power, cost, performance, instruction set principles, instruction and arithmetic pipelines, dynamic and speculative execution, precise exception, memory hierarchy, multilevel caches, virtual memory, multicores, multiprocessors, new trends in computer architecture.** | | | | | |
| **5. Pre-requirements for this course** (if any)**:** | | | | | |
| **CENX 316, Computer Architecture** | | | | | |
| **6. Co-requirements for this course** (if any)**:** | | | | | |
| | | | | | |
| **7. Course Main Objective(s):** | | | | | |
| **This course provides students with advanced knowledge in computer architecture hardware such as Instruction level parallelism, data level parallelism, multicore and multilevel memory hierarchy as well as virtual memory concepts.** | | | | | |

### 2. Teaching mode (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 4 hours per week | 100% |
| 2 | E-learning | | |
| 3 | Hybrid<br>• Traditional classroom<br>• E-learning | | |
| 4 | Distance learning | | |

### 3. Contact Hours (based on the academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1. | **Lectures** | 45 |
| 2. | **Laboratory/Studio** | |
| 3. | **Field** | |
| 4. | **Tutorial** | 15 |
| 5. | **Others (specify)** | |
| **Total** | | 60 |

## B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| **1.0** | **Knowledge and understanding** | | | |
| 1.1 | Explain pipelining and instruction level parallelism along with their related concepts. | **1** | **Lectures and Tutorials** | **Exams and Homework** |
| 1.2 | Describe the different forms of data-level parallelism, SIMD and loop-level parallelism. | **1** | **Lectures and Tutorials** | **Exams and Homework** |
| **2.0** | **Skills** | | | |
| 2.1 | Apply engineering skills to design the main types of memory and effectively deduce suitable memory hierarchy that include virtual memory. | **2** | **Lectures and Tutorials** | **Exams and Homework** |
| 2.2 | Draw block diagrams for pipelining based on a specific instruction set architecture and suggest changes that consider performance and cost. | **2** | **Lectures and Tutorials** | **Exams and Homework** |
| **3.0** | **Values, autonomy, and responsibility** | | | |
| 3.1 | Analyze computer systems based on performance, power consumption, cost and dependability. | **6** | **Lectures and Tutorials** | **Exams and Homework** |

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| 3.2 | Analyze high-performance computing systems, such as multi/many-core, distributed architectures as well as shared and distributed memory models. | 6 | Lectures and Tutorials | Exams and Homework |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1. | Defining computer architecture, classes of computers, technology trends, power in integrated circuits, cost, performance metrics, Amdahl's law, and benchmarks. | 8 |
| 2. | Instruction set architectures, simple pipelined processors, hazards, data forwarding, control, and branch prediction. | 8 |
| 3. | Memory hierarchy, DRAM, cache organization, multi-level caches, cache optimizations, virtual memory, cache performance. | 16 |
| 4. | Instruction-Level parallelism, complex pipelines, multiple-issue, VLIW approach, precise exceptions, software approaches to ILP. | 8 |
| 5. | Data-level parallelism, SIMD, Loop-level parallelism. | 8 |
| 6. | Multiprocessor architectures, shared and distributed memory models, multithreaded cores, cache coherence, and synchronization. | 12 |
| Total | | 60 |

## D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| 1. | Midterm Examination (1) | 6 | 20% |
| 2. | Midterm Examination (2) | 12 | 20% |
| 3. | Homework Assignments | Weekly | 20% |
| 4. | Final Exam | End | 40% |

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

## E. Learning Resources and Facilities

### 1. References and Learning Resources

| | |
|---|---|
| **Essential References** | Computer Architecture: A Quantitative Approach, Hennessy and Patterson, 5th Edition, 2011. |
| **Supportive References** | |
| **Electronic Materials** | https://lms.ksu.edu.sa |
| **Other Learning Materials** | |

## 2. Required Facilities and equipment

| Items | Resources |
|---|---|
| **facilities**<br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | Lecture room with number of seats enough to accommodate enrolled students. |
| **Technology equipment**<br>(projector, smart board, software) | Overhead projector with required software to facilitate presentations on smart board. |
| **Other equipment**<br>(depending on the nature of the specialty) | |

## F. Assessment of Course Quality

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Effectiveness of teaching | Department Council | Course reports are evaluated by the Department Council. |
| Effectiveness of Students assessment | Faculty-Peer Review | Final examination is moderated. |
| Quality of learning resources | Students | Indirect – Edu-gate survey. |
| The extent to which CLOs have been achieved | Students | Attainment level of every CLO is measured directly. |
| Other | | |

**Assessors** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

**Assessment Methods** (Direct, Indirect)

## G. Specification Approval

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|---|---|
| **COUNCIL /COMMITTEE** | |
| **REFERENCE NO.** | |
| **DATE** | |