# Course Specifications

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|---|---|
| **Course Title:** | Parallel and Distributed Computing |
| **Course Code:** | ICS 422 |
| **Program:** | Information and Computer Science |
| **Department:** | Computer Science and Information |
| **College:** | College of Science at Az Zulfi |
| **Institution:** | Majmaah University |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | (3) (2 Lec + 2 lab) |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ■ Others ☐ |
| **b.** | Required ■ Elective ☐ |
| **3. Level/year at which this course is offered:** | **8th Level – 4th year** |
| **4. Pre-requisites for this course** (if any)**:** | **Computer Organization and Architecture - ICS 222** |
| **5. Co-requisites for this course** (if any)**:** | **N/A** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | **Traditional classroom** | 48 | 80% |
| 2 | **Blended** | 6 | 10% |
| 3 | **E-learning** | 0 | 0% |
| 4 | **Correspondence** | 0 | 0% |
| 5 | **Other** | 6 | 10% |

**7. Actual Learning Hours** (based on academic semester)

| No | Activity | Learning Hours |
|---|---|---|
| **Contact Hours** | | |
| 1 | **Lecture** | 30 |
| 2 | **Laboratory/Studio** | 15 |
| 3 | **Tutorial** | 15 |
| 4 | **Others** (specify) | - |
| | **Total** | 60 |
| **Other Learning Hours*** | | |
| 1 | **Study** | 15 |
| 2 | **Assignments** | 15 |
| 3 | **Library** | 15 |
| 4 | **Projects/Research Essays/Theses** | 15 |
| 5 | **Others** (video lectures) | 15 |
| | **Total** | 75 |

* The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

## B. Course Objectives and Learning Outcomes

### 1. Course Description

This course aims to introduce the fundamentals of parallel and distributed processing, including system architecture, programming model, and performance analysis. It will focus on the basic architectural, programming, and algorithmic concepts in the design and implementation of parallel and distributed applications. The specific topics include, but not limited to, multithreaded programming, message passing interface, GPU, and cloud computing.

### 2. Course Main Objective

- To understand the fundamentals of parallel and distributed computing.
- To understand the fundamental questions in parallel and distributed computing.
- To formulate and evaluate a hypothesis by proposing, implementing and testing a project.
- To understand and account for models, limitations, and fundamental concepts in the area of message passing and shared memory concurrency, and apply this understanding to example systems and algorithms.
- To adapt, and design algorithms for execution in parallel and distributed settings, and analyze the algorithms for correctness, reliability, security, and performance.
- To understand different parallel and distributed programming paradigms and algorithms.

### 3. Course Learning Outcomes

| CLOs | | Aligned PLOs |
|---|---|---|
| 1 | **Knowledge:** | |
| 1.1 | Students will learn about parallel and distributed computers. | a1 |
| 1.2 | Students will be able to define the behavior of parallel and distributed systems in a rigorous way | a1 |
| 1.3 | Student will develop and apply knowledge of parallel and distributed computing techniques and methodologies. | a1 |
| 1.. | | |
| 2 | **Skills :** | |
| 2.1 | Student will gain experience in the design, development, and performance analysis of parallel and distributed applications. | b3 |
| 2.2 | Student will gain experience in the application of fundamental Computer Science methods and algorithms in the development of parallel applications. | b3 |
| 2.3 | | |
| 2... | | |
| 3 | **Competence:** | |
| 3.1 | Learn how to search for information through library and internet and Present a short report in a written form and orally using appropriate scientific language. | C2 |
| 3.2 | | |
| 3.3 | | |
| 3... | | |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | Introduction, Parallel and Distributed Computing | 4 |
| 2 | Distributed processing characteristics and processing. | 4 |
| 3 | Parallel architectures, MIMD, SIMD, interconnection topologies. | 8 |
| 4 | Performance measures, speedup, efficiency, limitations of parallel processing. | 4 |
| 5 | Parallel programming paradigms, shared memory, message passing, data parallel, data flow. | 8 |
| 6 | Parallelizing compiler techniques, code and data partitioning. | 8 |
| 7 | Parallel programming environments and tools | 4 |
| 8 | MPI and Teragrid | 4 |
| 9 | Distributed Systems, MapReduce, Clusters | 8 |
| 10 | Distributed Coordination, Security | 4 |
| **Total** | | 56 |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| **1.0** | **Knowledge** | | |
| 1.1 | Students will learn about parallel and distributed computers. | Lectures<br>Lab demonstrations<br>Case studies<br>Individual presentations | Written Exam<br>Homework assignments<br>Class & Lab Activities<br>Quizzes |
| 1.2 | Students will be able to define the behavior of parallel and distributed systems in a rigorous way | | |
| 1.3 | Student will develop and apply knowledge of parallel and distributed computing techniques and methodologies. | | |
| 1.. | | | |
| **2.0** | **Skills** | | |
| 2.1 | Student will gain experience in the design, development, and performance analysis of parallel and distributed applications. | Lectures<br>Lab demonstrations<br>Case studies<br>Individual presentations<br>Brainstorming | Written Exam<br>assignments<br>Lab Activities<br>Quizzes |
| 2.2 | Student will gain experience in the application of fundamental Computer Science methods and algorithms in the | | |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| | development of parallel applications. | | |
| … | | | |
| **3.0** | **Competence** | | |
| 3.1 | Learn how to search for information through library and internet and Present a short report in a written form and orally using appropriate scientific language. | Small group discussion Whole group discussion Brainstorming Presentation | Written Exam Homework assignments Lab assignments Class Activities Quizzes |
| 3.2 | | | |

**2. Assessment Tasks for Students**

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| **1** | First written mid-term exam | 6 | 20% |
| **2** | Second written mid-term exam | 12 | 20% |
| **3** | Class activities, group discussions, Presentation | Every 2 weeks | 5% |
| **4** | Homework + Assignments | After Every chapter | 5% |
| **5** | Electronic exam | 14 | 5% |
| **6** | Lab activities | 15 | 5% |
| **7** | Final written exam | 16 | 40% |
| **8** | | | |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :**

1. Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice. (include amount of time teaching staff are expected to be available each week)

- 6-office hours per week in the lecturer schedule.
- The contact with students by e-mail, mobile, office telephone, website and BlackBoard.

## F. Learning Resources and Facilities

**1.Learning Resources**

| | |
|---|---|
| **Required Textbooks** | Calvin Lin, Principles of Parallel Programming, Addison-Wesley, 2008<br>Gerassimos Barlas , Multicore and GPU Programming, Morgan Kaufmann, 2015 |

| | |
|---|---|
| **Essential References Materials** | Ian Foster, Cloud Computing for Science and Engineering, MIT Press, 2017 |
| **Electronic Materials** | https://www.coursera.org/ |
| **Other Learning Materials** | Videos and presentations made available on BlackBoard e-Learning platform. |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation** (Classrooms, laboratories, demonstration rooms/labs, etc.) | Classrooms with required digital aids and to support traditional method of teaching using blackboard.<br>Classrooms with proper lighting and air conditioning system integrated with the sound System /audio system.<br>Classroom with smart board interface, display screen and a computer to aid the sessions |
| **Technology Resources** (AV, data show, Smart Board, software, etc.) | Smart Board with supporting software / computers with updated versions of software as required to understand the subject concepts. |
| **Other Resources** (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | **N/A** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Strategies for Obtaining Student Feedback on Effectiveness of Teaching | Instructor | Analysis of students' results.<br>Observation during class work.<br>Students' evaluations.<br>Colleagues' evaluations.<br>Evaluation questionnaire filled by the students.<br>Interview a sample of students enrolled in the course to solicit their opinions |
| Other Strategies for Evaluation of Teaching | the Department | Self-assessment.<br>External evaluation.<br>Periodic review of course (the Commission of study plans). |
| Processes for Improvement of Teaching | the Department | Taking into account the recommendations yielded from the internal review of the course.<br>Guidelines about teaching the course provided by the study plans commission.<br>Department guidelines pertaining the faculty member's performance acquired using direct observation.<br>Training and development.<br>Workshops to improve the educational process |

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Processes for Verifying Standards of Student Achievement | Instructor | check marking by an independent member teaching staff of a sample of student work, periodic exchange and remarking of tests or a sample of assignments with staff at another institution.<br>Instructors of the course working together with Head of Department to adopt a unique process of the evaluation. |
| Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement. | Instructor | Comparison of the course to its counterparts offered in similar departments.<br>Periodic revision of course description by faculty member.<br>Periodic revision of course description by the study plans and schedules Commission.<br>Update learning resources related to the course to ensure that the course is up-to-date with the developments in the field.<br>Make use of statistical analysis of course evaluation carried out by the students to improve and develop the course.<br>Provide an opportunity to the students to express their opinions about what is taught and receive suggestions and evaluate their effectiveness. |
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| | | |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| **Council / Committee** | |
| **Reference No.** | |
| **Date** | |