**CSC-xxx: Parallel & Distributed Computing**

**General Information**

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| **Course Number** | CSC-xxx |
| **Credit Hours** | 3 (Theory Credit Hour = 3, Lab Credit Hours = 0) |
| **Prerequisite** | N/A |
| **Course Coordinator** |  |

**Course Objectives**

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| In this course students learn fundamental concepts of Cloud computing. Students will understand the basic concepts of distributed, cluster, grid, and utility computing architectures and build upon those concepts to explain existing cloud technologies. This course will provide high-level understanding of virtualization, containerization and dockerization in cloud computing environments. Students will learn and implement different cloud applications and cloud evaluation platforms such as Big Data, Data science and Machine learning using cloud infrastructures. Students will also be able to work with different Cloud storage models. In addition, we will study MapReduce and Spark platforms. The main objective of this course is to provide with the comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, architecture and applications by introducing state-of-the-art in Cloud Computing fundamental issues, technologies, applications and implementations. Another objective is to expose the students to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research. |

**Course Content**

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| **Week** | Topics | CLO |
| Week 01 | Briefly recall the recent history of cloud computing, illustrating its motivation and evolution.  List some of the enabling technologies in cloud computing and discuss their significance.  Distributed Computing  Grid Computing  Cluster Computing  Utility Computing  Software as a Service  Cloud Computing | C1 |
| Week 02 | What is Cloud Computing?  Why Cloud Computing?  Advantages and Disadvantages of Cloud Computing  Essential Characteristics of Cloud Computing  Three Service Models (PaaS, SaaS, IaaS) | C1 |
| Week 03 | Four Deployment Models (Private, Public, Hybrid, Community)  Overview of public cloud service providers (Amazon, Azure, GCP, etc.)  Exploring Deployment of Web Apps on Azure Cloud  Define SLAs and SLOs and illustrate their importance in Cloud Computing. | C1,C3 |
| Week 04 | Virtualization technology?  Cloud Computing and Virtualization  different CPU, memory and I/O virtualization techniques that serve in offering software, computation and storage services on the cloud  Virtual Machine Monitor (VMM)/Hypervisors?  Virtualization Models (Type-I and Type-II hypervisors) | C1,C2 |
| Week 05 | Full Virtualization vs Para Virtualization  Device Virtualization (Pass-through, Hypervisor-Direct, and Split Device Driver)  Network and Storage Virtualization  Software Defined Networks (SDN) and Software Defined Storage (SDS); | C1 |
| Week 06 | Midterm Exam |  |
| Week 07 | Containerization Technology?  Containers vs Virtual Machines in Cloud Computing  Docker containers  Container Management Platform (Kubernetes)  Working with Kubernetes in Azure cloud | C1,C2,C3 |
| Week 08 | Overview of OpenStack  Deployments Models of OpenStack  OpenStack Architecture  Working with OpenStack components  Deploying OpenStack based private Cloud | C1,C2 |
| Week 09 | Describe the overall organization of data and storage.  Understand Cloud storage services  Cloud based File storage  Cloud based Block storage  Cloud based Object storage  Cloud storage use cases in Azure Cloud | C1,C2 |
| Week 10 | Explain the fundamental aspects of parallel and distributed programming models.  Big Data and Cloud Computing  Apache Hadoop framework on cloud | C1,C2 |
| Week 11 | Hadoop Cluster on Azure Cloud  Different cloud programming models (MapReduce, Spark, GraphLab and Spark Streaming).  Apache Spark and Cloud computing | C1,C2 |
| Week 12 | Data Science and Machine Learning in Cloud  Demonstrate a Spark Cluster on top of HDInsight Cluster in Azure Cloud  Working with MLlib in Azure Cloud | C1,C2 |
| Week 13 | Understand Internet of Things.  IoT Infrastructure in Cloud Computing  Connecting IoT devices to Azure Cloud  Working with Azure Cloud IoT Suite.  Understand IoT Hub in Azure Cloud | C1,C2 |
| Week 14 | Cloud security challenges  Cloud security approaches: encryption, tokenization/obfuscation, cloud security alliance standards, cloud security models and related patterns  Cloud security in mainstream vendor solutions  Mainstream Cloud security offerings: security assessment, secure Cloud architecture design | C1 |
| Week 15 | Term paper group presentations | C1 |
| Week 16 | Final Exam | Online Course Completion Certificate  Term Paper Submission |

**Evaluation**

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| 1. | Online Course Completion Certificate (related to Cloud Computing) | 10% |
| 2. | Papers’ Reviews | 7% |
| 3. | Final Term Paper (Research Article) + Presentation | 8% |
| 4. | Midterm Exam I | 20% |
| 5. | Assignments and Quizzes | 10% |
| 6. | class participation (Weekly Q&A Sessions) | 10% |
| 7. | Final Exam | 35% |

**Text Book**

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| 1. K. Hwang, G. Fox, and J. Dongarra, Distributed and Cloud Computing: from Parallel Processing to the Internet of Things |

**Reference Book**

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| 1. R. Buyya, J. Broberg, and A. Goscinski (eds), Cloud Computing: Principles and Paradigms |

* ***Grading Policies***
* **Online Course Completion Certificate**

In this course each student must have to complete at least one online cloud computing related course from any reputed courses website (such as coursera, edX, etc). This should be noted that the online course completion certificate will have total marks 10.

* **Weekly Research Papers’ Reviews**

There will be research papers review assignments in this course. This should be noted that review assignments overall marks are 5.

* **Term Paper (Research Article) + Presentation**

In this course each student will have to produce at least one (01) conference level research paper, based on weekly research papers reading assignments. Also the final presentation will be conducted. This should be noted that the research article and presentation overall marks are 5.

* **Mid Term I**

There one midterm exam in this course. This should be noted that midterm I exam’s overall marks are 20.

* **Weekly Assignments and Quizzes**

There will be three (03) quizzes and five (05) weekly assignments throughout the course. This should be noted that quizzes and assignments overall marks are 10.

* **Class Participation (Online Q&A Sessions)**

There will be session with students, where teacher will ask questions from students to assess the understanding of asynchronous lectures. This should be noted that class participation and Q&A session’s overall marks are 10.

* **Final Exam**

The final exam will be conducted as per given policy of SIBAU management on 16th week on course. The final exam will be consist of total 40 marks.

* ***Availability of Course Material***

All the course related material will be uploaded on Sukkur IBA Learning Management System. You are advised to use your LMS credentials to access the course material. Furthermore, you can find the assignments, quizzes, deadlines on LMS.

* ***Availability of Teacher***
* ***Submission of Assessment materials (assignments, quizzes, labs, etc.):***

This is to inform you that the assessment material related to assignments, quizzes, course certificate, term papers, labs, etc. can be submitted on LMS. These all will be a time-bound and it will be the responsibility of students to submit as per given schedule.

**Course Learning Outcomes**

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| 1 | Define and explain the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; and benefits; Also understand how to use Cloud Services, deployment models, SLAs and SLOs. |
| 2 | Understand the importance of Virtualization and containerization technologies in cloud. Describe and implement open source private cloud platform using OpenStack. Also understand the working of different cloud storage services and distributed cloud programming models |
| 3 | Learn and implement different cloud applications and cloud evaluation platforms such as Big Data, Data science and Machine learning using cloud infrastructures |

**CLO-SO Map**

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|  | **SO IDs** | | | | | | | | | | |  |
| **CLO ID** | **GA1** | **GA2** | **GA3** | **GA4** | **GA5** | **GA6** | **GA7** | **GA8** | **GA9** | **GA10** | **GA11** | **GA12** |
| CLO 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| CLO 2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| CLO 3 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |

**Approvals**

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| Prepared By |  |
| Approved By | Not Specified |
| Last Update |  |