| **21CST/ITT-378** | **CLOUD COMPUTING & DISTRIBUTED SYSTEMS** | L | T | P | C |
| --- | --- | --- | --- | --- | --- |
| Total Contact Hours: 30 Hours | 2 | 0 | 0 | 2 |
| For CSE/IT 6th semester |
| Prerequisite: Basic Understanding of Computer Organization, Operating Systems, Computer Networks and Data Structures and Algorithms |
| Max Marks-100 | | | | | | |
| Internal-40 | External-60 | | | | |

**Course Objectives:**

| **1** | To get detailed knowledge about the Cloud Applications and Distributed Systems. |
| --- | --- |
| **2** | Comprehending cloud virtualization technique. |
| **3** | To gain familiarity of cloud applications in different sectors. |
| **4** | Awareness about the cloud implementation and going on advancements. |

**Course Outcomes:**

| **COs** |  | **BT Level** |
| --- | --- | --- |
| **1** | Understanding of various paradigm of cloud computing and distributed systems. | BT-2 Understand |
| **2** | Articulate the basic concepts, key technologies, strength and limitation of cloud computing and possible applications. | BT-4 Analyze |
| **3** | Appraise the architecture and infrastructure of cloud computing including SaaS, PaaS, IaaS, UCaaS/FaaS public cloud, private cloud and hybrid cloud. | BT-5 Evaluate |
| **4** | Interpret various data, scalability, security and cloud services to acquire efficient database for cloud storage. | BT-3 Apply |
| **5** | Develop the appropriate cloud computing solutions and recommendations according to the application used. | BT-6 Create |

**UNIT-I  INTRODUCTION TO CLOUD COMPUTING AND DISTRIBUTED SYSTEMS [10 HRS]**

* 1. **Distributed Systems:** Introduction to Distributed System, Examples of distributed systems, Trends in distributed Systems, Types of System Models: Physical models, Architectural models & Fundamental models.
  2. **Cloud Computing:** Introduction to Cloud Computing, Deployment models of Cloud: Public versus Private Clouds, Services offered by Cloud, Risk Related to Cloud Computing, Virtualization in Cloud Computing

**UNIT-II CLOUD INFRASTRUCTURE AND SERVICES [10 HRS]**

**2.1 Cloud Service Models:** Cloud Services Models & Features: SaaS, PaaS, IaaS and UcaaS/FaaS, Service oriented architecture and web services, Features of cloud computing architectures.

**2.2 Virtualization & Cloud Migration:** Types of virtualization in cloud computing, Tools and Products available for Virtualization, Seven step model of migration into a cloud, Broad approaches to migrating into the cloud, Enterprise cloud computing paradigm.

**UNIT-III CLOUD SECURITY SERVICES [10 HRS]**

**3.1 Data and Cloud Security:** Data security in cloud, Cloud Security Services: Confidentiality, Integrity and Availability, Secure Cloud Software requirements, Secure Cloud Software testing, Cloud Analytics.

**3.2 Case Studies:** Case studies related to existing cloud services like Google, EMC VMware, NetApp, Microsoft, Amazon, IBM, Salesforce.com and any other Partnerships.

**3.3 Presentation of Advanced Topics in Cloud Computing by the students (Included in the syllabus):** Map Reduce and GFS, Big data and Hadoop, Different modules of Data stores, Micro services: Kubernetes, Server less Computation with Open Lambda, Geo distribution, Scaling Distributed Machine Learning with the Parameter Server, Library from Apache, Open Source Cloud Software Systems, Eucalyptus, Nimbus, Open Nebula, AWS, EC2

**TEXT BOOKS**

1. Cloud Computing: A Practical Approach by Toby Velte, Anthony Velte, Robert C. Elsenpeter, McGraw Hill Professional, 22 Oct 2009

2. Buyya, Rajkumar, James Broberg, and Andrzej M. Goscinski, eds. Cloud computing: Principles and paradigms. Vol. 87. John Wiley & Sons, 2010.

3. Miller, Michael. Cloud computing: Web-based applications that change the way you work and collaborate online. Que publishing, 2008.

4. Hurwitz, Judith S., et al. Cloud computing for dummies. John Wiley & Sons, 2010.

5. Kris Jamsa. Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and more, Jones &Bartlet Learning Company LC, 20012.

**REFRENCE BOOKS**

1. G. Pfister. In Search of Clusters. Prentice Hall PTR, NJ, 2nd Edition, NJ, 1998.

2. Cloud Computing: Implementation, Management, and Security, by John Rittinghouse and James F.Ransome, CRC Press Taylor and Francis Group

3. Joshy Joseph and Craig Fellenstein, Grid Computing, Person Edition, (2004).

4. Maozhen Li, Mark Baker, “The Grid Core Technologies”, John Wiley & Sons (2005).

5. Cloud Computing: A Practical Approach for Learning and Implementation Paperback – 1 January 2014 by Srinivasan, Pearson Education

| **Course**  **Outcome** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CO1 | 3 | - | - | - | 1 | - | - | - | - | - | - | - | - | - |
| CO2 | 3 | - | - | - | 1 | - | - | - | - | - | - | - | - | 1 |
| CO3 | 3 | 3 | - | 3 | 2 | - | - | - | - | - | - | 2 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 3 | 2 | 1 | - | - | - | - | - | 2 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 1 | - | - | - | - | - | 2 | 2 | 3 |
| AVG | 3 | 3 | 2.5 | 3 | 1.8 | 1 | - | - | - | - | - | 2 | 2 | 2 |

# Mode of Evaluation: The performance of students is evaluated as follows:

|  | **Theory** | |
| --- | --- | --- |
| **Components** | **Continuous Internal Assessment (CAE)** | **Semester End Examination (SEE)** |
| **Marks** | **40** | **60** |
| **Total Marks** | **100** | |

**Relationship between the Course Outcomes (COs) and Program Outcomes (POs)**

| **Mapping Between COs and POs** | | |
| --- | --- | --- |
| **SN** | **Course Outcome (CO)** | **Mapped Programme Outcome (PO)** |
| 1 | CO1 | PO1, PO5 |
| 2 | CO2 | PO1, PO5, PSO2 |
| 3 | CO3 | PO1, PO2, PO4, PO5, PO12, PSO1, PSO2 |
| 4 | CO4 | PO1, PO2, PO3, PO4, PO5, PO6, PO12, PSO1, PSO2 |
| 5 | CO5 | PO1, PO2, PO3, PO4, PO5, PO6, PO12, PSO1, PSO2 |

0 –NO correlation, 1 = Slight, 2 = Moderate, 3 = Substantial

|  |  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO1**  **0** | **PO1**  **1** | **PO12** | **PSO1** | **PSO2** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Course Code | Course Name | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **1**  **0** | **1**  **1** | **12** | **PSO1** | **PSO2** |
| **21CST/ITT-378** | **Cloud Computing & Distributed Systems** | **3** | **3** | **2.5** | **3** | **1.8** | **1** | **0** | **0** | **0** | **0** | **0** | **2** | **2** | **2** |

**Program Outcomes (POs)**

**PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.**

**PO 2: Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.**

**PO 3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.**

**PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.**

**PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.**

**PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.**

**PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.**

**PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.**

**PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.**

**PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions**

**PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s work, as a member and leader in a team, to manage projects and in multidisciplinary environments.**

**PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.**

**Program Specific Outcomes (PSOs)**

**PSO 1: Exhibit attitude for continuous learning and deliver efficient solutions for emerging challenges in the computation domain.**

**PSO 2: Apply standard software engineering principles to develop viable solutions for Information Technology Enabled Services (ITES).**