Course	CSE540 Cloud Computing	Semester	Monsoon Semester 2024
Faculty Name(s)	Sanjay Chaudhary	Contact	sanjay.chaudhary@ahduni.edu.in
School	SEAS	Credits	3
GER Category:	Not Applicable	Teaching Pedagogy Enable:YES	P/NP Course: Can not be taken as P/NP

Schedule	Section 1	11:00 am to 12:30 pm	Tue	01-08-24 to 26-11-24
		11:00 am to 12:30 pm	Thu	01-08-24 to 26-11-24

Prerequisite	CSC330 Computer Networks/CSE330 Computer Networks & CSC340 Operating Systems/CSE340 Operating Systems
Antirequisite	Not Applicable
Corequisite	Not Applicable
Course Description	The course will introduce basic concepts of distributed and parallel computing, service-oriented architecture, virtualization, service and delivery models of cloud computing. The course will include internals of virtual machines, development and deployment of cloud services. Challenges and research issues like resource provisioning, Virtual Machine scheduling, load balancing, VM migration, privacy and security, energy efficiency in clouds etc. will be introduced. Students will work on group projects to address development or deployment related aspects of cloud services/applications.

Course Objectives	To introduce basic concepts of:
	▪ Large network-based systems
	▪ Geographically distributed compute and data intensive infrastructures
	▪ Parallel and distributed computing
	▪ Service Development and Deployment
	▪ Virtualization
	▪ Cloud Computing
	To Design, implement, and evaluate cloud computing systems
	To develop and deploy Cloud Services / Applications
	Create awareness about challenges and research issues
Learning Outcomes	• Understand distributed and parallel processing/computing
	• Understand the concepts of virtualization
	• Learn the principles of cloud computing
	• Gain an exposure about developing Cloud Services
	• Develop the know-how to develop and deploy services provided on Cloud (IaaS, PaaS, SaaS, DaaS etc…)
	Realize challenges and research issues in the field of cloud computing
Pedagogy	Lectures, class room discussions, presentations by students and case studies
Expectation From Students	Students will participate in discussions, work in the group of four members to design, develop and deploy cloud services / applications.

Assessment/Evaluation	- Mid-Semester Examination: - Written - 25% - End Semester Examination: - Project - 50% - Written - 25%
Attendance Policy	As per Ahmedabad University Policy. As per Ahmedabad University attendance policy (min 80%)
Project / Assignment Details	From week number five onwards students will work on group projects. Each project will comprise of four students. Each project team will work on one specific project. Each project will enforce broader theoretical foundation of cloud computing technologies. Multi-threading, sockets, C/C++, Java, Python, Bash Linux, Virtual Machines, Amazon AWS, Google App-Engine, Hadoop Each student is expected to know (or learn quickly) some of these languages and systems: • Set up Virtual Machines • Java / python programs using SOAP and REST APIs to develop services • Set up of cluster made of at least 2-3 nodes • Distributing Computing: RPC, RMI, J2EE / .NET For initial four weeks, each student will work on individual lab exercises to learn above mentioned topics:

Course Material	Text Book(s)
	• Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, 1st Edition, McGraw Hill, ISBN: 978-0124114548, Year: 2013, • Distributed and Cloud Computing: Clusters, Grids, Clouds, and the Future Internet, Kai Hwang, Jack Dongarra & Geoffrey C. Fox, 1st Edition, Morgan Kaufmann, ISBN: 978-01-28-00204-9, Year: 2011, Reference Book • Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More (Student Edition), Kris Jamsa, 1st Edition, Jones & Bartlett Learning, ISBN: 978-938-08-5377-2, Year: 2012, • Research Advances in Cloud Computing,, S. Chaudhary, G. Somani, and R. Buyya (Eds.),, 1 Edition, Springer Nature, ISBN: 978-981-10-5025-1, Year: 2017, Coursepacks • Mastering Cloud Computing, Description It is a text book written by Rajkumar Buyya. ,
Additional Information	It is offered as a technical elective course for MTech (CSE) semester III and BTech (ICT) semester – VII

Session Plan

NO.	TOPIC TITLE	TOPIC & SUBTOPIC DETAILS	READINGS,CASES,ETC.	ACTIVITIES	IMPORTANT DATES
1	Fundamentals of Distributed Computing - 1	Concepts of distributed computing, Remote procedure calls		Write, execute and test RPC, RMI, J2EE /.NET programs	
2	Fundamentals of Distributed Computing - 2	Concepts of distributed computing: Remote method invocation, Overview of J2EE / .NET		Write, execute and test RPC, RMI, J2EE /.NET programs	
3	Introduction to Service-Oriented Computing - 1	Overview of cluster computing, p2p computing, grid computing		Create a cluster of nodes, use publicly available grid and prepare a brief report on features of service-oriented computing	
4	Introduction to Service-Oriented Computing - 2	Introduction to Service-Oriented Computing, Principles of Service-Oriented Architecture		Create a cluster of nodes, use publicly available grid and prepare a brief report on features of service-oriented computing	
5	Communication protocols - 1	Development of Services using SOAP		Write, test and execute SOAPprograms	
6	Communication protocols - 2	Development of Services using REST		Write, test and execute REST based programs	
7	Introduction to Virtualization - 1	Virtualization Concepts and types		Set up of Virtual Machine Monitors using open source platform Xen / OpenStack, Apache CloudStack, Cloud Foundry etc.\n\nInitiate teaming and project proposals\n	

8	Introduction to Virtualization - 2	Virtualization: formal model and requirements		Set up of Virtual Machine Monitors using open source platform Xen / OpenStack, Apache CloudStack, Cloud Foundry etc.\n\nInitiate teaming and project proposals\n	
9	Details of Virtualization - 1	Processor Virtualization, Binary Translator, Memory Virtualization, I/O Virtualization, Network Virtualization, Open Virtualization Format (OVF)		Experiments of Processor, Memory, Network and I/O Virtualization\n\nUse of any of Resource Managers – Open Nebula, Haezea, Eucalyptus, Nimbus etc.\n	
10	Details of Virtualization - 2	Processor Virtualization, Binary Translator, Memory Virtualization, I/O Virtualization, Network Virtualization, Open Virtualization Format (OVF)		Experiments of Processor, Memory, Network and I/O Virtualization\n\nUse of any of Resource Managers – Open Nebula, Haezea, Eucalyptus, Nimbus etc.\n	
11	Introduction to Cloud Computing - 1	Definitions, Cloud Service Models: Infrastructure as a Service (IaaS)		Continue experiments\n\nSubmission of group project proposals\n	
12	Introduction to Cloud Computing - 2	Cloud Service Models: Platform as a Service (PaaS), and Software as a Service (SaaS)		Continue experiments\n\nSubmission of group project proposals\n	
13	Parallel Programming Models	Parallel Programming Models : Multi-Thread Programming		Implementation of Parallel Algorithms using Hadoop, MapReduce, OpenMP, MPI using Java / Python	
14	Parallel Programming Models	Parallel Programming Models : Hadoop, MapReduce Programming		Implementation of Parallel Algorithms using Hadoop, MapReduce, OpenMP, MPI using Java / Python	

15	Case studies of various Cloud Platforms / Systems for development of cloud services	Study and evaluation of any of:\nGoogle AppEngine,\nAmazon Web Services (AWS), Microsoft Azure, Hadoop, Salesforce.Com, Manjrasoft Aneka etc.\n		Study of Commercial platforms: \nCitrix, VMvare vSHere, MicroSoft Hyper-V\n\n\n	
16	Case studies of various Cloud Platforms / Systems for development of cloud services (Cont)	Study and evaluation of any of:\nGoogle AppEngine,\nAmazon Web Services (AWS), Microsoft Azure, Hadoop, Salesforce.Com, Manjrasoft Aneka etc.\n		Study of Commercial platforms: \nCitrix, VMvare vSHere, MicroSoft Hyper-V\n\n\n	
17	Development of Cloud Services - 1	Development and deployment of Cloud Services:\nIaaS		Reviews and feedback of Project Proposals\n\nUse of cloud software development platforms / APIs\n	
18	Development of Cloud Services - 2	Development and deployment of Cloud Services:\n PaaS		Reviews and feedback of Project Proposals\n\nUse of cloud software development platforms / APIs\n	
19	Development and deployment of Cloud Services - 3	Development and deployment of Cloud Services:\n SaaS		Use of cloud software development platforms / APIs	
20	Development and deployment of Cloud Services - 4	Development and deployment of Cloud Services: DaaS\n		Use of cloud software development platforms / APIs	
21	Testing and evaluation of deployed Cloud Services	Development and deployment of Cloud Services:\nIaaS, PaaS, SaaS, DaaS\n		Peer reviews (by project teams) of cloud services deployed by other project teams, feedback and reflections	

22	Cloud Computing Architecture, Cloud Applications, and Advanced Topics	Advanced Topics: Physical versus Virtual Clusters, Live VM Migration, Migration of Memory, File and Network Resources, Dynamic Deployment of Virtual Clusters		Each project team will select one topic and perform live demonstration	
23	Advanced Topics	Advanced Topics: Physical versus Virtual Clusters, Live VM Migration, Migration of Memory, File and Network Resources, Dynamic Deployment of Virtual Clusters		Each project team will select one topic and perform live demonstration	
24	Research topics	Resource provisioning, Virtual Machine Scheduling, Load Balancing, VM Migration, Privacy and security, Energy Efficiency in Clouds		Each project team will select and present one of the published research papers	
25	Group Project presentation and evaluation			Walk through and review of each project	
26	Group Project presentation and evaluation			Walk through and review of each project	
27	Mid-Semester Examination				
28	End-Semester Examination				
29	Reflection and Review				
30	Reflection and Review				