

Name of Subject	Cloud Computing
Credits	3
Nature of Elective	Functional

Background	<ol style="list-style-type: none"> 1. To understand the principles and paradigm of Cloud Computing 2. To appreciate the role of Virtualization Technologies 3. Ability to design and deploy Cloud Infrastructure 4. Understand cloud security issues and solutions
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Course Outcomes: At the end of the course the student will be able to:

CO#	Cognitive Abilities	Course Outcomes
CO1	Remembering	Identify Ethical hacking processes and become acquainted with Penetration testing.
CO2	Understanding	Recognize Footprinting techniques and apply them in real-time applications
CO3	Applying	Build knowledge about the Meta split tool with Kali Linux
CO4	Analyzing	Differentiate Privilege Escalation in Windows and Linux
CO5	Evaluating	Construct Secure Web Applications to understand Hacking Techniques and recognize Wi-Fi hacking and Security techniques.

Course Outline:

Unit	Outline
1	<p>Introduction to Cloud Computing: • Difference between Cloud Computing and On-Premise Computing • How to access Big Clouds (such as the AWS Cloud, Google Cloud, Microsoft Azure Cloud, or IBM Cloud) via portals, APIs, and SDKs • Cloud Computing definition and characteristics (e.g., elasticity, multi-tenancy, on-demand access, ubiquitous access, usage metering, self-service capability, SLA-monitoring) • Cloud Computing and Service Oriented Architecture (SOA) • Enterprise Cloud drivers and Adoption Trends • Typical Cloud Enterprise workloads • Cloud Service Models/Types (i.e., Public, Private, Hybrid, and Community) • Cloud deployment models (i.e., IaaS, PaaS, SaaS, and BPaaS) • Cloud Return on Investment (ROI) models • Cloud Reference Architectures • Cloud Standards (e.g., OSDI APIs) • Technology Providers vs. Cloud providers vs. Cloud vendors • Planning Cloud transformations</p>
2	<p>Managing Data in the Cloud ,Abstraction and Virtualization: Storage models and storage as a service • Using Amazon Cloud Storage Services via Portal and APIs • Using Microsoft Azure Cloud Storage Services via Portal and APIs • Using Google Cloud Storage Services via Portal and APIs • Using IBM Cloud Storage Services via Portal and APIs • Using OpenStack Cloud Storage Services via Portal and APIs, Virtualization in Cloud Computing Systems and Use of Hypervisors to Create Virtual</p>

	<p>Machines • Computing as a Service • Serverless Computing • Using and Managing Virtual Machines on the Big Clouds • Using and Managing Containers (Container Orchestration) • Understanding and use of Docker containers and the Docker Hub • Understanding and use of Google Kubernetes Engine and Alternative Container Management Solutions, Cloud Architectures and Infrastructure Design • Dynamic Deployment of Virtual Clusters • Parallel Computing in the Cloud • SPMD and HPC-Style Parallelism • Many Task Parallelism • MapReduce and Bulk Synchronous Parallelism • Graph Dataflow Execution and Spark • Agents and Microservices • HTCondor</p>
3	<p>Cloud Networking Services and Service Platform Design: Virtual Private Cloud Networking • High-Performance, Scalable Load Balancing • Cloud API Gateways • Global Content Delivery Networks • Cloud-Managed High-Performance Network Address Translation • Network Edge Connectivity • Reliable, Resilient, Low-Latency DNS Serving on the Cloud • Network Performance and Availability Optimization on the Cloud • Big Cloud Service Platforms Convergence and Service Offerings (Amazon AWS, Google GCP, Microsoft Azure, IBM Cloud, Force.com Cloud, Clouds at SGI, NASA, and CERN)</p>
4	<p>Cloud Platforms and Big Data Analytics and Machine/Deep Learning Cloud Services: Data Science and Big Data Characteristics • Data Collection, Mining, and Analytics on Clouds • Scalable Parallel Computing Over Large Clusters • Data Analytics Frameworks (e.g., Hadoop programming with HDFS/MapReduce and YARN; Spark Core and Resilient Distributed Data Sets; Amazon Elastic MapReduce; Amazon Athena Analytics, Google Cloud Datalab) • Example: Big Data Analytics for Healthcare Applications • Example: Big Data Analytics for Social Media Applications Scientific Streams Examples • Basic Design Challenges of Streaming Systems • Data Stream Analytics Frameworks (e.g., Spark SQL and Streaming Programming; Amazon Kinesis and Firehose; Kinesis/Spark and the Array of Things; Azure Data Streaming; Kafka, Storm and Heron Streams; Google Dataflow and Apache Beam; Apache Flink) • Example: Streaming Big Data Analytics for Social-Media Applications</p>
5	<p>Cloud-Based Distributed Data Management Platforms and Other Cloud Topics: Challenge and Opportunities of Distributed Data • Transferring and Sharing Data and Managing Identity and Credentials Using the Globus Platform • Using Open Source Framework to Build a Cloud (e.g., Eucalyptus, OpenStack, VMWare) o Virtual Clustering in Private Clouds Using Eucalyptus o Private and Public Clouds Building Using OpenStack o Building Hybrid Clouds Using VMWare Virtualization Support • Use Globus to Build a SaaS capability • Security in the Cloud (i.e., Role-Based Access Control, Data Security, VMs and Containers Security, Cloud Software Services Security, Managing Trust in Clouds and Data Centers) Ethereum Overview (Ethereum vs. Bitcoin, Components of a Blockchain, Ethereum History, Ethereum Development Stages, General Purpose Blockchain, Decentralized Applications (DApps), Web3, Ethereum Development Culture) • Ether Currency Units • Ethereum Wallets Overview • Control and Responsibility • Using MetaMask • Externally Owned Accounts (EOAs) and Contracts</p>

Practicals:

List of Practical Experiments on Cloud Computing (30 HRS)

1.	Study and implementation of Infrastructure as a Service.
2.	Study and implementation of Platform as a Service.
3.	Study and implementation of Software as a Service.
4.	Study and implementation of Storage as a Service.
5.	User Management in Cloud.
6.	Study and implement Identity and Access Management (IAM).
7.	Study and implement MFA in the environment of popular Cloud Service Provider.
8.	Write a program for Web Feed.
9.	Study and implementation of Single-Sign-On (SSO).
10.	Access, label, and process large amounts of structured data (tabular data) and unstructured data (photo, video, geospatial, and audio) for ML using AWS Sagemaker
11.	Create repeatable training workflows to accelerate model development using AWS Sagemaker
12.	Integrate ML workflows with CI/CD pipelines for faster time to production using AWS Sagemaker
13.	Deploy and manage models in production in AWS Sagemaker
14.	Automate integration and deployment (CI/CD) workflows in AWS Sagemaker
15.	Implementation of Virtualization in Cloud Computing to Learn Virtualization Basics, Benefits of Virtualization in Cloud using Open Source Operating System.

References:

1. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood
2. "The Big Switch: Rewiring the World, from Edison to Google" by Nicholas Carr
3. "Architecting the Cloud: Design Decisions for Cloud Computing Service Models" by Michael J. Kavis
4. "Cloud Native Transformation: Practical Patterns for Innovation" by Pini Reznik and Jamie Dobson
5. "Cloud Computing: From Beginning to End" by Ray J. Rafaels