Programme: B. Tech. CSE/CCE & Integrated B.Tech-M.Tech (CSE)	Course Title: Foundations of Cloud Computing			Course Code: CSEXXXX
Type: Program Elective	Prerequisites: NIL			Total Contact Hours: 26(L)+26(P)
Year/Semester: III/6	Lecture Hrs /Week: 2	Tutorial Hrs /Week: 0	Practical Hrs /Week: 2	Credits: 2+1 = 3

Learning Objective:

The course will discuss the basics of Cloud computing. It will cover storage services, cloud economics, levels of managed infrastructure, and GCP services. We will also explore different deployment models of Cloud computing, as well as several hosting scenarios. It aims to provide basic ideas of cloud management techniques and cloud software deployment considerations. It provides an overview of different CPU, memory and I/O virtualization techniques that serve in offering software, computation and storage services on the cloud.

Course outcomes (Cos):

On completion of this course, the students will have the ability to:		Bloom's Level
CO-1	**Understand** fundamental concepts cloud computing and cloud service provider.	2
CO-2	**Review**, **analyze and implement** of virtualization techniques.	2, 3, 4
CO-3	**Differentiate** between data storage options for various types of application data.	4
CO-4	**Understand** and **classify** issues related to networking and security in the Cloud.	2
CO-5	**Implement** automated cloud based solution in ML and BigData.	4

Course Topics:

Topics	Hours	
UNIT – I: Cloud Computing Basics		
Need of cloud computing, Characteristics and benefits, Cloud reference model - IaaS, PaaS, SaaS, Features of a Cloud Deployment models - Public, Private, Hybrid.	2	4
Open challenges - Cloud interoperability and standards, Scalability and fault tolerance, Security, trust, and privacy, Organizational aspects.	2	
UNIT – II: Getting Started with Cloud Platform		
Cloud Platforms: Google Cloud Computing, Amazon web services, Microsoft Azure (Compute services, Storage services, Communication services, Additional services).	2	3

GCP & AWS Resource hierarchy, Identity and Access Management (IAM), IAM roles.	1	
UNIT – III: Virtual Machines and Migration in the Cloud		
Virtualizations / VMs – Definition, understanding, Characteristics of virtualized environments - Increased security, Managed execution, Portability, taxonomy of virtualization techniques, Execution virtualization, Virtualization of CPU, memory, I/O devices, resource management.	3	8
Virtualization and cloud computing, Pros and cons of virtualization, Technology examples- Xen: paravirtualization, VMware: full virtualization, Microsoft Hyper-V, Containerizing and Orchestrating.	3	
Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud , Virtual Machines Provisioning and Manageability, Virtual Machine Migration Services, VM Provisioning and Migration in Action, Provisioning in the Cloud Context.	2	
UNIT – IV: Storage and APIs in the Cloud		
Cloud Storage, Architecture of Cloud Storage, Pros and Cons, Cloud Storage Providers. Storage options, Structured and unstructured storage in the cloud. Google Cloud storage, SQL Managed Services, Cloud Spanner as a managed services, NoSQL Managed Services Options, Cloud Bigtable as NoSQL Option. Purpose of APIs, Cloud Endpoints, Using Apigee, Managed Message Services, Cloud Pub/Sub.	2	2
UNIT – V: Networking and Security in Cloud		
Introduction to Networking in the Cloud, Defining a Virtual Private Cloud, Public and Private IP Address Basics, Google Network Architecture.	2	5
Introduction to security in the cloud, Current State of Data Security in the Cloud, Understanding the shared security model, Explore encryption options, Understand authentication and authorization, Technologies for Data Security in Cloud Computing, Digital Identity and Data Security, Content Level Security – Pros and Cons.	3	
UNIT – VI: BigData, ML and AI in Cloud		
Introduction to Big Data, Characteristics of Big Data, Basics of Machine Learning (ML), Types of Machine Learning, Applications of ML. Cloud big data platform, Cloud Dataflow, BigQuery, ML platforms, ML APIs.	2	2
Unit – VII: Enterprise Paradigm in Cloud		
Issues for Enterprise Applications on the Cloud , Transition Challenges, Enterprise Cloud Technology and Market Evolution, Business Drivers Toward a Marketplace for Enterprise Cloud Computing, The Cloud Supply Chain.	2	2

Labs:

Topics		Hours
Module 1: Cloud Computing Fundamentals		
Lab 1	• The Google cloud console. • Getting Started with Cloud Shell and gcloud • Google cloud to build your apps: Creating Virtual Machine	2
Lab 2	• App Engine: Qwik Start - Python • Cloud Functions: Qwik Start - Command Line • Kubernetes Engine: Qwik Start	2
Module 2: Infrastructure in Google Cloud		
Lab 3	• Google Cloud Fundamentals: Getting Started with Cloud Marketplace • Getting Started with VPC Networking and Google Compute Engine	2
Lab 4	• Google Cloud Fundamentals: Getting Started with Cloud Storage and Cloud SQL	2
Lab 5	• Google Cloud Fundamentals: Getting Started with GKE • Hello Cloud Run [APPRUN] • Automating the deployment of infrastructure using Terraform	3
Module 3: Networking and Security in Google Cloud		
Lab 6	• Multiple VPC Networks • VPC Networks - Controlling Access	3
Lab 7	• HTTP Load Balancer with Cloud Armor • Create an Internal Load Balancer	3
Module 4: Data, ML, and AI in Google Cloud		
Lab 8	• Dataproc: Console, Command Line • Dataflow: Templates • Dataflow: Python, Dataprep	3
Lab 9	• Vertex AI Workbench Notebook • Cloud Natural Language API	3
Lab 10	• Google Cloud Speech API • Video Intelligence • Reinforcement Learning	3

Textbook references:

1. Mastering Cloud Computing Foundations and Applications Programming, Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi. Morgan Kaufmann, 2013.
2. Cloud Computing Black Book, Kailash Jayaswal, Jagannath Kallakurchi, Donald J Houde, Dr. Deven Shah, dreamteach press, 2014.

Reference Book:

1. Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, Inc, 2010
2. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008
3. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
4. Cloud Computing (Principles and Paradigms), Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2013
5. Cloud Computing A practical approach for learning and implementation, A Srinivasan and J. Suresh, Person. 2014

Additional Resources:

Google Cloud Computing Course, NPTEL lectures

Evaluation Method:

Item	Weightage (%)
Theory Quiz	10
Theory Mid-Term Exam	15
Theory End-Term Exam	25
Lab Quiz	10
Lab Assignments	25
Lab Endterm	15

CO and PO, PSO Correlation Matrix for CSE

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1		3	2	2		1	1	2	3	3	1	3
CO2	3	2	2		2	1	1		1	1	2	3	3	3	2
CO3	3	2	1		2	2	2		1	1	2	3	3	2	2
CO4	3	2	1		2	2	1		2	1	2	2	3	1	2
CO5	1	1	1		3	2	3		2	3	2	2	3	1	3

CO and PO, PSO Correlation Matrix for CCE

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1		3	2	2		1	1	2	3	-	1	2
CO2	3	2	2		2	1	1		1	1	2	3	-	-	1
CO3	3	2	1		2	2	2		1	1	2	3	-	-	1
CO4	3	2	1		2	2	1		2	1	2	2	1	1	1
CO5	1	1	1		3	2	3		2	3	2	2	1	1	1

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