rBIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI

WORK INTEGRATED LEARNING PROGRAMMES

Digital Learning

Part A: Content Design

Course Title	Cloud Computing
Course No(s)	CC ZG527
Credit Units	5
Credit Model	1-2-2, (total 5 units or credits) ie 1 unit for class room hours, 2 unit for lab hours, 2 units for student preparation. Typically 1 unit translates to 32 hours
Course Author	Chandra Shekar RK/Saleem/Dr. Sai Kishor
Version No	V 1.5
Date	27th June 2015/08th Aug 2015/12th Jan 2016/12th Nov 2017/25th September 2022

Course Objectives

No	Course Objective
CO1	Students will learn the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges;
CO2	Students will learn the basic ideas and principles in data centre design and
CO3	Students will learn about cloud components and technologies and relevant distributed file systems
CO4	Students will learn a variety of programming models and develop working experience

Text Book(s)

T1	Dinkar Sitaram and Geetha Manjunath. Moving to the Cloud. Syngress (Elsevier) Pub, 2011
T2	Marinescu, ***Cloud computing theory and practice***, Morgan Kaufmann Publisher

Reference Book(s) & other resources

R1	Rajkumar Buyya, James Broburg & Anderzej M.G, Cloud Computing – Principles and Paradigms. John Wiley Pub, 2011
R2	Cloud Computing bible by Barrie Sosinsky, Wiley Publishers, 2010
R3	Virtualization A Beginner's guide, Danielle Ruest, Nelson Ruest, TMH, 2009
R4	Cloud Computing bible by Barrie Sosinsky, Wiley Publishers, 2010
R5	Cloud security, a comprehensive guide to secure cloud computing, by Ronald L.Krutz et al, Wiley Publishers, 2010

Modular Content Structure

1. **Introduction to Cloud Computing**
   1.1. Cloud Computing, services, deployment models
   1.2. Introduction to Cloud Computing
   1.3. Origins and Motivation
   1.4. Types of Clouds and Services
   1.5. Cloud Infrastructure and Deployment

2. **Virtualization Techniques and Types**
   2.1. Introduction to Virtualization
   2.2. Use & demerits of Virtualization
   2.3. Types of Virtualization
   2.4. Examples
   2.5. x86 Hardware Virtualization
   2.6. Manage the resources for the SaaS, PaaS and IaaS models
   2.7. Containers – Docker
   2.8. Namespace, Cgroup
   2.9. System Containers and Application Containers
   2.10. Dockers - Elements, Images, Files, Containers
   2.11. Virtual Machine vs Container
   2.12. Cloud orchestration technologies – Brief overview of Kubernetes

3. **Infrastructure as a Service**
   3.1. Introduction to IaaS
   3.2. IaaS examples
   3.3. Reference Model of AWS
   3.4. Amazon cloud services - Compute, Database, Storage
      3.4.1. Region Vs Availability zones
      3.4.2. IAM (A &A)
      3.4.3. Compute: Instance, Cluster, VPC
      3.4.4. Storage: File, Block and Object
      3.4.5. Data: RDS, NoSQL data services,
      3.4.6. Data storage, processing and analytics
      3.4.7. Data warehousing - examples HDFS, EMR

4. **Platform as a Service and SaaS**
   4.1. Introduction to PaaS
   4.2. PaaS examples
   4.3. AWS/Azure – Managed Services
   4.4. Introduction to SaaS
   4.5. Pros and Cons of SaaS model and applications

5. Managing Virtual Resources on the Cloud: Provisioning and Migration
   5.1. Virtual Machine Provisioning and Manageability
   5.2. VM Provisioning Process
   5.3. Virtual Machine Migration Services
   5.4. Migrations Techniques
   5.5. VM Provisioning and Migration in action

6. **Capacity management and Scheduling in cloud computing**
   6.1. Capacity management and Scheduling
   6.2. Distributed management of virtual machines

Learning Outcomes:

No	Learning Outcomes
LO1	**Explain** the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing
LO2	**Apply** the fundamental concepts in data-centres to understand the tradeoffs in power, efficiency and cost
LO3	**Discuss** system virtualization and outline its role in enabling the cloud computing system model.
LO4	**Illustrate** the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon S3 and HDFS
LO5	**Analyze** various cloud programming models and apply them to solve problems on the cloud

Experiential learning components

1. Lab work: See below in **Detailed Plan for Lab work/Design work**.

Additional documentation

Part B: Course Handout

Academic Term	Second Semester 2023-2024
Course Title	Cloud Computing
Course No	CC ZG527
Lead Instructor	Aditya Goel

Contact Hour	List of Topic Title (from content structure in Part A)	Topic # (from content structure in Part A)	Text/Ref Book/external resource
1	1.1. Cloud Computing, services, deployment models 1.2. Introduction to Cloud Computing	Already Part of list in Column 2(List of Topic Title)	T1: Ch1 T2: Ch1
2	1.4. Types of Clouds and Services 1.5. Cloud Infrastructure and Deployment		T1: Ch1 T2: Ch1
3	2. Virtualization Techniques and Types 2.1. Introduction to Virtualization 2.2. Use & demerits of		T1: Ch9 T2: Ch5
4	2.3. Types of Virtualization 2.4. Examples		T1: Ch9 T2: Ch5
5	2.5. x86 Hardware Virtualization		T1: Ch9 T2: Ch5
6	2.6. Manage the resources for the SaaS, PaaS and IaaS models		T1: Ch9
7-8	2.7. Containers – Docker 2.8. Namespace, Cgroup 2.9. System Containers and Application Containers		https://linuxcontainers.org/lxc/introduction/ https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux_atomic_host/7/html/overview_of_containers_in_red_hat_systems/introduction_to_linux_

9-10	2.10. Dockers - Elements, Images, Files, Containers 2.11. Virtual Machine vs Container 2.12. Cloud orchestration technologies – Brief overview of Kubernetes		https://docs.docker.com/get-started/ more focus on 1: Orientation 2: Containers
11-12	Infrastructure as a Service (3L) 3.1. Introduction to IaaS 3.2. IaaS examples 3.3. Reference Model of AWS		T1: Ch2 T2: Ch3
13-14	3.4. Amazon cloud services - Compute, Database, Storage 3.4.1. Region Vs Availability zones 3.4.2. IAM (A &A) 3.4.3. Compute: Instance, Cluster, VPC		
15-16	3.4.4. Storage: File, Block and Object 3.4.5. Data: RDS, NoSQL data services, 3.4.6. Data storage, processing and analytics 3.4.7. Data warehousing - examples HDFS, EMR		
17-18	4. Platform as a Service and SaaS (2L) 4.1. Introduction to PaaS 4.2. PaaS examples 4.3. AWS/Azure – Managed		T1: Ch3
19-20	4.4. Introduction to SaaS 4.5. Pros and Cons of SaaS model and applications		T1: Ch4
21-22	5. Managing Virtual Resources on the Cloud: Provisioning and Migration (1L) 5.1. Virtual Machine Provisioning and Manageability 5.2. VM Provisioning Process 5.3. Virtual Machine Migration Services 5.4. Migrations Techniques 5.5. VM Provisioning and Migration in action		R1: Ch5 T2: Ch6
23-24	6. Capacity management and Scheduling in cloud computing (2L) 6.1. Capacity management and Scheduling 6.2. Distributed management of virtual machines 6.3. Reservation-based provisioning of		R1: Ch6 T2: Ch6

25-26	6.4. Provisioning to meet SLA commitments 6.5. Stages of VM life cycle within OpenNebula 6.6. Network model for OpenNebula		R1: Ch6 T2: Ch6
27-28	7. Issues and Challenges : Availability, Multi-Tenancy, Security and SLA (2L) 7.1.　　Multi-Tenancy, 4 levels of multi tenancy 7.2.　　Multi-tenant models for cloud 7.3.　　Introduction to cloud security 7.4.　　Cloud security Issues 7.5.　　Threat Model		T1: Ch6,7 R1: Ch 23 T2: Ch9
29-30	7.7. who is responsible for managing security 7.8. Service License Agreements: Lifecycle and Management 7.9. Traditional approaches to SLO management 7.10. SLA Management in Cloud 7.11. Automated Policy based management 7.12. Managing Clouds: Services and Infrastructure		R1: Ch16 T2:Ch9
31-32	8. Application Development and Deployment (1L) 8.1. Development: Services, BaaS, FaaS, Dev Environments (formation and runs), IDEs, Integrations with other services (APIs and Gateways 8.2. CT/CI/CD: Continuous build and testing, deployment with cloud based service 8.3. Deployment, scaling and availability: Custom, Managed,		

Detailed Plan for Lab work/Design work

Lab No	Lab Objective	Lab Sheet Access URL	Content Reference
1	Understand Virtualization Install Virtual Box and create VM(Linux) for MVC	TBD	
2	Understand the concept of Docker-Container Implement a Docker web server container with Ubuntu, Nginx, MongoDB/MySql	TBD	
3	Understand the working of AWS Create AWS-InstanceCreation, AWS-S3-ObjStorage	TBD	
4	Understand the working of Openstack OS-InstanceCreateWithVol, OS-Swift-ObjStorage, OS-LoadBalancer-Manual	TBD	
5	Understand Provisioning in VB and Openstack OS-InstanceCreate-Heat-Provision, OS-LoadBalancer-Heat-Provision, Vagrant-Provision-WebServer	TBD	
6	Understand Migration Implement Proxmox cluster and try migration	TBD	
7	PaaS Exercise : Running Azure app locally and Deploying the local app to Azure		
8	PaaS Exercise : Determine which instance gets serves the		
9	SaaS: Developing website using Salesforce		
10			
11			

Case studies: Detailed Plan

Case study No	Case study Objective	Case study Sheet Access URL
1		
2		

Work integration: Detailed plan

No	Activity description
1	
2	
3	

4	

Project work: Detailed Plan

1. Objective of the project:

2. Project scenario description:

3. Tasks to be performed by the students:

4. Expected deliverables:

5. Duration of the project:

Evaluation Scheme

Legend: EC = Evaluation Component; AN = After Noon Session; FN = Fore Noon Session

No	Name	Type	Duration	Weight	Day, Date, Session, Time
EC-1	Quiz-1		*	5%	February 19-28, 2024
	Quiz-2		*	5%	March 19-28, 2024
	Assignment		*	5%	April 19-28, 2024
EC-2	Mid-Semester	Closed	2 hours	35%	Friday, 15/03/2024 (AN)
EC-3	Comprehensive Exam	Open Book	2 ½ hours	50%	Friday, 17/05/2024 (AN)

Note - *Evaluation components can be tailored depending on the proposed model.*

Important Information: