Diploma Engineering

Laboratory Manual

(Cloud Computing)
(4360709)

[Computer Engineering, Semester VI]

Enrolment No	
Name	
Branch	
Academic Term	
Institute	

Directorate of Technical Education
Gandhinagar – Gujarat

DTE's Vision: To facilitate quality technical and professional education has relevance for both industry and society, with moral and ethical values, giving equal opportunity and access, aiming to prepare globally competent technocrats.

DTE's Mission:

1. Quality technical and professional education with continuous improvement of all the resources and personnel
2. To promote conducive ecosystem for Academic, Industry, Research, Innovations and Startups
3. To provide affordable quality professional education with moral values, equal opportunities, accessibility and accountability
4. To allocate competent and dedicated human resources and infrastructure to the institutions for providing world-class professional education to become a Global Leader ("Vishwa Guru")

Institute's Vision:

To cater skilled engineers having potential to convert global challenges into opportunities through embedded values and quality technical education.

Institute's Mission:

1. Impart quality technical education and prepare diploma engineering professionals to meet the need of industries and society.
2. Adopt latest tools and technologies for promoting systematic problem solving skills to promote innovation and entrepreneurship
3. Emphasize individual development of students by inculcating moral, ethical and life skills.

Department's Vision:

Develop competent Computer Engineering Professionals to achieve excellence in an environment conducive for technical knowledge, skills, moral values and ethical values with a focus to serve the society.

Department's Mission:

1. To provide state of the art infrastructure and facilities for imparting quality education and computer engineering skills for societal benefit.
2. Adopt industry oriented curriculum with an exposure to technologies for building systems & application in computer engineering.
3. To provide quality technical professional as per the industry and societal needs, encourage entrepreneurship, nurture innovation and life skills in consonance with latest interdisciplinary trends.

Certificate

This is to certify that Mr. /Ms. …… Enrolment No. …… of ……. Semester of Diploma in Computer Engineering of …… (GTU Code) has satisfactorily completed the term work in course Cloud Computing (4360709) for the academic year: …… Term: …… Odd prescribed in the GTU curriculum.

Place: ……..

Date: ……..

Signature of Course Faculty

Preface

The primary aim of any laboratory/Practical/field work is enhancement of required skills as well as creative ability amongst students to solve real time problems by developing relevant competencies in psychomotor domain. Keeping in view, GTU has designed competency focused outcome-based curriculum -2021 (COGC-2021) for Diploma engineering programmes. In this more time is allotted to practical work than theory. It shows importance of enhancement of skills amongst students and it pays attention to utilize every second of time allotted for practical amongst Students, Instructors and Lecturers to achieve relevant outcomes by performing rather than writing practice in study type. It is essential for effective implementation of competency focused outcome- based green curriculum-2021. Every practical has been keenly designed to serve as a tool to develop & enhance relevant industry needed competency in each and every student. These psychomotor skills are very difficult to develop through traditional chalk and board content delivery method in the classroom. Accordingly, this lab manual has been designed to focus on the industry defined relevant outcomes, rather than old practice of conducting practical to prove concept and theory.

By using this lab manual, students can read procedure one day in advance to actual performance day of practical experiment which generates interest and also, they can have idea of judgement of magnitude prior to performance. This in turn enhances predetermined outcomes amongst students. Each and every Experiment /Practical in this manual begins by competency, industry relevant skills, course outcomes as well as practical outcomes which serve as a key role for doing the practical. The students will also have a clear idea of safety and necessary precautions to be taken while performing experiment.

This manual also provides guidelines to lecturers to facilitate student-centred lab activities for each practical/experiment by arranging and managing necessary resources in order that the students follow the procedures with required safety and necessary precautions to achieve outcomes. It also gives an idea that how students will be assessed by providing Rubrics.

Introduction of machine learning course will help students to build up core competencies in understanding machine learning approaches and students will be able to design and train machine learning modes for various use cases. The lab work of the course is designed to develop crisp understanding of the underpinning theory.

Although we try our level best to design this lab manual, but always there are chances of improvement. We welcome any suggestions for improvement.

Programme Outcomes (POs):

1. **Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the *engineering* problems.

2. **Problem analysis**: Identify and analyse well-defined *engineering* problems using codified standard methods.

3. **Design/ development of solutions:** Design solutions for *engineering* well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

4. **Engineering Tools, Experimentation and Testing:** Apply modern *engineering* tools and appropriate technique to conduct standard tests and measurements.

5. **Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.

6. **Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

7. **Life-long learning:** Ability to analyze individual needs and engage in updating in the context of technological changes *in field of engineering*

Practical Outcome - Course Outcome matrix

Course Outcomes (COs):

a) *CO1: To describe the principles and paradigm of Cloud Computing*
b) *CO2: To compare the Deployment models with reference to Cloud Computing*
c) *CO3: To simulate the Service Model with reference to Cloud Computing*
d) *CO4: To evaluate various virtualization technologies and methods*
e) *CO5: To implement comprehensive security measures, ensuring the security and privacy of data*

Sr. No.	Practical Outcome/Title of experiment	CO1	CO2	CO3	CO4	CO5
1.	To study cloud architecture and cloud computing model.	✓				
2.	**Study and implementation of Infrastructure as a Service** ● OpenStack Computing Components ● Install OpenStack on Ubuntu 18.04 with DevStack		✓			
3.	Study and implementation of Storage as a Service		✓			
4.	**Case Study: "Choosing the Right Cloud Deployment Model"** ● Examine case studies of organizations adopting different cloud deployment models (public, private, hybrid, community). ● Analyze the advantages and disadvantages of each model. ● Discuss key drivers influencing the choice of a specific cloud deployment model.		✓			
5.	**Case Study: "Comparative Analysis of Cloud Service Providers"** ● Evaluate case studies of major cloud service providers (e.g., AWS, Azure, Google Cloud). ● Analyze their service models (SaaS, PaaS, IaaS) and advantages/disadvantages. ● Discuss the impact of cloud computing on users using real-world examples.			✓		
6.	Working and installation of Google App Engine			✓		

7.	Working and installation of Microsoft Azure.			✓		
8.	Design an Assignment to retrieve, verify, and store user credentials using Firebase Authentication, the Google App Engine standard environment, and Google Cloud Data store			✓		
9.	Develop a hello world program web application and deploy it on the Google app engine.			✓		
10.	**Case Study: "Implementing Virtualization in Enterprise IT"** ● Explore a case where an organization successfully implemented virtualization. ● Discuss the types of virtualization used (desktop, network, storage, data). ● Analyze the advantages and disadvantages experienced by the organization.				✓	
11.	Installation and Configuration of virtualization using KVM.				✓	
12.	**Case Study: "Data Security and Privacy in a Cloud-Based Healthcare System"** ● Investigate a case where a healthcare organization adopted cloud computing. ● Discuss infrastructure security at the network, host, and application levels. ● Analyze data security, storage, and privacy issues in the context of sensitive healthcare data.					✓
13.	**"Migration to the Cloud: A Banking Sector Perspective"** ● Explore how a traditional bank migrated its infrastructure to a public cloud. ● Analyze the security considerations and challenges faced during the migration.					✓
14.	**"Global Company's Hybrid Cloud Strategy"**					✓

	● Examine a multinational corporation's use of a hybrid cloud model. ● Analyze how the organization balances data storage, compliance, and efficiency.					

Continuous Assessment Sheet

Enrolment No: **Name:**

Term:

Industry Relevant Skills

The following industry relevant skills are expected to be developed in the students by performance of experiments of this course.

a) *Student will learn to automate variety of task making system more efficient and cost effective*
b) *to become problem solver so that s/he contributes to the projects of the industry*

Guidelines to Course Faculty

1. Course faculty should demonstrate experiment with all necessary implementation strategies described in curriculum.
2. Course faculty should explain industrial relevance before starting of each experiment.
3. Course faculty should involve& give opportunity to all students for hands on experience.
4. Course faculty should ensure mentioned skills are developed in the students by asking.
5. Utilise 2 hours of lab hours effectively and ensure completion of write up with quiz also.
6. Encourage peer to peer learning by doing same experiment through fast learners.

Instructions for Students

1. Organize the work in the group and make record of all observations.
2. Students shall develop maintenance skill as expected by industries.
3. Student shall attempt to develop related hand-on skills and build confidence.
4. Student shall develop the habits of evolving more ideas, innovations, skills etc.
5. Student shall refer technical magazines and data books.
6. Student should develop habit to submit the practical on date and time.
7. Student should well prepare while submitting write-up of exercise.

Sr no	Practical Outcome/Title of experiment	Page	Date	Marks (25)	Sign
1	To study cloud architecture and cloud computing model.				
2	**Study and implementation of Infrastructure as a Service** ● OpenStack Computing Components ● Install OpenStack on Ubuntu 18.04 with DevStack				
3	Study and implementation of Storage as a Service				
4	**Case Study: "Choosing the Right Cloud Deployment Model"** ● Examine case studies of organizations adopting different cloud deployment models (public, private, hybrid, community). ● Analyze the advantages and disadvantages of each model. ● Discuss key drivers influencing the choice of a specific cloud deployment model.				
5	**Case Study: "Comparative Analysis of Cloud Service Providers"** ● Evaluate case studies of major cloud service providers (e.g., AWS, Azure, Google Cloud). ● Analyze their service models (SaaS, PaaS, IaaS) and advantages/disadvantages. ● Discuss the impact of cloud computing on users using real-world examples.				
6	Working and installation of Google App Engine				
7	Working and installation of Microsoft Azure.				
8	Design an Assignment to retrieve, verify, and store user credentials using Firebase Authentication, the Google App Engine standard environment, and Google Cloud Data store				
9	Develop a hello world program web application and deploy it on the Google app engine.				

10	**Case Study: "Implementing Virtualization in Enterprise IT"** ● Explore a case where an organization successfully implemented virtualization. ● Discuss the types of virtualization used (desktop, network, storage, data). ● Analyze the advantages and disadvantages experienced by the organization.				
11	Installation and Configuration of virtualization using KVM.				
12	**Case Study: "Data Security and Privacy in a Cloud-Based Healthcare System"** ● Investigate a case where a healthcare organization adopted cloud computing. ● Discuss infrastructure security at the network, host, and application levels. ● Analyze data security, storage, and privacy issues in the context of sensitive healthcare data.				
13	**"Migration to the Cloud: A Banking Sector Perspective"** ● Explore how a traditional bank migrated its infrastructure to a public cloud. ● Analyze the security considerations and challenges faced during the migration.				
14	**"Global Company's Hybrid Cloud Strategy"** ● Examine a multinational corporation's use of a hybrid cloud model. ● Analyze how the organization balances data storage, compliance, and efficiency.				

Practical No.1: To study cloud architecture and cloud computing model.

A. Objective

From this experiment, the student will be able to

- Provide an overview of concepts of Cloud Computing.
- To encourage students to indulge into research in Cloud Computing.

B. Expected Program Outcomes (POs)

PO1, PO7

C. Expected Skills to be developed based on competency

- Understand and appreciate cloud architecture.
- Analyze the local and global impact of computing on individuals, organizations, and society.
- Recognize the need for, and an ability to engage in life-long learning.

D. Expected Course Outcomes(Cos)

CO-1,CO-2

E. Practical Outcome(PRo)

Understand cloud computing architecture and model

F. Expected Affective domain Outcome(ADos)

- Handle tools /components/equipment carefully with safety and necessary precaution.
- In software ethics Environment sustainability and environment consciousness whenever suitable.
- Leadership Qualities

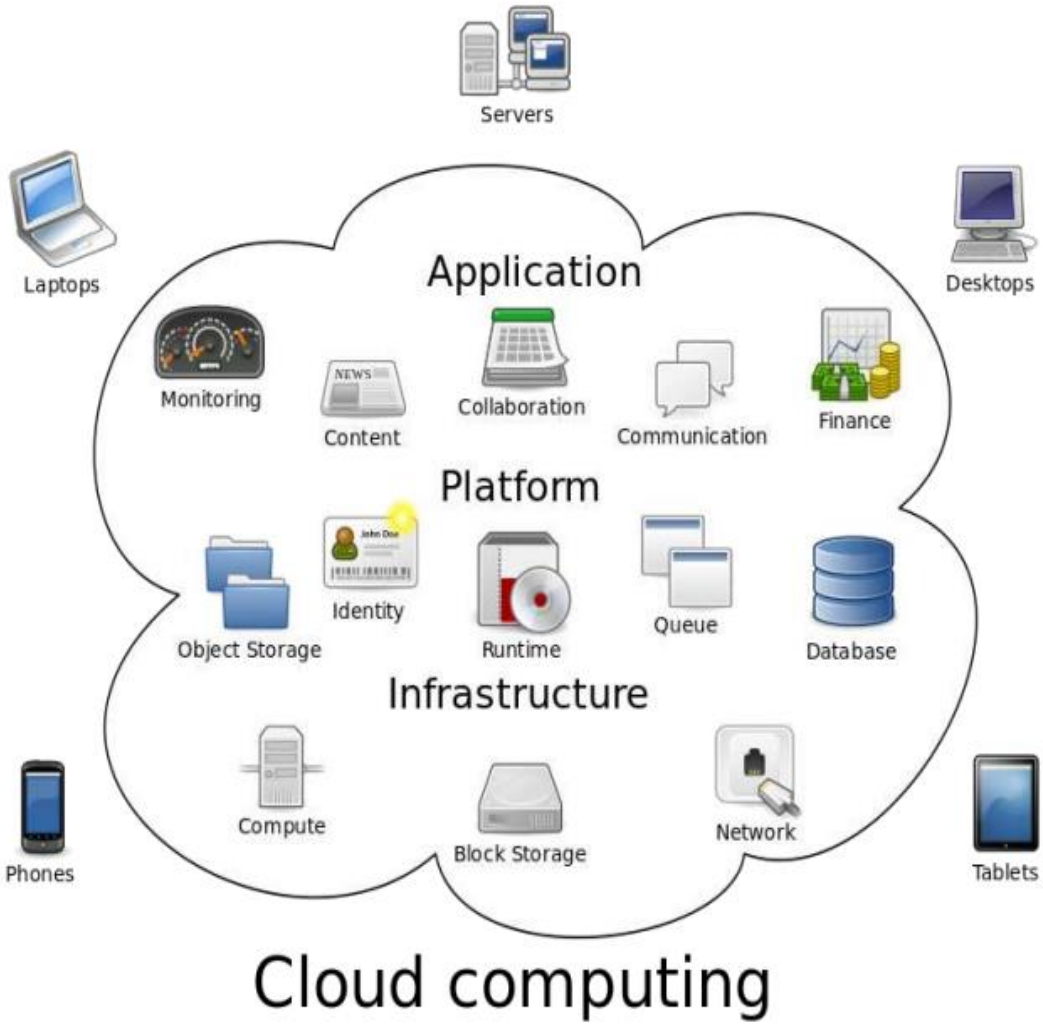
G. Prerequisite Theory:

Cloud computing enables companies to consume compute resources as a utility -- just like electricity -- rather than having to build and maintain computing infrastructures in-house. Cloud computing promises several attractive benefits for businesses and end users.

Three of the main benefits of cloud computing includes:

- **Self-service provisioning:** End users can spin up computing resources for almost any type of workload on-demand.
- **Elasticity:** Companies can scale up as computing needs increase and then scale down again as demands decreases.

- **Pay per use:** Computing resources are measured at a granular level, allowing users to pay only for the resources and workloads they use.



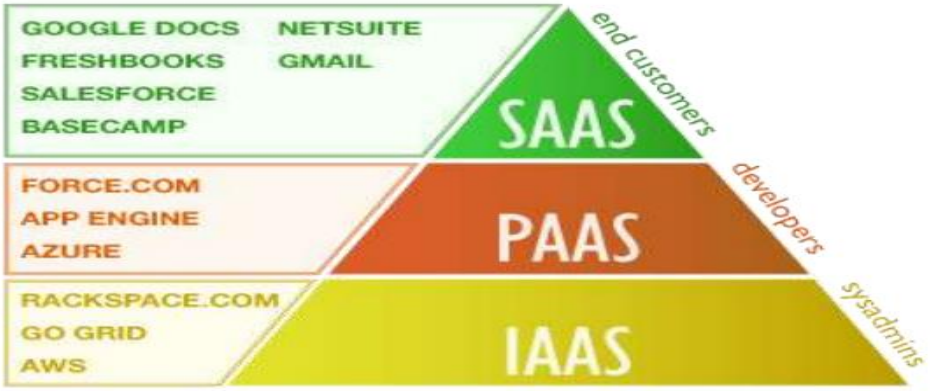
Types of cloud computing:

IT people talk about three different kinds of cloud computing, where different services are being provided for you. Note that there's a certain amount of vagueness about how these things are defined and some overlap between them.

- ***Infrastructure as a Service*** (IaaS) means you're buying access to raw computing hardware over the Net, such as servers or storage. Since you buy what you need and pay-as-you-go, this is often referred to as utility computing. Ordinary web hosting is a simple example of IaaS: you pay a monthly subscription or a per-megabyte/gigabyte fee to have a hosting company serves up files for your website from their servers.

- **Software as a Service (SaaS)** means you use a complete application running on someone else's system. Web-based email and Google Documents are perhaps

the best-known examples. Zoho is another well-known SaaS provider offering a variety of office applications online.



- ***Platform as a Service (PaaS)*** means you develop applications using Web-based tools so they run on systems software and hardware provided by another company. So, for example, you might develop your own ecommerce website but have the whole thing, including the shopping cart, checkout, and payment mechanism running on a merchant's server. Force.com (from salesforce.com) and the Google App Engine are examples of PaaS.

H. Resources/Equipment Required

Sr. No.	Instrument/Equipment with Broad Specifications
1	Computer system with operating system: Windows 7 or higher VerIntel Core i7 processor 16GB RAM 512GB SSD, Ubuntu operating system
2	VMware -vSphere Version 7.0 Microsoft Hyper-V Integration with Windows Server OpenStack - Infrastructure as a Service (IaaS)
3	Internet Connection

I. Safety and necessary Precautions followed

- Read the experiment thoroughly before starting and ensure that you understand all the steps and concepts involved from underpinning theory.
- Keep the workspace clean and organized, free from clutter and unnecessary materials.
- Use the software according to its intended purpose and instructions.

- Ensure that all the necessary equipment and software are in good working condition.
- Never eat or drink in the lab, as it can cause contamination and create safety hazards.
- If any accidents or injuries occur, immediately notify the instructor and seek medical attention if necessary.

J. Source code

- To study cloud architecture and cloud computing model.

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K. Practical related Quiz

1. What is Cloud Computing? List characteristics and challenges of cloud computing
2. State Advantages and Disadvantages of cloud computing.

L. References / Suggestions

1. https://www.javatpoint.com/cloud-computing-architecture
2. https://www.javatpoint.com/cloud-service-models

M. Assessment-Rubrics

Criteria	Total Marks	Exceptional (5- Marks)	Satisfactory (4 to 3 Marks)	Developing (2-Marks)	Limited (1-Mark)
Content Understanding	**5**	Demonstrates a profound understanding of the case study, including technical concepts, challenges, and solutions.	Understands the core aspects of the case study with some minor gaps.	Shows a basic understanding of the case study but lacks depth.	Fails to grasp essential elements of the case study.
Analysis and Critical Thinking	**5**	Provides insightful analysis, considers multiple perspectives, and demonstrates critical thinking skills.	Offers a reasonable analysis with some critical thinking evident.	Analysis is basic, lacks depth, and shows limited critical thinking.	Analysis is minimal or absent; lacks critical thinking.
Presentation and Clarity	**5**	Presents ideas clearly, logically structured, and uses appropriate language.	Generally clear presentation with some minor organizational issues or language usage.	Presentation is somewhat unclear, lacks structure, and uses language inconsistently.	Poorly presented, disorganized, and uses language that hinders understanding.
Application of Cloud Computing Concepts	**5**	Effectively applies relevant cloud computing concepts to the case study.	Applies concepts reasonably well with some minor gaps.	Demonstrates limited application of cloud computing concepts.	Fails to apply cloud computing concepts appropriately.
Identification of Key Issues	**5**	Clearly identifies and prioritizes key issues related to the case study.	Identifies key issues with some minor omissions.	Identifies basic issues but may miss key points.	Fails to identify significant issues.
Total Marks:			**Signature with Date:**		

Practical No.2: Study and implementation of Infrastructure as a Service

- OpenStack Computing Components
- Install OpenStack on Ubuntu 18.04 with DevStack

A. Objective

From this experiment, the student will be able to,

- Understand concepts of virtualization and to use cloud as Infrastructure as a services.
- Learn the technique and its complexity
- Understand the importance of this technique from application point of view

B. **Expected Program Outcomes (POs)**

PO1, PO2, PO3, PO4, PO5, PO6, PO7

C. Expected Skills to be developed based on competency

- Installing and configuring software as per the requirements
- Programming skills
- Debugging skills

D. Expected Course Outcomes(Cos)

CO -2

E. Practical Outcome(PRo)

- To match the industry requirements in the domains of Database management, Programming and Networking with limited infrastructure.
- To analyze the local and global impact of computing on individuals, organizations, and society.
- To use current techniques, skills, and tools necessary for computing practice.

F. Expected Affective domain Outcome(ADos)

- Handle tools /components/equipment carefully with safety and necessary precaution.
- In software ethics Environment sustainability and environment consciousness whenever suitable.
- Leadership Qualities

G. Prerequisite Theory:

Installation Steps:

Add user

useradd -s /bin/bash -d /opt/stack -m stack

apt-get install sudo -y

echo "stack ALL=(ALL) NOPASSWD: ALL" >> /etc/sudoers

login as stack user

Download DevStack

sudoapt-getinstallgit -y || sudoyuminstall -ygit

gitclonehttps://git.openstack.org/openstack-dev/devstack

cddevstack

Run DevStack

Now to configure **stack.sh**. DevStack includes a sample in **devstack/samples/local.conf**. Create **local.conf** as shown below to do the following:

- Set **FLOATING_RANGE** to a range not used on the local network, i.e. 192.168.1.224/27. This configures IP addresses ending in 225-254 to be used as floating IPs.
- Set **FIXED_RANGE** and **FIXED_NETWORK_SIZE** to configure the internal address space used by the instances.
- Set **FLAT_INTERFACE** to the Ethernet interface that connects the host to your local network. This is the interface that should be configured with the static IP address mentioned above.
- Set the administrative password. This password is used for the **admin** and **demo** accounts set up as OpenStack users.
- Set the MySQL administrative password. The default here is a random hex string which is inconvenient if you need to look at the database directly for anything.
- Set the RabbitMQ password.
- Set the service password. This is used by the OpenStack services (Nova, Glance, etc) to authenticate with Keystone.

local.conf should look something like this:

[[local|localrc]]

FLOATING_RANGE=192.168.1.224/27

FIXED_RANGE=10.11.12.0/24

FIXED_NETWORK_SIZE=256

FLAT_INTERFACE=eth0

ADMIN_PASSWORD=supersecret

DATABASE_PASSWORD=iheartdatabases

RABBIT_PASSWORD=flopsymopsy

SERVICE_PASSWORD=iheartksl

Run DevStack:

./stack.sh

At this point you should be able to access the dashboard from other computers on the local network. In this example that would behttp://192.168.43.29/ for the dashboard (aka Horizon). Launch VMs and if you give them floating IPs and security group access those VMs will be accessible from other machines on your network.

H. Resources/Equipment Required

Sr. No.	Instrument/Equipment with Broad Specifications
1	Computer system with operating system: Windows 7 or higher VerIntel Core i7 processor 16GB RAM 512GB SSD
2	VMware -vSphere Version 7.0 Microsoft Hyper-V Integration with Windows Server OpenStack - Infrastructure as a Service (IaaS) WAMP/ZAMP server, Any tool or technology can be used for implementation of web application e.g., JAVA, PHP, etc.
3	Internet Connection

I. Safety and necessary Precautions followed

- Read the experiment thoroughly before starting and ensure that you understand all the steps and concepts involved from underpinning theory.
- Keep the workspace clean and organized, free from clutter and unnecessary materials.
- Use the software according to its intended purpose and instructions.
- Ensure that all the necessary equipment and software are in good working condition.
- Never eat or drink in the lab, as it can cause contamination and create safety hazards.
- If any accidents or injuries occur, immediately notify the instructor and seek medical attention if necessary.

J. Source code

Study and implementation of Infrastructure as a Service

- OpenStack Computing Components
- Install OpenStack on Ubuntu 18.04 with DevStack

K. Practical related Quiz

1. List out components of cloud computing and explain any two in detail.
2. Explain infrastructure as a services of cloud computing.

L. References / Suggestions

1. https://docs.openstack.org/devstack/latest/guides/single-machine.html

M. Assessment-Rubrics

Criteria	Total Marks	Exceptional (5- Marks)	Satisfactory (4 to 3 Marks)	Developing (2-Marks)	Limited (1-Mark)
Engagement	**5**	Performed practical independently	Performed practical with some help.	Watched others but didn't try them.	Present but not actively participating.
Accuracy	**5**	Accurately executed tasks.	1-2 errors/mistakes found.	3-5 errors/mistakes identified.	More than 5 errors/mistakes committed.
Documentation	**5**	No errors; well-executed program.	Complete write-up with output tables but poor presentation.	Some commands missing with missing outputs.	Poor write-up and diagram or missing content.
Understanding & Explanation	**5**	Fully understood and can explain perfectly.	Understood the performance but cannot explain.	Partially understood and can give little explanation.	Partially understood and cannot give explanation.
Time Management	**5**	Completed the work within a week.	Work submitted later than 1 week but by the end of 2nd week.	Work done after 2nd week but before the end of 3rd week.	Work submitted after 3 weeks.
Total Marks:			**Signature with Date:**		

Practical No.3: Study and implementation of Storage as a Service

A. Objective

From this experiment, the student will be able to

- To make the students understand use of cloud as Platform, Storage as a services.
- To learn the efficient tools to implement the technique

B. Expected Program Outcomes (POs)

PO1, PO2, PO3, PO4, PO5, PO6, PO7

C. Expected Skills to be developed based on competency

- Installing and configuring software as per the requirements
- Programming skills
- Debugging skills

D. Expected Course Outcomes(Cos)

CO -2

E. Practical Outcome(PRo)

Implement storage as a service using its own cloud/AWS S3 and azure storage

F. Expected Affective domain Outcome(ADos)

- Handle tools /components/equipment carefully with safety and necessary precaution.
- In software ethics Environment sustainability and environment consciousness whenever suitable.
- Leadership Qualities

G. Prerequisite Theory:

Storage as a Service or STaaS is cloud storage that you rent from a Cloud Service Provider (CSP) and that provides basic ways to access that storage. Enterprises, small and medium businesses, home offices, and individuals can use the cloud for multimedia storage, data repositories, data backup and recovery, and disaster recovery. There are also higher-tier managed services that build on top of STaaS, such as Database as a Service, in which you can write data into tables that are hosted through CSP resources.

The key benefit to STaaS is that you are offloading the cost and effort to manage data storage infrastructure and technology to a third-party CSP. This

makes it much more effective to scale up storage resources without investing in new hardware or taking on configuration costs. You can also respond to changing market conditions faster. With just a few clicks you can rent terabytes or more of storage, and you don't have to spin up new storage appliances on your own.

H. Resources/Equipment Required

Sr. No.	Instrument/Equipment with Broad Specifications
1	Computer system with operating system: Windows 7 or higher VerIntel Core i7 processor 16GB RAM 512GB SSD
2	VMware -vSphere Version 7.0 Microsoft Hyper-V Integration with Windows Server OpenStack - Storage as a Service (STaaS)
3	Internet Connection

I. Safety and necessary Precautions followed

- Read the experiment thoroughly before starting and ensure that you understand all the steps and concepts involved from underpinning theory.
- Keep the workspace clean and organized, free from clutter and unnecessary materials.
- Use the software according to its intended purpose and instructions.
- Ensure that all the necessary equipment and software are in good working condition.
- Never eat or drink in the lab, as it can cause contamination and create safety hazards.
- If any accidents or injuries occur, immediately notify the instructor and seek medical attention if necessary.

J. Source code

Study and implementation of Storage as a Service

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K. Practical related Quiz

1. List out different services of cloud computing.
2. Explain storage as a service of cloud computing.

L. References / Suggestions (lab manual designer should give)

1. https://itvoyagers.in/cc-practical-4-study-and-implementation-of-storage-as-a-service/
2. https://www.warse.org/IJATCSE/static/pdf/file/ijatcse40816sl2019.pdf
3. https://www.studocu.com/in/document/pillai-college-of-engineering/cloud-computing/cloud-computing-experiment-06-implementing-storage-as-a-service/27186241
4. https://www.tutorialspoint.com/cloud_computing/index.htm

M. Assessment-Rubrics

Criteria	Total Marks	Exceptional (5- Marks)	Satisfactory (4 to 3 Marks)	Developing (2-Marks)	Limited (1-Mark)
Engagement	**5**	Performed practical independently	Performed practical with some help.	Watched others but didn't try them.	Present but not actively participating.
Accuracy	**5**	Accurately executed tasks.	1-2 errors/mistakes found.	3-5 errors/mistakes identified.	More than 5 errors/mistakes committed.
Documentation	**5**	No errors; well-executed program.	Complete write-up with output tables but poor presentation.	Some commands missing with missing outputs.	Poor write-up and diagram or missing content.
Understanding & Explanation	**5**	Fully understood and can explain perfectly.	Understood the performance but cannot explain.	Partially understood and can give little explanation.	Partially understood and cannot give explanation.
Time Management	**5**	Completed the work within a week.	Work submitted later than 1 week but by the end of 2nd week.	Work done after 2nd week but before the end of 3rd week.	Work submitted after 3 weeks.
Total Marks:			**Signature with Date:**		

Practical No.4: Case Study: "Choosing the Right Cloud Deployment Model"

- Examine case studies of organizations adopting different cloud deployment models (public, private, hybrid, community).
- Analyze the advantages and disadvantages of each model.
- Discuss key drivers influencing the choice of a specific cloud deployment model.

A. Objective

The case study can serve as a valuable resource for businesses, IT professionals, and decision-makers navigating the complex landscape of cloud computing deployment options.

B. Expected Program Outcomes (POs)

PO1, PO2, PO3, PO4, PO5, PO6, PO7

C. Expected Skills to be developed based on competency

- Understanding Skills
- Analytical Skills

D. Expected Course Outcomes(Cos)

CO -2

E. Practical Outcome(PRo)

Outcome for case study is the Knowledge, insights, and tools necessary to navigate the complexities of cloud deployment, fostering successful and strategic adoption within their respective organizations.

F. Expected Affective domain Outcome(ADos)

- Handle tools /components/equipment carefully with safety and necessary precaution.
- In software ethics Environment sustainability and environment consciousness whenever suitable.
- Leadership Qualities

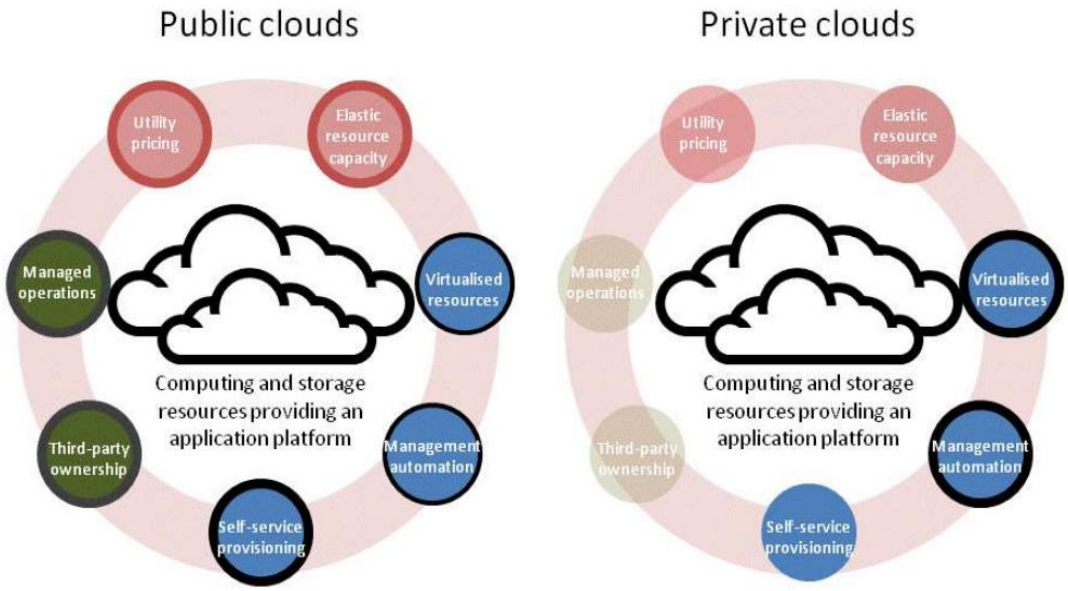
G. Prerequisite Theory:

Cloud computing services can be Private, Public or Hybrid.

Private cloud services are delivered from a business' data centre to internal users. This model offers versatility and convenience, while preserving management, control and security. Internal customers may or may not be billed for services through IT chargeback.

In the Public cloud model, a third-party provider delivers the cloud service over the Internet. Public cloud services are sold on-demand, typically by the minute or the hour. Customers only pay for the CPU cycles, storage or bandwidth they consume. Leading public cloud providers include Amazon Web Services (AWS), Microsoft Azure, IBM/Soft Layer and Google Compute Engine.

Hybrid cloud is a combination of public cloud services and on-premises private cloud – with orchestration and automation between the two.



Companies can run mission-critical workloads or sensitive applications on the private cloud while using the public cloud for workloads that must scale on-demand. The goal of hybrid cloud is to create a unified, automated, scalable environment which takes advantage of all that a public cloud infrastructure can provide, while still maintaining control over mission-critical data.

H. Resources/Equipment Required

Sr. No.	Instrument/Equipment with Broad Specifications
1	Computer system with operating system: Windows 7 or higher VerIntel Core i7 processor 16GB RAM 512GB SSD
2	VMware -vSphere Version 7.0 Microsoft Hyper-V Integration with Windows Server OpenStack - Infrastructure as a Service (IaaS)
3	Internet Connection

I. Safety and necessary Precautions followed

- Read the experiment thoroughly before starting and ensure that you understand all the steps and concepts involved from underpinning theory.

- Keep the workspace clean and organized, free from clutter and unnecessary materials.
- Use the software according to its intended purpose and instructions.
- Ensure that all the necessary equipment and software are in good working condition.
- Never eat or drink in the lab, as it can cause contamination and create safety hazards.
- If any accidents or injuries occur, immediately notify the instructor and seek medical attention if necessary.

J. Source code

Case Study: "Choosing the Right Cloud Deployment Model"

- Examine case studies of organizations adopting different cloud deployment models (public, private, hybrid, community).
- Analyze the advantages and disadvantages of each model.
- Discuss key drivers influencing the choice of a specific cloud deployment model.

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K. Practical related Quiz

a. Write A Comparative Analysis of Cloud Deployment Models
b. Differentiate Public cloud and private cloud

L. References / Suggestions

C. https://www.geeksforgeeks.org/difference-between-public-cloud-and-private-cloud/

D. https://www.rishabhsoft.com/blog/basics-of-cloud-computing-deployment-and-service-models#comparative-analysis

E. https://www.linkedin.com/pulse/how-choose-right-type-cloud-deployment-model-grapestechsolutions/

M. Assessment-Rubrics

Criteria	Total Marks	Exceptional (5- Marks)	Satisfactory (4 to 3 Marks)	Developing (2-Marks)	Limited (1-Mark)
Content Understanding	**5**	Demonstrates a profound understanding of the case study, including technical concepts, challenges, and solutions.	Understands the core aspects of the case study with some minor gaps.	Shows a basic understanding of the case study but lacks depth.	Fails to grasp essential elements of the case study.
Analysis and Critical Thinking	**5**	Provides insightful analysis, considers multiple perspectives, and demonstrates critical thinking skills.	Offers a reasonable analysis with some critical thinking evident.	Analysis is basic, lacks depth, and shows limited critical thinking.	Analysis is minimal or absent; lacks critical thinking.
Presentation and Clarity	**5**	Presents ideas clearly, logically structured, and uses appropriate language.	Generally clear presentation with some minor organizational issues or language usage.	Presentation is somewhat unclear, lacks structure, and uses language inconsistently.	Poorly presented, disorganized, and uses language that hinders understanding.
Application of Cloud Computing Concepts	**5**	Effectively applies relevant cloud computing concepts to the case study.	Applies concepts reasonably well with some minor gaps.	Demonstrates limited application of cloud computing concepts.	Fails to apply cloud computing concepts appropriately.
Identification of Key Issues	**5**	Clearly identifies and prioritizes key issues related to the case study.	Identifies key issues with some minor omissions.	Identifies basic issues but may miss key points.	Fails to identify significant issues.
Total Marks:			**Signature with Date:**		

Practical No.5: Case Study: "Comparative Analysis of Cloud Service Providers"

- Evaluate case studies of major cloud service providers (e.g., AWS, Azure, Google Cloud).
- Analyze their service models (SaaS, PaaS, IaaS) and advantages/disadvantages.
- Discuss the impact of cloud computing on users using real-world examples.

A. Objective

The objective of the case study is to empower decision-makers with a comprehensive understanding of major cloud service providers, their service models, and the real-world impact of cloud computing on users for informed and strategic adoption.

B. Expected Program Outcomes (POs)

PO1, PO2, PO3, PO4, PO5, PO6, PO7

C. Expected Skills to be developed based on competency

- Understanding Skills
- Analytical Skills

D. Expected Course Outcomes(Cos)

CO -3

E. Practical Outcome(PRo)

The knowledge and insights necessary for making informed decisions in selecting cloud service providers, optimizing service model choices, and understanding the tangible impact of cloud computing on users.

F. Expected Affective domain Outcome(ADos)

- Handle tools /components/equipment carefully with safety and necessary precaution.
- In software ethics Environment sustainability and environment consciousness whenever suitable.
- Leadership Qualities

G. Prerequisite Theory:

A CSP (cloud service provider) is a third-party company that provides scalable computing resources that businesses can access on demand over a network, including cloud-based compute, storage, platform, and application services.

Cloud service provider examples

The CSP market includes cloud providers of all shapes and sizes. The big three—Google Cloud, Microsoft Azure, and Amazon Web Services (AWS)—are considered the established leaders. However, there is a host of other smaller or niche players that offer cloud services as well, including IBM, Alibaba, Oracle, Red Hat, DigitalOcean, and Rackspace.

Increasingly, companies are choosing to mix and match cloud services from different CSPs for different requirements rather than choosing one provider for everything. In most cases, choosing to work with multiple cloud providers helps businesses select the best cloud capabilities for their unique use cases. For instance, different providers may specialize in certain areas like data analytics and AI services or offer better support for legacy environments or broader compute options.

CSPs that follow an open approach to the cloud give their customers the freedom to combine the services and providers that best fit their needs, allowing them to move workloads to and from on-premises and between cloud providers at any time.

H. Resources/Equipment Required

Sr. No.	Instrument/Equipment with Broad Specifications
1	Computer system with operating system: Windows 7 or higher VerIntel Core i7 processor 16GB RAM 512GB SSD
2	VMware -vSphere Version 7.0 Microsoft Hyper-V Integration with Windows Server OpenStack - Infrastructure as a Service (IaaS)
3	Internet Connection

I. Safety and necessary Precautions followed

- Read the experiment thoroughly before starting and ensure that you understand all the steps and concepts involved from underpinning theory.
- Keep the workspace clean and organized, free from clutter and unnecessary materials.
- Use the software according to its intended purpose and instructions.
- Ensure that all the necessary equipment and software are in good working condition.
- Never eat or drink in the lab, as it can cause contamination and create safety hazards.
- If any accidents or injuries occur, immediately notify the instructor and seek medical attention if necessary.

J. Source code

Case Study: "Comparative Analysis of Cloud Service Providers"

- Evaluate case studies of major cloud service providers (e.g., AWS, Azure, and Google Cloud).
- Analyze their service models (SaaS, PaaS, IaaS) and advantages/disadvantages.
- Discuss the impact of cloud computing on users using real-world examples.

K. Practical related Quiz

1. Explain different cloud service model.

2. Differentiate IAAS,PAAS,SAAS

L. References / Suggestions

1. https://www.techtarget.com/searchitchannel/definition/cloud-service-provider-cloud-provider
2. http://docs.neu.edu.tr/library/6842203396.pdf
3. https://www.techtarget.com/searchitchannel/definition/cloud-service-provider-cloud-provider

M. Assessment-Rubrics

Criteria	Total Marks	Exceptional (5- Marks)	Satisfactory (4 to 3 Marks)	Developing (2-Marks)	Limited (1-Mark)
Content Understanding	**5**	Demonstrates a profound understanding of the case study, including technical concepts, challenges, and solutions.	Understands the core aspects of the case study with some minor gaps.	Shows a basic understanding of the case study but lacks depth.	Fails to grasp essential elements of the case study.
Analysis and Critical Thinking	**5**	Provides insightful analysis, considers multiple perspectives, and demonstrates critical thinking skills.	Offers a reasonable analysis with some critical thinking evident.	Analysis is basic, lacks depth, and shows limited critical thinking.	Analysis is minimal or absent; lacks critical thinking.
Presentation and Clarity	**5**	Presents ideas clearly, logically structured, and uses appropriate language.	Generally clear presentation with some minor organizational issues or language usage.	Presentation is somewhat unclear, lacks structure, and uses language inconsistently.	Poorly presented, disorganized, and uses language that hinders understanding.
Application of Cloud Computing Concepts	**5**	Effectively applies relevant cloud computing concepts to the case study.	Applies concepts reasonably well with some minor gaps.	Demonstrates limited application of cloud computing concepts.	Fails to apply cloud computing concepts appropriately.
Identification of Key Issues	**5**	Clearly identifies and prioritizes key issues related to the case study.	Identifies key issues with some minor omissions.	Identifies basic issues but may miss key points.	Fails to identify significant issues.
Total Marks:			**Signature with Date:**		

Practical No.6: Working and installation of Google App Engine

A. Objective

The objective is to proficiently install, configure, and deploy a Google App Engine application on a Windows environment, ensuring understanding of local testing, deployment processes, and integration with Google Cloud services.

B. Expected Program Outcomes (POs)

PO1, PO2, PO3, PO4, PO5, PO6, PO7

C. Expected Skills to be developed based on competency

- Installing and configuring software as per the requirements
- Programming skills
- Debugging skills

D. Expected Course Outcomes(Cos)

CO -3

E. Practical Outcome(PRo)

The student should be capable of independently installing, configuring, testing, and deploying an App Engine application on a Windows environment. The outcome is a practical understanding of the App Engine development workflow, enabling the participant to develop, deploy, and maintain applications on the Google Cloud Platform.

F. Expected Affective domain Outcome(ADos)

- Handle tools /components/equipment carefully with safety and necessary precaution.
- In software ethics Environment sustainability and environment consciousness whenever suitable.
- Leadership Qualities

G. Prerequisite Theory:

Installing and working with Google App Engine on Windows involves several steps. Here's a general guide to help you get started:

Prerequisites:

1. **Python Installation:**
    a. Download and install Python from python.org.
    b. Make sure to add Python to your system PATH during the installation.

2. **Google Cloud SDK:**
    a. Download and install the Google Cloud SDK.

Steps to Install and Work with Google App Engine:

1. **Install Google Cloud SDK:**
    - Follow the instructions on the Google Cloud SDK installation page for Windows.
2. **Initialize Google Cloud SDK:**
    - Open a command prompt and run **gcloud init** to initialize the SDK.
    - Follow the prompts to authenticate and set up your Google Cloud project.
3. **Install Google App Engine SDK:**
    - Run the following command in the command prompt to install the App Engine component: **gcloud components install app-engine-python**.
4. **Create a New App Engine Project:**
    - Run **gcloud app create --project=[your-project-id]** to create a new App Engine project.
5. **Create a Python App:**
    - Create a new directory for your App Engine project.
    - Inside the project directory, create a Python file (e.g., **main.py**) containing your App Engine application code.
6. **App.yaml Configuration:**
    - Create an **app.yaml** file in your project directory to configure your App Engine application. Define runtime, handler settings, etc.
7. **Testing Locally:**
    - Run dev_appserver.py app.yaml in the command prompt from your project directory to test your application locally.
8. **Deploy to App Engine:**
    - Deploy your application to App Engine by running gcloud app deploy in the command prompt. Follow the prompts and confirm the deployment.
9. **Access the Deployed App:**
    - Once deployed, your app will be accessible at https://[your-project-id].appspot.com.

10. View Logs and Status:

- Use gcloud app browse to open the deployed app in your web browser.
- View logs with gcloud app logs tail.

Make sure your firewall allows outgoing connections on port 443, as App Engine communicates over HTTPS.

H. Resources/Equipment Required

Sr. No.	Instrument/Equipment with Broad Specifications
1	Computer system with operating system: Windows 7 or higher VerIntel Core i7 processor 16GB RAM 512GB SSD
2	Python
3	Internet Connection

I. Safety and necessary Precautions followed

- Read the experiment thoroughly before starting and ensure that you understand all the steps and concepts involved from underpinning theory.
- Keep the workspace clean and organized, free from clutter and unnecessary materials.
- Use the software according to its intended purpose and instructions.
- Ensure that all the necessary equipment and software are in good working condition.
- Never eat or drink in the lab, as it can cause contamination and create safety hazards.
- If any accidents or injuries occur, immediately notify the instructor and seek medical attention if necessary.

J. Source code

1. **Working and installation of Google App Engine**

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K. References / Suggestions

1. https://public.websites.umich.edu/~csev/books/gae/handouts/AppEngine-Install-Windows.pdf
2. https://cloud.google.com/appengine/docs/legacy/standard/java/building-app/environment-setup

L. Assessment-Rubrics

Criteria	Total Marks	Exceptional (5- Marks)	Satisfactory (4 to 3 Marks)	Developing (2-Marks)	Limited (1-Mark)
Engagement	**5**	Performed practical independently	Performed practical with some help.	Watched others but didn't try them.	Present but not actively participating.
Accuracy	**5**	Accurately executed tasks.	1-2 errors/mistakes found.	3-5 errors/mistakes identified.	More than 5 errors/mistakes committed.
Documentation	**5**	No errors; well-executed program.	Complete write-up with output tables but poor presentation.	Some commands missing with missing outputs.	Poor write-up and diagram or missing content.
Understanding & Explanation	**5**	Fully understood and can explain perfectly.	Understood the performance but cannot explain.	Partially understood and can give little explanation.	Partially understood and cannot give explanation.
Time Management	**5**	Completed the work within a week.	Work submitted later than 1 week but by the end of 2nd week.	Work done after 2nd week but before the end of 3rd week.	Work submitted after 3 weeks.
Total Marks:			**Signature with Date:**		

Practical No.7: Working and installation of Microsoft Azure.

A. Objective

The objective is to successfully install and work with Microsoft Azure, including setting up the Azure environment, creating resources, deploying applications, and understanding key Azure services.

B. Expected Program Outcomes (POs)

PO1, PO2, PO3, PO4, PO5, PO6, PO7

C. Expected Skills to be developed based on competency

- Installing and configuring software as per the requirements
- Programming skills
- Debugging skills

D. Expected Course Outcomes(Cos)

CO -3

E. Practical Outcome(PRo)

The outcome is the ability to independently install, configure, and utilize Microsoft Azure, including resource creation, application deployment, and a comprehensive understanding of essential Azure services and functionalities.

F. Expected Affective domain Outcome(ADos)

- Handle tools /components/equipment carefully with safety and necessary precaution.
- In software ethics Environment sustainability and environment consciousness whenever suitable.
- Leadership Qualities

G. Prerequisite Theory:

Step 1: Install Windows Server
Step 2: Install Web Server IIS Role
Step 3: Installing the Microsoft Web Platform Installer
Step 4: Installing the Portal and API Express option

H. Resources/Equipment Required

Sr. No.	Instrument/Equipment with Broad Specifications
1	Computer system with operating system: Hardware Requirements RAM: 8 GB (do not use dynamic memory) HDD Space: 40 GB
2	Windows Server 2012 Microsoft Web Platform Installer 4.6 Microsoft .NET Framework 3.5 Service Pack (SP) 1 Internet Information Services (IIS) 8 (built-in component of Windows Server 2012) or IIS 8.5 (built-in component of Windows Server 2012 R2) .NET Framework 4.5 Extended with ASP.NET for Windows 8
3	Internet Connection

I. Safety and necessary Precautions followed

- Read the experiment thoroughly before starting and ensure that you understand all the steps and concepts involved from underpinning theory.
- Keep the workspace clean and organized, free from clutter and unnecessary materials.
- Use the software according to its intended purpose and instructions.
- Ensure that all the necessary equipment and software are in good working condition.
- Never eat or drink in the lab, as it can cause contamination and create safety hazards.
- If any accidents or injuries occur, immediately notify the instructor and seek medical attention if necessary.

J. Source code

Working and installation of Microsoft Azure

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K. References / Suggestions

1. https://asha24.net/blog/windows-azure-pack-step-by-step-installation-guide/
2. https://learn.microsoft.com/en-us/azure/industry/training-services/microsoft-community-training/infrastructure-management/install-your-platform-instance/detailed-step-by-step-installation-guide

L. Assessment-Rubrics

Criteria	Total Marks	Exceptional (5- Marks)	Satisfactory (4 to 3 Marks)	Developing (2-Marks)	Limited (1-Mark)
Engagement	**5**	Performed practical independently	Performed practical with some help.	Watched others but didn't try them.	Present but not actively participating.
Accuracy	**5**	Accurately executed tasks.	1-2 errors/mistakes found.	3-5 errors/mistakes identified.	More than 5 errors/mistakes committed.
Documentation	**5**	No errors; well-executed program.	Complete write-up with output tables but poor presentation.	Some commands missing with missing outputs.	Poor write-up and diagram or missing content.
Understanding & Explanation	**5**	Fully understood and can explain perfectly.	Understood the performance but cannot explain.	Partially understood and can give little explanation.	Partially understood and cannot give explanation.
Time Management	**5**	Completed the work within a week.	Work submitted later than 1 week but by the end of 2nd week.	Work done after 2nd week but before the end of 3rd week.	Work submitted after 3 weeks.
Total Marks:			**Signature with Date:**		

Practical No.8: Design an Assignment to retrieve, verify, and store user credentials using Firebase Authentication, the Google App Engine standard environment, and Google Cloud Data store

A. Objective

Design and implement a secure user authentication and data storage system utilizing Firebase Authentication for user credentials, Google App Engine standard environment for hosting, and Google Cloud Data store for storing user-related information.

B. Expected Program Outcomes (POs)

PO1, PO2, PO3, PO4, PO5, PO6, PO7

C. Expected Skills to be developed based on competency

- Installing and configuring software as per the requirements
- Programming skills
- Debugging skills

D. Expected Course Outcomes(Cos)

CO -3

E. Practical Outcome(PRo)

To equip the student with practical skills in designing and implementing a secure user authentication and data storage system, leveraging popular cloud services, and applying security best practices in a real-world scenario.

F. Expected Affective domain Outcome(ADos)

- Handle tools /components/equipment carefully with safety and necessary precaution.
- In software ethics Environment sustainability and environment consciousness whenever suitable.
- Leadership Qualities

G. Prerequisite Theory:

Step-I: Install Git,
Step-II: Install Python 2.7
Step-III: Sign in to your Google Account.
Step-IV: Select or create a GCP project.
Step-V: Install and initialize the Cloud SDK.
Step-VI: Cloning the sample app

Step-VII: Adding the Firebase Authentication user interface

H. Resources/Equipment Required

Sr. No.	Instrument/Equipment with Broad Specifications
1	Computer system with operating system: Windows 7 or higher VerIntel Core i7 processor 16GB RAM 512GB SSD
2	Python, firebase admin SDK, Google cloud SDK
3	Internet Connection

I. Safety and necessary Precautions followed

- Read the experiment thoroughly before starting and ensure that you understand all the steps and concepts involved from underpinning theory.
- Keep the workspace clean and organized, free from clutter and unnecessary materials.
- Use the software according to its intended purpose and instructions.
- Ensure that all the necessary equipment and software are in good working condition.
- Never eat or drink in the lab, as it can cause contamination and create safety hazards.
- If any accidents or injuries occur, immediately notify the instructor and seek medical attention if necessary.

J. Source code

Design an Assignment to retrieve, verify, and store user credentials using Firebase Authentication, the Google App Engine standard environment, and Google Cloud Data store

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K. References / Suggestions

1. https://jainakshay781.files.wordpress.com/2019/02/lp-iv-cc-10.pdf
2. https://cloud.google.com/appengine/docs/standard/python3/building-app/authenticating-users

L. Assessment-Rubrics

Criteria	Total Marks	Exceptional (5- Marks)	Satisfactory (4 to 3 Marks)	Developing (2-Marks)	Limited (1-Mark)
Engagement	**5**	Performed practical independently	Performed practical with some help.	Watched others but didn't try them.	Present but not actively participating.
Accuracy	**5**	Accurately executed tasks.	1-2 errors/mistakes found.	3-5 errors/mistakes identified.	More than 5 errors/mistakes committed.
Documentation	**5**	No errors; well-executed program.	Complete write-up with output tables but poor presentation.	Some commands missing with missing outputs.	Poor write-up and diagram or missing content.
Understanding & Explanation	**5**	Fully understood and can explain perfectly.	Understood the performance but cannot explain.	Partially understood and can give little explanation.	Partially understood and cannot give explanation.
Time Management	**5**	Completed the work within a week.	Work submitted later than 1 week but by the end of 2nd week.	Work done after 2nd week but before the end of 3rd week.	Work submitted after 3 weeks.
Total Marks:			**Signature with Date:**		

Practical No.9: Develop a hello world program web application and deploy it on the Google app engine.

A. Objective

The objective is to provide a practical introduction to web development and deployment on a cloud platform, using Google App Engine as the chosen service.

B. Expected Program Outcomes (POs)

PO1, PO2, PO3, PO4, PO5, PO6, PO7

C. Expected Skills to be developed based on competency

- Installing and configuring software as per the requirements
- Programming skills
- Debugging skills

D. Expected Course Outcomes(Cos)

CO -3

E. Practical Outcome(PRo)

The outcome is a practical understanding of deploying a basic web application on a cloud platform, providing a foundation for more advanced web development and cloud-based projects.

F. Expected Affective domain Outcome(ADos)

- Handle tools /components/equipment carefully with safety and necessary precaution.
- In software ethics Environment sustainability and environment consciousness whenever suitable.
- Leadership Qualities

G. Prerequisite Theory:

1. Install Necessary Tools:
   - Install Python: Download Python
   - Install Google Cloud SDK: Install Google Cloud SDK.
2. Create a Simple Python Web App
3. Install Flask
4. Test Locally
5. Create app.yaml Configuration File

6. Deploy to Google App Engine
7. View Your Deployed App

H. Resources/Equipment Required

Sr. No.	Instrument/Equipment with Broad Specifications
1	Computer system with operating system: Windows 7 or higher VerIntel Core i7 processor 16GB RAM 512GB SSD
2	Python, Google cloud SDK
3	Internet Connection

I. Safety and necessary Precautions followed

- Read the experiment thoroughly before starting and ensure that you understand all the steps and concepts involved from underpinning theory.
- Keep the workspace clean and organized, free from clutter and unnecessary materials.
- Use the software according to its intended purpose and instructions.
- Ensure that all the necessary equipment and software are in good working condition.
- Never eat or drink in the lab, as it can cause contamination and create safety hazards.
- If any accidents or injuries occur, immediately notify the instructor and seek medical attention if necessary.

J. Source code

Develop a hello world program web application and deploy it on the Google app engine.

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L. References / Suggestions

1. https://mkyong.com/google-app-engine/google-app-engine-python hello-world-example-using-eclipse/
2. https://www.bogotobogo.com/python/GoogleApp/python_GoogleApp HelloWorld.php

M. Assessment-Rubrics

Criteria	Total Marks	Exceptional (5- Marks)	Satisfactory (4 to 3 Marks)	Developing (2-Marks)	Limited (1-Mark)
Engagement	**5**	Performed practical independently	Performed practical with some help.	Watched others but didn't try them.	Present but not actively participating.
Accuracy	**5**	Accurately executed tasks.	1-2 errors/mistakes found.	3-5 errors/mistakes identified.	More than 5 errors/mistakes committed.
Documentation	**5**	No errors; well-executed program.	Complete write-up with output tables but poor presentation.	Some commands missing with missing outputs.	Poor write-up and diagram or missing content.
Understanding & Explanation	**5**	Fully understood and can explain perfectly.	Understood the performance but cannot explain.	Partially understood and can give little explanation.	Partially understood and cannot give explanation.
Time Management	**5**	Completed the work within a week.	Work submitted later than 1 week but by the end of 2nd week.	Work done after 2nd week but before the end of 3rd week.	Work submitted after 3 weeks.
Total Marks:			**Signature with Date:**		

Practical No.10: Case Study: "Implementing Virtualization in Enterprise IT"

- Explore a case where an organization successfully implemented virtualization.
- Discuss the types of virtualization used (desktop, network, storage, data).
- Analyze the advantages and disadvantages experienced by the organization.

A. Objective

The objective is to provide a comprehensive and insightful examination of an organization's journey in implementing virtualization, facilitating knowledge transfer and informed decision-making within the broader IT community.

B. Expected Program Outcomes (POs)

PO1, PO2, PO3, PO4, PO5, PO6, PO7

C. Expected Skills to be developed based on competency

- Understanding Skill
- Analytical Skill

D. Expected Course Outcomes(Cos)

CO -4

E. Practical Outcome(PRo)

The outcome is to provide a comprehensive, insightful, and practical resource that contributes to the knowledge base of virtualization in enterprise IT, fostering informed decision-making and promoting effective implementation strategies.

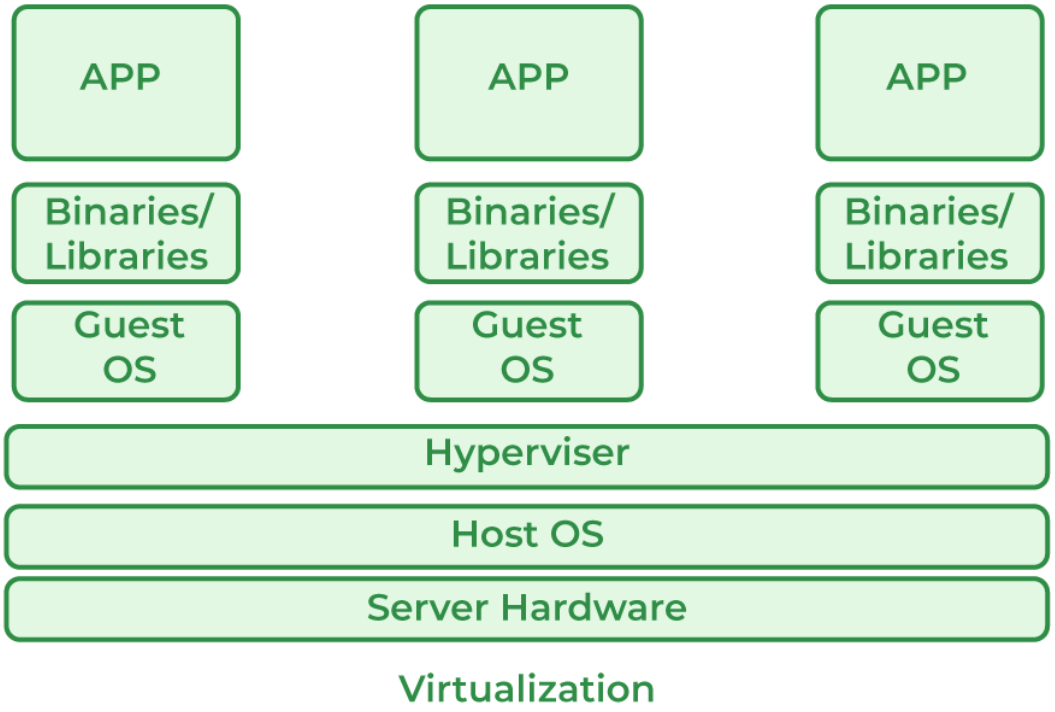
F. Expected Affective domain Outcome(ADos)

- Handle tools /components/equipment carefully with safety and necessary precaution.
- In software ethics Environment sustainability and environment consciousness whenever suitable.
- Leadership Qualities

G. Prerequisite Theory:

Virtualization is a technique how to separate a service from the underlying physical delivery of that service. It is the process of creating a virtual version of something like computer hardware. It was initially developed during the mainframe era. It involves

using specialized software to create a virtual or software-created version of a computing resource rather than the actual version of the same resource. With the help of Virtualization, multiple operating systems and applications can run on the same machine and its same hardware at the same time, increasing the utilization and flexibility of hardware.



Types of Virtualization

1. Application Virtualization
2. Network Virtualization
3. Desktop Virtualization
4. Storage Virtualization
5. Server Virtualization
6. Data virtualization

H. Resources/Equipment Required

Sr. No.	Instrument/Equipment with Broad Specifications
1	Computer system with operating system: Windows 7 or higher VerIntel Core i7 processor 16GB RAM 512GB SSD
2	VMware -vSphere Version 7.0 Microsoft Hyper-V Integration with Windows Server
3	Internet Connection

I. Safety and necessary Precautions followed

- Read the experiment thoroughly before starting and ensure that you understand all the steps and concepts involved from underpinning theory.
- Keep the workspace clean and organized, free from clutter and unnecessary materials.
- Use the software according to its intended purpose and instructions.
- Ensure that all the necessary equipment and software are in good working condition.
- Never eat or drink in the lab, as it can cause contamination and create safety hazards.
- If any accidents or injuries occur, immediately notify the instructor and seek medical attention if necessary.

J. Source code

Case Study: "Implementing Virtualization in Enterprise IT"

- Explore a case where an organization successfully implemented virtualization.
- Discuss the types of virtualization used (desktop, network, storage, data).
- Analyze the advantages and disadvantages experienced by the organization.

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K. Practical related Quiz

1. Explain working of virtualization in cloud computing.
2. Write Characteristic and Applications of Virtualization

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L. References / Suggestions

1. https://www.geeksforgeeks.org/virtualization-cloud-computing-types/
2. https://www.javatpoint.com/advantages-and-disadvantages-of virtualization

M. Assessment-Rubrics

Criteria	Total Marks	Exceptional (5- Marks)	Satisfactory (4 to 3 Marks)	Developing (2-Marks)	Limited (1-Mark)
Content Understanding	**5**	Demonstrates a profound understanding of the case study, including technical concepts, challenges, and solutions.	Understands the core aspects of the case study with some minor gaps.	Shows a basic understanding of the case study but lacks depth.	Fails to grasp essential elements of the case study.
Analysis and Critical Thinking	**5**	Provides insightful analysis, considers multiple perspectives, and demonstrates critical thinking skills.	Offers a reasonable analysis with some critical thinking evident.	Analysis is basic, lacks depth, and shows limited critical thinking.	Analysis is minimal or absent; lacks critical thinking.
Presentation and Clarity	**5**	Presents ideas clearly, logically structured, and uses appropriate language.	Generally clear presentation with some minor organizational issues or language usage.	Presentation is somewhat unclear, lacks structure, and uses language inconsistently.	Poorly presented, disorganized, and uses language that hinders understanding.
Application of Cloud Computing Concepts	**5**	Effectively applies relevant cloud computing concepts to the case study.	Applies concepts reasonably well with some minor gaps.	Demonstrates limited application of cloud computing concepts.	Fails to apply cloud computing concepts appropriately.

Identification of Key Issues	**5**	Clearly identifies and prioritizes key issues related to the case study.	Identifies key issues with some minor omissions.	Identifies basic issues but may miss key points.	Fails to identify significant issues.
Total Marks:			**Signature with Date:**		

Practical No.11: Installation and Configuration of virtualization using KVM.

A. Objective

From this experiment, the student will be able to,

- Understand the concepts of virtualization.
- Understand KVM architecture and its configuration.

B. Expected Program Outcomes (POs)

PO1, PO2, PO3, PO4, PO5, PO6, PO7

C. Expected Skills to be developed based on competency

- Installing and configuring software as per the requirements
- Programming skills
- Debugging skills

D. Expected Course Outcomes(Cos)

CO -4

E. Practical Outcome(PRo)

- To analyze user models and develop user centric interfaces
- To analyze the local and global impact of computing on individuals, organizations, and society.
- To engage in life-long learning development and higher studies.
- To understand, identify, analyze and design the problem, implement and validate the solution including both hardware and software.

F. Expected Affective domain Outcome(ADos)

- Handle tools /components/equipment carefully with safety and necessary precaution.
- In software ethics Environment sustainability and environment consciousness whenever suitable.
- Leadership Qualities

G. Prerequisite Theory:

Virtualization is software that separates physical infrastructures to create various dedicated resources. It is the fundamental technology that powers cloud computing.
The technology behind virtualization is known as a virtual machine monitor (VMM) or virtual manager, which separates compute environments from the actual physical infrastructure.

- Virtualization makes servers, workstations, storage and other systems independent of the physical hardware layer. This is done by installing a Hypervisor on top of the hardware layer, where the systems are then installed.
- There are three areas of IT where virtualization is making head roads, network virtualization, storage virtualization and server virtualization:
- Network virtualization is a method of combining the available resources in a network by splitting up the available bandwidth into channels, each of which is independent from the others, and each of which can be assigned (or reassigned) to a particular server or device in real time. The idea is that virtualization disguises the true complexity of the network by separating it into manageable parts, much like your partitioned hard drive makes it easier to manage your files.
- Storage virtualization is the pooling of physical storage from multiple network storage devices into what appears to be a single storage device that is managed from a central console. Storage virtualization is commonly used in storage area networks (SANs).
- Server virtualization is the masking of server resources (including the number and identity of individual physical servers, processors, and operating systems) from server users. The intention is to spare the user from having to understand and manage complicated details of server resources while increasing resource sharing and utilization and maintaining the capacity to expand later.
- Virtualization can be viewed as part of an overall trend in enterprise IT that includes autonomic computing, a scenario in which the IT environment will be able to manage itself based on perceived activity, and utility computing, in which computer processing power is seen as a utility that clients can pay for only as needed. The usual goal of virtualization is to centralize administrative tasks while improving scalability and workloads.

Procedure:

Installation Steps :

1. #sudo grep -c "svm\|vmx" /proc/cpuinfo
2. #sudo apt-get install qemu-kvmlibvirt-bin bridge-utilsvirt-manager
3. #sudoadduserrait

#sudoadduserraitlibvirtd

After running this command, log out and log back in as rait

4. Run following command after logging back in as rait and you should see an empty list of virtual machines. This indicates that everything is working correctly.

#virsh -c qemu:///system list

5. Open Virtual Machine Manager application and Create Virtual Machine

#virt-manager

H. Resources/Equipment Required

Sr. No.	Instrument/Equipment with Broad Specifications
1	Computer system with operating system: Windows 7 or higher VerIntel Core i7 processor 16GB RAM 512GB SSD
2	VMware -vSphere Version 7.0 Microsoft Hyper-V Integration with Windows Server KVM Hypervisor
3	Internet Connection

I. Safety and necessary Precautions followed

- Read the experiment thoroughly before starting and ensure that you understand all the steps and concepts involved from underpinning theory.
- Keep the workspace clean and organized, free from clutter and unnecessary materials.
- Use the software according to its intended purpose and instructions.
- Ensure that all the necessary equipment and software are in good working condition.
- Never eat or drink in the lab, as it can cause contamination and create safety hazards.
- If any accidents or injuries occur, immediately notify the instructor and seek medical attention if necessary.

J. Source code

- Installation and Configuration of virtualization using KVM.

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K. Practical related Quiz

1. What is hypervisor and explain types of hypervisor.

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L. References / Suggestions

1. https://www.javatpoint.com/what-is-a-hypervisor
2. https://www.javatpoint.com/cloud-hypervisor
3. https://trueconf.com/blog/knowledge-base/configure-kvm-hypervisor-ubuntu-server.html

M. Assessment-Rubrics

Criteria	Total Marks	Exceptional (5- Marks)	Satisfactory (4 to 3 Marks)	Developing (2-Marks)	Limited (1-Mark)
Engagement	**5**	Performed practical independently	Performed practical with some help.	Watched others but didn't try them.	Present but not actively participating.
Accuracy	**5**	Accurately executed tasks.	1-2 errors/mistakes found.	3-5 errors/mistakes identified.	More than 5 errors/mistakes committed.
Documentation	**5**	No errors; well-executed program.	Complete write-up with output tables but poor presentation.	Some commands missing with missing outputs.	Poor write-up and diagram or missing content.
Understanding & Explanation	**5**	Fully understood and can explain perfectly.	Understood the performance but cannot explain.	Partially understood and can give little explanation.	Partially understood and cannot give explanation.
Time Management	**5**	Completed the work within a week.	Work submitted later than 1 week but by the end of 2nd week.	Work done after 2nd week but before the end of 3rd week.	Work submitted after 3 weeks.
Total Marks:			**Signature with Date:**		

Practical No.12: Case Study: "Data Security and Privacy in a Cloud-Based Healthcare System"

- Investigate a case where a healthcare organization adopted cloud computing.
- Discuss infrastructure security at the network, host, and application levels.
- Analyze data security, storage, and privacy issues in the context of sensitive healthcare data.

A. Objective

To Enhance Patient Care, Improve Operational Efficiency, and Ensure Secure Access to Medical Information.

B. Expected Program Outcomes (POs)

PO1, PO2, PO3, PO4, PO5, PO6, PO7

C. Expected Skills to be developed based on competency

- Understanding Skill
- Analytical Skill

D. Expected Course Outcomes(Cos)

CO -5

E. Practical Outcome(PRo)

Understand the emphasizing patient-centric care, operational efficiency, data security, and continuous improvement

F. Expected Affective domain Outcome(ADos)

- Handle tools /components/equipment carefully with safety and necessary precaution.
- In software ethics Environment sustainability and environment consciousness whenever suitable.
- Leadership Qualities

G. Prerequisite Theory:

Data Security and Privacy in a Cloud-Based Healthcare System

Implementing robust data security and privacy measures in a cloud-based healthcare system is critical to ensure the confidentiality, integrity, and availability of sensitive patient information. Here's a comprehensive overview of the key considerations and best practices:

1. **Encryption:** Employ end-to-end encryption for data at rest, in transit, and during processing. Utilize strong encryption algorithms to protect patient health records and sensitive information.
2. **Access Controls:** Implement stringent access controls and role-based permissions to restrict system and data access. Authenticate and authorize healthcare professionals based on their roles and responsibilities.
3. **Multi-Factor Authentication (MFA):** Enforce multi-factor authentication for accessing healthcare systems and patient data. MFA adds an additional layer of security beyond traditional username and password credentials.
4. **Regular Security Audits:** Conduct regular security audits and assessments of the cloud infrastructure, applications, and data storage to identify and rectify vulnerabilities. Perform penetration testing to evaluate the system's resistance to cyber threats.
5. **Compliance with Healthcare Regulations:** Adhere to healthcare data protection regulations such as HIPAA (Health Insurance Portability and Accountability Act) in the U.S. or GDPR (General Data Protection Regulation) in the European Union. Stay informed about and complies with regional and industry-specific standards.
6. **Data Residency and Sovereignty:** Ensure compliance with data residency laws by storing patient data in specific geographical locations. Understand and adhere to data sovereignty regulations governing cross-border data transfers.
7. **Secure Data Transmission:** Use secure communication protocols (e.g., TLS/SSL) for data transmission between healthcare systems, ensuring the confidentiality and integrity of patient data during transit.
8. **Regular Employee Training:** Provide comprehensive training for healthcare professionals and staff on data security best practices. Foster a culture of awareness and responsibility regarding patient data protection.
9. **Incident Response Plan:** Develop and regularly test an incident response plan to effectively respond to security incidents or data breaches. Establish clear protocols for reporting and mitigating security events.

H. Resources/Equipment Required

Sr. No.	Instrument/Equipment with Broad Specifications
1	Computer system with operating system: Windows 7 or higher VerIntel Core i7 processor 16GB RAM 512GB SSD
2	VMware -vSphere Version 7.0 Microsoft Hyper-V Integration with Windows Server
3	Internet Connection

I. Safety and necessary Precautions followed

- Read the experiment thoroughly before starting and ensure that you understand all the steps and concepts involved from underpinning theory.
- Keep the workspace clean and organized, free from clutter and unnecessary materials.
- Use the software according to its intended purpose and instructions.
- Ensure that all the necessary equipment and software are in good working condition.
- Never eat or drink in the lab, as it can cause contamination and create safety hazards.
- If any accidents or injuries occur, immediately notify the instructor and seek medical attention if necessary.

J. Source code

Case Study: "Data Security and Privacy in a Cloud-Based Healthcare System"

- Investigate a case where a healthcare organization adopted cloud computing.
- Discuss infrastructure security at the network, host, and application levels.
- Analyze data security, storage, and privacy issues in the context of sensitive healthcare data.

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K. Practical related Quiz

1. Describe protocols and mechanisms are in place to secure the transmission of patient data between different components of the healthcare system.
2. List training programs are provided to healthcare professionals and staff regarding data security best practices.

L. References / Suggestions

1. https://www.edx.org/learn/cloud-computing/ibm-introduction-to-cloud-computing
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8485370/
3. https://www.sciencedirect.com/science/article/pii/S1110866517302797
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8465695/

M. Assessment-Rubrics

Criteria	Total Marks	Exceptional (5- Marks)	Satisfactory (4 to 3 Marks)	Developing (2-Marks)	Limited (1-Mark)
Content Understanding	**5**	Demonstrates a profound understanding of the case study, including technical concepts, challenges, and solutions.	Understands the core aspects of the case study with some minor gaps.	Shows a basic understanding of the case study but lacks depth.	Fails to grasp essential elements of the case study.
Analysis and Critical Thinking	**5**	Provides insightful analysis, considers multiple perspectives, and demonstrates critical thinking skills.	Offers a reasonable analysis with some critical thinking evident.	Analysis is basic, lacks depth, and shows limited critical thinking.	Analysis is minimal or absent; lacks critical thinking.
Presentation and Clarity	**5**	Presents ideas clearly, logically structured, and uses appropriate language.	Generally clear presentation with some minor organizational issues or language usage.	Presentation is somewhat unclear, lacks structure, and uses language inconsistently.	Poorly presented, disorganized, and uses language that hinders understanding.
Application of Cloud Computing Concepts	**5**	Effectively applies relevant cloud computing concepts to the case study.	Applies concepts reasonably well with some minor gaps.	Demonstrates limited application of cloud computing concepts.	Fails to apply cloud computing concepts appropriately.
Identification of Key Issues	**5**	Clearly identifies and prioritizes key issues related to the case study.	Identifies key issues with some minor omissions.	Identifies basic issues but may miss key points.	Fails to identify significant issues.
Total Marks:			**Signature with Date:**		

Practical No.13: "Migration to the Cloud: A Banking Sector Perspective"

- Explore how a traditional bank migrated its infrastructure to a public cloud.
- Analyze the security considerations and challenges faced during the migration.

A. Objective

Enhance Operational Agility, Security, and Customer Experience through a Thoughtful and Secure Migration of Banking Services to the Cloud.

B. Expected Program Outcomes (POs)

PO1, PO2, PO3, PO4, PO5, PO6, PO7

C. Expected Skills to be developed based on competency

- Understanding Skill
- Analytical Skill

D. Expected Course Outcomes(Cos)

CO -5

E. Practical Outcome(PRo)

Understand a phased migration plan for the bank's infrastructure, including core banking systems, databases, and customer-facing applications, to a public cloud environment.

F. Expected Affective domain Outcome(ADos)

- Handle tools /components/equipment carefully with safety and necessary precaution.
- In software ethics Environment sustainability and environment consciousness whenever suitable.
- Leadership Qualities

G. Prerequisite Theory:

Migrating to the Cloud

"Migrating to the Cloud" refers to the process of transitioning an organization's computing resources, applications, data, and services from on-premises infrastructure or traditional data centres to cloud-based solutions. This migration can encompass various deployment models, including public cloud, private cloud, hybrid cloud, or multi-cloud environments. The goal is to leverage the benefits of cloud computing, such as scalability, flexibility, cost-efficiency, and improved business agility.

Key Considerations and Steps in Cloud Migration:

1. **Assessment and Planning:** Conduct a thorough analysis of existing infrastructure, applications, and data to determine suitability for migration. Develop a comprehensive migration plan outlining goals, timelines, and resource requirements.
2. **Workload Identification:** Identify and categorize workloads based on their complexity, dependencies, and criticality. Prioritize migration based on business priorities.
3. **Choose the Right Cloud Model:** Determine the most suitable cloud deployment model (public, private, hybrid, or multi-cloud) based on security, compliance, and business requirements.
4. **Data Migration Strategy:** Develop a strategy for migrating data to the cloud, considering factors such as data volume, sensitivity, and the chosen cloud storage solutions.
5. **Application Refactoring and Modernization:** Assess applications for compatibility with the cloud environment. Consider refactoring or modernizing applications to leverage cloud-native features.
6. **Security and Compliance**: Implement robust security measures, including encryption, identity and access management, and compliance controls. Ensure that the cloud environment meets industry and regulatory standards.
7. **Performance Optimization:** Optimize application and infrastructure performance in the cloud environment. Utilize cloud-native services for improved scalability and efficiency.
8. **Cost Management:** Develop a cost management strategy to control expenses and optimize spending in the cloud. Utilize cost-monitoring tools and adopt a pay-as-you-go model.
9. **Testing and Validation:** Conduct thorough testing, including performance, security, and functionality testing, to ensure a seamless transition. Validate that migrated workloads meet business and technical requirements.
10. **Training and Skill Development:** Provide training for IT staff to acquire the necessary skills for managing and maintaining the cloud environment. Foster a culture of continuous learning.
11. **Monitoring and Governance:** Implement monitoring tools and governance frameworks to track performance, detect issues.

H. Resources/Equipment Required

Sr. No.	Instrument/Equipment with Broad Specifications
1	Computer system with operating system: Windows 7 or higher VerIntel Core i7 processor 16GB RAM 512GB SSD
2	VMware -vSphere Version 7.0 Microsoft Hyper-V Integration with Windows Server OpenStack - Infrastructure as a Service (IaaS)
3	Internet Connection

I. Safety and necessary Precautions followed

- Read the experiment thoroughly before starting and ensure that you understand all the steps and concepts involved from underpinning theory.
- Keep the workspace clean and organized, free from clutter and unnecessary materials.
- Use the software according to its intended purpose and instructions.
- Ensure that all the necessary equipment and software are in good working condition.
- Never eat or drink in the lab, as it can cause contamination and create safety hazards.
- If any accidents or injuries occur, immediately notify the instructor and seek medical attention if necessary.

J. Source code

"Migration to the Cloud: A Banking Sector Perspective"

- Explore how a traditional bank migrated its infrastructure to a public cloud.
- Analyze the security considerations and challenges faced during the migration.

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K. Practical related Quiz

1. Explain tools and processes are in place for monitoring system performance in the cloud.
2. Describe the benefits of Cloud Migration.

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L. References / Suggestions

1. https://www.edx.org/learn/cloud-computing/ibm-introduction-to-cloud-computing
2. https://www.innovativesystems.com/data-migration/
3. https://www.saasdirect.us/data-migration/

M. Assessment-Rubrics

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Application of Cloud Computing Concepts	**5**	Effectively applies relevant cloud computing concepts to the case study.	Applies concepts reasonably well with some minor gaps.	Demonstrates limited application of cloud computing concepts.	Fails to apply cloud computing concepts appropriately.
Identification of Key Issues	**5**	Clearly identifies and prioritizes key issues related to the case study.	Identifies key issues with some minor omissions.	Identifies basic issues but may miss key points.	Fails to identify significant issues.
Total Marks:			**Signature with Date:**		

Practical No.14: "Global Company's Hybrid Cloud Strategy"

- Examine a multinational corporation’s use of a hybrid cloud model.
- Analyze how the organization balances data storage, compliance, and efficiency.

A. Objective

Achieve cost savings and optimize IT spending by leveraging the flexibility of the hybrid cloud model

B. Expected Program Outcomes (POs)

PO1, PO2, PO3, PO4, PO5, PO6, PO7

C. Expected Skills to be developed based on competency

- Understanding Skill
- Analytical Skill

D. Expected Course Outcomes(Cos)

CO -5

E. Practical Outcome(PRo)

Understand hybrid cloud strategy with overall business goals and objectives

F. Expected Affective domain Outcome(ADos)

- Handle tools /components/equipment carefully with safety and necessary precaution.
- In software ethics Environment sustainability and environment consciousness whenever suitable.
- Leadership Qualities

G. Prerequisite Theory:

Hybrid Cloud Strategy

A hybrid cloud strategy involves combining on-premises infrastructure, private cloud services, and public cloud services to create a flexible and scalable IT environment. Here's a more detailed breakdown of the key components and considerations for developing a hybrid cloud strategy:

1. Assessment and Workload Analysis:

Objective: Assess existing workloads and applications to identify those suitable for on-premises hosting, private cloud deployment, or public cloud migration.

2. Business Alignment:

Objective: Align the hybrid cloud strategy with the organization's overall business goals and objectives. Ensure that IT initiatives support and enhance the company's strategic vision.

3. Cost Management:

Objective: Optimize costs by balancing on-premises and cloud resources effectively. Utilize cost analysis tools to monitor spending and choose the most cost-effective deployment models.

4. Security and Compliance:

Objective: Develop a robust security framework that spans on-premises and cloud environments. Implement encryption, identity and access management, and regular security audits. Ensure compliance with industry regulations.

5. Data Management and Governance:

Objective: Establish data governance policies to manage and protect data across hybrid environments. Implement data backup and recovery solutions, considering the location and sensitivity of data.

6. Application Deployment and Modernization:

Objective: Strategically deploy applications based on their requirements. Consider modernizing applications through containerization and micro services architecture for easier migration and scalability.

7. Scalability and Flexibility:

Objective: Leverage the scalability of the cloud for dynamic workloads. Design the hybrid architecture to handle varying demands, allowing for easy scaling up or down based on requirements.

8. Disaster Recovery and Business Continuity:

Objective: Develop a comprehensive disaster recovery plan that includes both on-premises and cloud resources. Ensure data integrity, minimize downtime, and establish clear recovery time objectives (RTOs).

9. Interoperability and Integration:

Objective: Ensure seamless integration between on-premises and cloud systems. Implement APIs, middleware, and integration platforms to facilitate communication and data exchange.

10. Vendor Management:

Objective: Manage relationships with cloud service providers. Establish service level agreements (SLAs) that align with business needs. Regularly review and optimize cloud contracts.

11. Performance Optimization:

Objective: Optimize overall system performance by strategically placing workloads. Utilize cloud services for compute-intensive tasks, ensuring optimal performance and responsiveness.

12. Training and Skill Development:

Objective: Invest in training programs for IT staff to enhance skills related to managing hybrid cloud environments. Foster a culture of continuous learning to keep up with evolving technologies.

13. Monitoring and Analytics:

Objective: Implement robust monitoring and analytics tools to gain insights into hybrid cloud performance. Use data-driven insights for proactive issue resolution and continuous improvement.

14. Environmental Sustainability:

Objective: Consider green IT practices, choose energy-efficient cloud options, and implement eco-friendly policies to contribute to environmental sustainability goals.

15. Review and Adaptation:

Objective: Regularly review and adapt the hybrid cloud strategy to align with emerging technologies, business changes, and industry trends. Foster a culture of continuous improvement and innovation.

H. Resources/Equipment Required

Sr. No.	Instrument/Equipment with Broad Specifications
1	Computer system with operating system: Windows 7 or higher VerIntel Core i7 processor 16GB RAM 512GB SSD
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3	Internet Connection

I. Safety and necessary Precautions followed

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- Use the software according to its intended purpose and instructions.

- Ensure that all the necessary equipment and software are in good working condition.
- Never eat or drink in the lab, as it can cause contamination and create safety hazards.
- If any accidents or injuries occur, immediately notify the instructor and seek medical attention if necessary.

J. Source code

"Global Company's Hybrid Cloud Strategy"

- Examine a multinational corporations use of a hybrid cloud model.
- Analyze how the organization balances data storage, compliance, and efficiency.

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K. Practical related Quiz

1. What security measures are in place to ensure data protection and compliance with industry regulations in your hybrid cloud environment?
2. What factors influenced your decision to adopt a hybrid cloud model for your organization?

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L. References / Suggestions

1. https://www.edx.org/learn/cloud-computing/ibm-introduction-to-cloud-computing
2. https://www.ibm.com/topics/hybrid-cloud
3. https://cloud.google.com/learn/what-is-hybrid-cloud
4. https://enterprisersproject.com/article/2020/9/hybrid-cloud-strategy-5-essentials

M. Assessment-Rubrics

Criteria	Total Marks	Exceptional (5- Marks)	Satisfactory (4 to 3 Marks)	Developing (2-Marks)	Limited (1-Mark)
Content Understanding	**5**	Demonstrates a profound understanding of the case study, including technical concepts, challenges, and solutions.	Understands the core aspects of the case study with some minor gaps.	Shows a basic understanding of the case study but lacks depth.	Fails to grasp essential elements of the case study.
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Identification of Key Issues	**5**	Clearly identifies and prioritizes key issues related to the case study.	Identifies key issues with some minor omissions.	Identifies basic issues but may miss key points.	Fails to identify significant issues.
Total Marks:			**Signature with Date:**		