SCHEME :K

Name :_____
Roll No.:_____ Year : 20 ___ 20 __
Exam Seat No. :_____

LABORATORY MANUAL FOR

CLOUD COMPUTING (315325)

COMPUTER ENGINEERING GROUP

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI
(Autonomous)(ISO21001:2018)(ISO/IEC27001:2013)

VISION

To ensure that the Diploma level Technical Education constantly matches the latest requirements of Technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the challenging technological & environmental challenges.

Quality Policy

We, at MSBTE are committed to offer the best-in-class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programmes.

Core Values

MSBTE believes in the following:

- Skill development in line with industry requirements.
- Industry readiness and improved employability of Diploma holders.
- Synergistic relationship with industry.
- Collective and Cooperative development of all stake holders.
- Technological interventions in societal development.
- Access to uniform quality technical education.

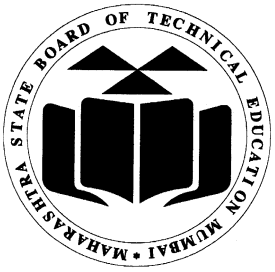
A Practical Manual
for

Cloud Computing
(315325)

Semester– (V)

"K-SCHEME"

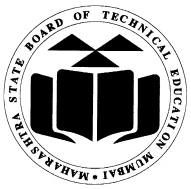
(CM/ CO/ CW/ HA/ IH/ SE)



Maharashtra State

Board of Technical Education, Mumbai

(Autonomous) (ISO21001:2018)(ISO/IEC 27001:2013)



Maharashtra State

Board of Technical Education, Mumbai

(Autonomous) (ISO21001:2018)(ISO/IEC 27001:2013)

4th Floor, Government Polytechnic Building, 49, Kherwadi,

Bandra (East), Mumbai -400051.

(Printed on : _____)

Maharashtra State
Board of Technical Education

Certificate

This is to certify that Mr. / Ms …….
Roll No……. of fifth Semester of Diploma in ……. of the institute ……
(Inst. Code……...) has completed the term work satisfactorily in course **Cloud Computing (315325)** for the academic year 20…….to 20…..... as prescribed in the curriculum.

Place: ……. Enrollment No: ……

Date: ..... Exam Seat No.: …….....

Course Teacher **Head of the Department** **Principal**

Preface

The objective of all engineering laboratories or field experience in the technical education system is to help students acquire the critical competencies and skills that businesses demand. In light of this, MSBTE developed the cutting-edge "K" Scheme curricula for engineering diploma programs, emphasizing outcome-based learning and the National Education Policy 2020 (NEP2020). As a result, a sizable portion of the program is dedicated to practical work. This demonstrates how crucial laboratory work is in helping teachers, instructors, and students understand that every minute of lab time must be used efficiently to create these outcomes rather than being spent on pointless tasks. Consequently, each practical has been created to operate as a "vehicle" to advance this industry in order to ensure the successful implementation of this outcome-based curriculum. It is challenging to teach practical skills using only the "chalk and duster" activity. Because of this, the "K" scheme laboratory manual creation team focused on the outcomes when designing the practical rather than following the long-standing custom of doing the practical to "verify the theory" (which may turn out to be a by-product along the way).

This lab manual is intended to support all parties involved, particularly the students, instructors, and teachers, in helping the students achieve the pre-established objectives. It is required of every student to read through the relevant practical process in its entirety and comprehend the bare minimum of theoretical background related to the practical at least one day in advance of the practical. As a crucial starting point for carrying out the practical, each exercise in this manual starts with establishing the competency, industry-relevant skills, course outcomes, and practical outcomes. The skills, the students will acquire from the process outlined there, together with the necessary safety measures to be followed, will subsequently be made clear to them. These will enable them to apply the knowledge and abilities to solve real-world problems in their professional lives.

In today's data-driven world, cloud computing provides scalable, cost-effective solutions for managing and analysing large datasets. Cloud platforms like Amazon Web Services (AWS) offer robust tools such as Amazon SageMaker to streamline the machine learning workflow, from data preparation and model training to deployment and validation.

This practical exercise guides students in leveraging cloud resources to build, train, and deploy machine learning models. It provides hands-on experience with real-world data, ensuring a deep understanding of both theoretical concepts and practical implementation in a modern cloud-based environment.

The team responsible for developing the Practical manual would like to express its gratitude to MSBTE for taking the lead in developing and implementing the curriculum. Additionally, the team recognizes the valuable contributions made by individual course experts who have been directly or indirectly involved in the development of the "K" scheme curriculum and the laboratory manual. It is impossible to claim perfection in this laboratory manual, even though every effort has been made to verify it for errors, especially because this is the first edition. Any such mistakes and recommendations for enhancements are quite appreciated and can be brought to our attention.

Lab Manual Development Team

Program Outcomes (POs) to be achieved through Practical of this Course

Following POs are expected to be achieved through the practical's of the **Cloud computing** course.

PO1. Basic and Discipline specific knowledge: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.

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

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

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

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

PO 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 in diverse and multidisciplinary fields.

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

List of Industry Relevant Skills:

The following industry relevant skills of the competency 'Cloud Computing' are expected to be developed in you by undertaking the practical of this laboratory manual.

- Cloud Platforms
- Data Management
- Machine Learning & Model Deployment
- Scalable Computing
- Security & IAM

Practical- Course Outcome (CO) matrix

CO1 - Use basic Cloud based applications.

CO2 - Explain Virtualization in Cloud Computing.

CO3 - Maintain storage system and services in Cloud.

CO4 - Apply Security in Cloud Computing.

CO5 - Use various Cloud Platforms.

Sr. No.	Title of the Practical	CO 1.	CO 2.	CO 3.	CO 4.	CO 5.
1	* Configure Cloud using JustCloud	√	-	-	-	-
2	Use Goggle Doc to make spreadsheet and notes	√	-	-	-	-
3	* Create Virtual Machines using VMware (Private Cloud) and delete the created VM after completion	-	√	-	-	-
4	* Implement Storage Service on Cloud using OpenStack	-	√	-	-	-
5	* Create and Host Simple Web Application on Google cloud/Any cloud platform	-	-	√	-	-
6	Create a File System using HDFS	-	-	√	-	-
7	Work in Codenvy to show Provisioning and Scaling of a website	-	-	√	-	-
8	* Implement Identity Management and Access Management using OpenStack	-	-	√	-	-
9	Configure Server using CFEngine or any other open source tool	-	-	√	-	-
10	* Design an application based on IoT using Arduino or Raspberry Pi	-	-	-	-	√
11	Design any automated application using RFID	-	-	-	-	√

Guidelines to Teachers

1. There will be two sheets of blank pages after every practical for the student to report other matters (if any), which is not mentioned in the printed practical.
2. For difficult practical if required, teacher could provide the demonstration of the practical emphasizing of the skills which the student should achieve.
3. Teachers should give opportunity to students for hands-on after the demonstration.
4. Assess the skill achievement of the students and COs of each unit.
5. One or two questions ought to be added in each practical for different batches. For this teacher can maintain various practical related question banks for each course.
6. For effective implementation and attainment of practical outcomes, teacher ought to ensure that in the beginning itself of each practical, students must read through the complete write-up of that practical sheet.
7. During practical, ensure that each student gets chance and takes active part in taking observations/ readings and performing practical.
8. Teacher ought to assess the performance of students continuously according to the MSBTE guidelines.

Instructions for Students

1. For incidental writing on the day of each practical session every student should maintain a ***dated log book*** for the whole semester, apart from this laboratory manual which s/he has to ***submit for assessment to the teacher*** in the next practical session.
2. For effective implementation and attainment of practical outcomes, in the beginning itself of each practical, students need to read through the complete write-up including the practical related questions and assessment scheme of that practical sheet.
3. Student ought to refer the reference book, lab manuals etc. Student should not hesitate to ask any difficulties they face during the conduct of practical's.

Content Page

List of Practical and Progressive Assessment Sheet

Note: To be transferred to Proforma of CIAAN-2023.

Note : Out of above suggestive LLOs -

- '*' Marked Practical's (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

Practical No. 1: Configure Cloud using JustCloud

I Practical Significance

The practical value of cloud computing is that it enables the delivery of adaptable, affordable, and scalable computing resources via the internet. It gives individuals and businesses the ability to use data, apps, and services from any location at any time, facilitating increased mobility and remote cooperation.

II Industry/Employer Expected outcome(s)

Manage Cloud based services.

III Course Level Learning outcome(s)

CO1 - Use basic Cloud based applications.

IV Laboratory Learning outcome(s)

LLO 1.1 Configure Cloud storage.

V Relevant Affective Domain Related Outcomes

Demonstrates the Role of Cloud in Modern IT.

VI Relevant Theoretical Background

A fundamental grasp of cloud computing principles, such as the function of cloud storage and the distinction between cloud-based and local data storage, is the minimum theoretical foundation needed to set up cloud storage using JustCloud. The significance of internet access for downloading and uploading files to the cloud, as well as the concepts of data backup, synchronization, and restoration, should be understood by users. It's also crucial to have a basic understanding of the files and directories that make up an operating system since users must choose the precise data they want to backup. Furthermore, a basic understanding of cloud security, such as the usage of strong passwords and the significance of account authentication, is helpful. Generally speaking, setting up JustCloud only requires a basic understanding of internet access, computer use, and data management concepts; no sophisticated IT expertise is necessary.

Step 1:

1. Log in to Your Bluehost India Control Panel.
2. Navigate to Bluehost India.
3. Click on the "Control Panel Login" button located at the top-right corner.
4. Enter your username (email or domain name) and password, then click Login.

Step 2:

Access the Advanced (cPanel) Features

1. Once logged in, locate the Advanced tab in the left-hand navigation menu.
2. Click on Advanced to access the cPanel interface, which provides advanced tools for managing your hosting account.

Step 3:

Set Up Your Website

1. In the Advanced section, scroll down to the Software section.
2. Click on WordPress Manager or Softaculous Apps Installer.

3. Select WordPress and click Install.
4. Fill in the required details, such as site name, description, admin username, and password.
5. Choose the domain where you want to install WordPress.
6. Click Install to begin the installation process.

Step 4:

Manage Files and Databases

1. File Manager: Access the File Manager under the Files section to upload, edit, or delete website files.
2. MySQL Databases: Under the Databases section, use MySQL Databases to create and manage databases for your applications.

Step 5:

Set Up Email Accounts

1. In the Advanced section, scroll down to the Email section.
2. Click on Email Accounts.
3. Click Create to set up a new email account associated with your domain.
4. Fill in the necessary details and set a password.
5. Click Create Account.

Step 6:

Secure Your Website with SSL

1. In the Advanced section, navigate to the Security section.
2. Click on SSL/TLS.
3. Use the Manage SSL Sites option to install or manage SSL certificates for your domains.

Step 7:

Manage Domains and DNS

1. Click on the Domains tab in the main navigation menu.
2. Here, you can register new domains, assign domains to your account, or manage existing ones.
3. To modify DNS records, go to the Advanced section and click on Zone Editor under the Domains section.
4. Use the Zone Editor to add or edit DNS records like A, CNAME, and MX records. BluehostBluehost+1Bluehost+1Bluehost

Step 8:

Utilize Additional Tools

1. SSH Access: For secure remote access, set up SSH keys under the Security section.
2. Backup: Use the Backup tool under the Files section to create or restore backups of your website.
3. Cron Jobs: Automate tasks by setting up cron jobs under the Advanced section.

VII Resources required (Additional)

Sr. No.	Name of Resource	Specification	Quantity	Remarks (If any)
1.	Cloud Service Provider	AWS / Azure / Google Cloud / DigitalOcean / Bluehost	1 Account	For ALL Experiments
2.	Storage Type	Object Storage (e.g., AWS S3), Block Storage (e.g., EBS), or File Storage	1 1 Service	
3.	Internet Connectivity	Minimum 10 Mbps stable connection for upload/download	1 Connection	

VIII Precautions to be followed

1. Follow precautionary measures.
2. Follow naming conventions.
3. Follow ethical practices.

IX Conclusion

……
……
……
……
……

X Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions to ensure the achievement of identified CO.

1. Create a cloud storage bucket using your chosen cloud provider (AWS/GCP/Azure/Bluehost). Document the steps with screenshots.
2. Upload a file (PDF/image/text) to the cloud storage bucket.
3. Write a short script (in Python/Node.js) to upload and download files from the configured cloud storage.

(Space for Answer)

……
……
……
……
……
……

……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……

XI References / Suggestions for further Reading

1. **https://www.justcloud.com/**
2. **https://learn.microsoft.com/en-us/azure/storage/blobs/**
3. **https://docs.aws.amazon.com/s3/**

XII Assessment Scheme

The given performance indicators should serve as a guideline for assessment regarding process and product related marks. Faculty must fill only the table at bottom.

Performance indicators		Weightage
Process related (15 Marks)		**70%**
1	Logic formation	30%
2	Debugging ability	30%
3	Follow ethical practices	10%
Product related (10 Marks)		**30%**
4	Expected output	10%
5	Timely Submission	10%
6	Answer to sample questions	10%
	Total (25 Marks)	100%

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 2: Use Goggle Doc to make spreadsheet and notes

I Practical Significance

Google Docs and Google Sheets are cloud-based programs, users may create, modify, and share documents and spreadsheets in real-time from any device with an internet connection. Particularly useful for students, researchers, and professionals who must record observations, keep records, analyse data, or take organized notes.

II Industry/Employer Expected outcome(s)

Manage Cloud based services.

III Course Level Learning outcome(s)

CO1-Use basic Cloud based applications.

IV Laboratory Learning outcome(s)

LLO 2.1 Create document for given application.

V Relevant Affective Domain Related Outcomes

These outcomes focus on the values, attitudes, and interpersonal skills developed during this digital productivity task.

VI Relevant Theoretical Background

To use Google Docs and Google Sheets for spreadsheet and note creation, one must have at least a fundamental understanding of digital literacy and standard office software. Users should be comfortable with basic computer skills like utilizing a keyboard and mouse, navigating web browsers, and managing files and folders. Having a basic understanding of text formatting, such as using bold, italics, and headings, is beneficial for taking notes well in Google Docs. In the same way, knowing the fundamentals of spreadsheets, such as rows, columns, cells, and simple formulas (e. g. addition, averaging), is essential for maximizing your use of Google Sheets. Additionally, it's crucial to comprehend how cloud storage operates, notably the notion of storing data online and being able to retrieve it from various devices. With this fundamental understanding, users may efficiently generate, modify, save, and share spreadsheets and documents in a cloud-based platform.

A. Steps to Create Notes Using Google Docs:

- Go to Google Docs

Visit https://docs.google.com and sign in with your Google account.

- Start a New Document

Click on “Blank” or select a template to begin.

- Rename the Document

Click on “Untitled document” at the top-left and enter a meaningful name.

- Type and Format Notes

Use headings, bullet points, numbering, and formatting tools to organize your notes.

- Insert Additional Elements (Optional)

Add images, tables, charts, or links via the Insert menu.

- Save and Share (Optional)

Docs auto-save automatically. To share, click the "Share" button and set permissions.

B. Steps to Create a Spreadsheet Using Google Sheets:

- Go to Google Sheets

Visit https://sheets.google.com.

- Start a New Spreadsheet

Click on "Blank" to open a new sheet.

- Rename the Spreadsheet

Click on "Untitled spreadsheet" and enter a name.

- Enter and Organize Data

Input your data in rows and columns. Use formatting tools for clarity.

- Use Formulas and Functions (Optional)

Apply basic formulas like =SUM(), =AVERAGE() to process data.

- Insert Charts or Graphs (Optional)

Use Insert > Chart to visualize data.

- Save and Share (Optional)

Sheets auto-save automatically. Click "Share" to collaborate.

C. Link Sheets with Docs:

- In Google Docs, go to Insert > Chart > From Sheets.
- Select the spreadsheet and choose the chart to embed.
- Alternatively, copy and paste a link to the spreadsheet into your notes.

VII Resources required (Additional)

Sr. No.	Name of Resource	Specification	Quantity	Remarks (If any)
1.	Google Docs	Online word processor	1	For all experiments.
2.	Google Sheets	Online spreadsheet tool	1	

VIII Precautions to be followed

1. Follow precautionary measures.
2. Follow naming conventions.
3. Follow ethical practices.

IX Conclusion

……
……
……

……
……

X Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions to ensure the achievement of identified CO.

1. **Create a Google Doc titled "Weekly Study Notes".** Add three headings: *Math, Science,* and *English.* Under each heading, add at least 3 bullet points summarizing what you learned.
2. **Create a spreadsheet titled "Monthly Expense Tracker". Include columns: Date, Item, Category, Amount. Add at least 5 rows of sample data.**
3. Create a folder in Google Drive called “Class Work” and move both files into it.

(Space for Answer)

……
……
……
……
……
……
……
……
……
……
……
……

XI References / Suggestions for further Reading

1. https://edu.gcfglobal.org/en/googledocuments/
2. https://www.khanacademy.org

XII Assessment Scheme

The given performance indicators should serve as a guideline for assessment regarding process and product related marks. Faculty must fill only the table at bottom.

Performance indicators		Weightage
Process related (15 Marks)		**70%**
1	Logic formation	30%
2	Debugging ability	30%
3	Follow ethical practices	10%
Product related (10 Marks)		**30%**
4	Expected output	10%
5	Timely Submission	10%
6	Answer to sample questions	10%
	Total (25 Marks)	100%

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 3: Create Virtual Machines using VMware (Private Cloud) and delete the created VM after completion

I Practical Significance

Creating and deleting VMs using VMware in a Private Cloud enables efficient, secure, and on-demand use of resources for testing, development, or training. It ensures optimal resource utilization and maintains a clean environment post-completion.

II Industry/Employer Expected outcome(s)

Manage Cloud based services.

III Course Level Learning outcome(s)

CO2 - Explain Virtualization in Cloud Computing.

IV Laboratory Learning outcome(s)

LLO 3.1 Create virtual environment.

V Relevant Affective Domain Related Outcomes

Demonstrates responsibility and discipline in managing virtual resources efficiently and ethically within a private cloud environment.

VI Relevant Theoretical Background

A fundamental grasp of a few essential theoretical concepts is necessary in order to successfully develop and administer virtual machines (VMs) using VMware in a private cloud environment. First, users need to understand the basics of virtualization, such as what a virtual machine is, how it functions, and the purpose of a hypervisor like VMware Workstation. To comprehend the extent of resource management, security, and scalability, it is also necessary to understand private cloud infrastructure and how it differs from public and hybrid clouds.

Additionally, in order to allocate the necessary resources when creating a VM, one must have a fundamental knowledge of computer hardware components like the CPU, RAM, disk storage, and network interfaces. Users should be comfortable with basic setup and installing operating systems like Windows or Linux. In the end, knowing about file systems, virtual machine snapshots, and virtual storage can help you manage and eventually remove virtual machines securely without harming the host system. This basic knowledge guarantees that VMware will be used effectively and without errors for virtualization activities in a private cloud environment, even though no in-depth understanding is necessary.

Steps to Create a Virtual Machine Using VMware (Private Cloud)

1. Log in to VMware platform
   Open VMware vSphere Client or VMware Workstation, and log in with your credentials.
2. Start the VM creation wizard
   Click on “Create New Virtual Machine” or similar option.
3. Choose the configuration type
   Select Typical (recommended) for simple setup or Custom for advanced options.

4. Name your VM and select storage location

Enter a name for the VM and choose where the VM files will be stored in your datastore.

5. Select the guest operating system
   Choose the OS type (Windows, Linux, etc.) and version you want to install.
6. Assign hardware resources
   Allocate CPU cores, RAM size, disk space, and network adapter settings.
7. Attach installation media
   Mount an ISO image or connect a physical installation disk for the OS.
8. Review and finish
   Review the settings and click Finish to create the VM.
9. Power on the VM
   Start the VM and proceed with the operating system installation.

Steps to Delete the Created Virtual Machine

1. Shut down the VM

Properly power off the VM from within the guest OS or through VMware controls.

2. Remove VM from inventory

In VMware vSphere: Right-click the VM and choose "Remove from Inventory".

3. Delete VM files

Select the option "Delete from Disk" to permanently remove VM files and free up storage.

4. Confirm deletion

Verify that the VM is no longer listed and that associated files have been removed from storage.

VII Resources required (Additional)

Sr. No.	Name of Resource	Specification	Quantity	Remarks (If any)
1.	Host Computer / Server	Intel i5/i7 or Xeon processor, 16 GB+ RAM, 500 GB+ SSD, virtualization-enabled BIOS	1	For ALL Experiments
2.	VMware Software	VMware Workstation Pro / VMware ESXi / vSphere	1	

VIII Precautions to be followed

1. Follow precautionary measures.
2. Follow naming conventions.
3. Follow ethical practices.

IX Conclusion

……
……
……

X Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions to ensure the achievement of identified CO.

1. Create a virtual machine using VMware Workstation or vSphere with the following specifications: OS: Ubuntu/Linux/Windows (choose one), RAM: 4 GB, CPU: 2 cores. Disk: 40 GB
2. Install the selected operating system on the VM using an ISO image.
3. Change the VM settings to increase the RAM to 6 GB. Note the effect.
4. Remove the VM from inventory without deleting its files. Then re-add it to the inventory.

(Space for Answer)

……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……

XI References / Suggestions for further Reading

1. **https://docs.vmware.com**
2. **https://docs.vmware.com/en/VMware-Workstation-Pro/index.html**
3. **https://www.youtube.com/watch?v=BHpRTVP8upg**
4. **https://youtu.be/LkdvyTuFpY0**

XII Assessment Scheme

The given performance indicators should serve as a guideline for assessment regarding process and product related marks. Faculty must fill only the table at bottom.

Performance indicators		Weightage
Process related (15 Marks)		**70%**
1	Logic formation	30%
2	Debugging ability	30%
3	Follow ethical practices	10%
Product related (10 Marks)		**30%**
4	Expected output	10%
5	Timely Submission	10%
6	Answer to sample questions	10%
	Total (25 Marks)	100%

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 4: Implement Storage Service on Cloud using OpenStack

I Practical Significance

Implementing storage service on cloud using OpenStack enables scalable, cost-effective, and flexible data storage management. It ensures high availability and easy integration with other cloud services for seamless operations.

II Industry/Employer Expected outcome(s)

Manage Cloud based services.

III Course Level Learning outcome(s)

CO3- Maintain storage system and services in Cloud.

IV Laboratory Learning outcome(s)

LLO 4.1 Implement storage service on Cloud.

V Relevant Affective Domain Related Outcomes

Demonstrates responsibility and willingness to adopt cloud-based storage solutions while appreciating their role in enhancing data accessibility and efficiency.

VI Relevant Theoretical Background

Learners must have basic understanding in a few essential topics in order to utilize OpenStack to deliver cloud storage services. This involves comprehending the distinctions between block storage and object storage, as well as cloud computing models (particularly Infrastructure as a Service, or IaaS). It is imperative to have a fundamental understanding of the architecture of OpenStack and its fundamental elements, notably Cinder (for block storage) and Swift (for object storage). In addition, a strong understanding of networking principles, such as IP addressing and storage protocols like iSCSI or NFS, as well as Linux operating system commands and virtualization concepts will aid in successful setup and maintenance. Familiarity with storage lifecycle management, APIs, and client-server architecture enhances value at the novice level, although it is not required.

Steps to Implement Storage Service on Cloud Using OpenStack

a. Prerequisites
   - A working OpenStack environment (e.g., installed via DevStack, Packstack, or manually).
   - Root or admin access to the OpenStack dashboard (Horizon) and CLI.
   - Sufficient compute and storage resources on the host machine.

b. Steps to Configure Block Storage (Cinder)
   - Install and Configure Cinder Service
     - Install openstack -cinder packages on the controller node and storage node.
     - Configure /etc/cinder/cinder.conf with correct database, message queue, and authentication settings.
   - Create Cinder Database and User
     - Create a Cinder database in MariaDB/MySQL.
     - Add Cinder user and assign it the admin role.
   - Register Cinder with Identity Service (Keystone)

- Create a service entry for Cinder in Keystone.
- Add API endpoints (public, internal, admin) for Cinder.

- Start Cinder Services
  - Enable and start cinder-api, cinder-scheduler, and cinder-volume.
- Add and Manage Block Storage Volumes
  - Use OpenStack CLI or Horizon to create and attach volumes to instances.
  - Monitor volume status, attach/detach operations, and snapshots.

c. Steps to Configure Object Storage (Swift)

- Install and Configure Swift
  - Install Swift packages: openstack-swift, swift-account, swift-container, swift-object.
  - Set up ring files (account, container, object) using swift-ring-builder.
- Create Swift User and Endpoint.
  - Add a Swift user in Keystone and register service and endpoints.
- Configure Storage Node
  - Format and mount storage disks.
  - Configure rsync, account-server.conf, container-server.conf, and object-server.conf.
- Start Swift Services
  - Start the Swift proxy and storage node services.
- Upload and Access Objects
  - Use OpenStack Horizon or CLI to create containers and upload files.
  - Access objects using URLs or APIs.

d. Verification and Testing

- Create instances and attach Cinder volumes.
- Upload/download files to Swift containers.
- Monitor storage usage and logs for errors.

VII Resources required (Additional)

Sr. No.	Name of Resource	Specification	Quantity	Remarks (If any)
1.	Server Machine (Controller Node)	CPU: Quad-Core, RAM: 16 GB, Storage: 250 GB SSD	1	s
2.	Server Machine (Storage Node)	CPU: Quad-Core, RAM: 16 GB, Storage: 500 GB+ HDD/SSD	1	

VIII Precautions to be followed

1. Follow precautionary measures.
2. Follow naming conventions.
3. Follow ethical practices.

IX Conclusion

……..
……
……

X Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions to ensure the achievement of identified CO.

1. Create and manage a block storage volume using OpenStack CLI and dashboard.
2. Attach a Cinder volume to a running virtual machine instance.
3. Detach and delete a block storage volume from an instance.

(Space for Answer)

……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……

XI References / Suggestions for further Reading

1. https://docs.openstack.org/cinder/latest/
2. https://docs.openstack.org/install/
3. https://youtu.be/vhYvtIl7Byc

XII Assessment Scheme

The given performance indicators should serve as a guideline for assessment regarding process and product related marks. Faculty must fill only the table at bottom.

Performance indicators		Weightage
Process related (15 Marks)		**70%**
1	Logic formation	30%
2	Debugging ability	30%
3	Follow ethical practices	10%
Product related (10 Marks)		**30%**
4	Expected output	10%
5	Timely Submission	10%
6	Answer to sample questions	10%
	Total (25 Marks)	100%

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 5: Create and Host Simple Web Application on Google cloud/Any cloud platform

I Practical Significance

Creating and hosting a simple web application on Google Cloud or any cloud platform provides hands-on experience with cloud deployment and scalability. It enables students to understand real-world application hosting, resource management, and cost-effective cloud usage.

II Industry/Employer Expected outcome(s)

Manage Cloud based services.

III Course Level Learning outcome(s)

CO3- Maintain storage system and services in Cloud.

IV Laboratory Learning outcome(s)

LLO 5.1 Create and Host Web Application.

V Relevant Affective Domain Related Outcomes

Demonstrate curiosity and enthusiasm towards learning cloud-based web deployment and also shows responsibility in managing and hosting applications on cloud platforms.

VI Relevant Theoretical Background

Creating and hosting a simple web application on Google Cloud or any cloud platform involves understanding the fundamentals of cloud computing, including service models like IaaS, PaaS, and SaaS, as well as deployment models such as public, private, and hybrid clouds. It requires knowledge of web technologies such as HTML, CSS, JavaScript, and client-server architecture, along with an understanding of HTTP/HTTPS protocols. Familiarity with cloud-specific services like Google App Engine, Compute Engine, or similar offerings from AWS or Azure is essential for deploying applications. Additionally, concepts of virtual machines, containers, cloud storage, and databases provide the foundation for hosting scalable and reliable applications. Understanding version control and basic DevOps practices can further enhance the development and deployment process.

Steps to create and host simple web application

1. Prepare Your Web Application
    - Create a simple web app using HTML, CSS, JavaScript, or a framework like Flask, Node.js, etc.
    - Test it locally to ensure it's working as expected.
2. Create a Cloud Account
    - Sign up for a Google Cloud account (or AWS, Azure, etc.).
    - Activate the free trial or billing account to access services.
3. Create a New Project
    - In the cloud console, create a new project for your application.
4. Set Up Cloud Environment
    - Enable relevant APIs e.g., App Engine, Compute Engine, Cloud Storage.

- Install **Google Cloud SDK** on your local machine.

5. Deploy Using One of the Following Services:
   Option A: Google App Engine (PaaS)
   - Create an app.yaml file specifying runtime (e.g., python39).
   - Deploy using:
     gcloud app deploy

   Access the app via the generated URL.
   Option B: Compute Engine (IaaS)
   - Create a virtual machine.
   - Upload your web app files.
   - Install a web server (e.g., Apache, Nginx).
   - Start the server and configure the firewall to allow HTTP traffic.

   Option C: Cloud Storage (Static Website Hosting)
   - Upload static files (HTML, CSS, JS) to a Cloud Storage bucket.
   - Set the bucket as public and configure it for website hosting.
6. Test and Access the App
   - Visit the provided URL (App Engine or static site) or public IP (Compute Engine) to verify hosting.
7. Optional Enhancements
   - Connect a custom domain.
   - Set up HTTPS (SSL/TLS).
   - Monitor using Cloud Monitoring tools.

VII Resources required (Additional)

Sr. No.	Name of Resource	Specification	Quantity	Remarks (If any)
1.	Code Editor	Visual Studio Code, Sublime Text, Atom		
2.	Cloud Account	Google Cloud / AWS / Azure with free tier or billing setup		

VIII Precautions to be followed

1. Follow precautionary measures.
2. Follow naming conventions.
3. Follow ethical practices.

IX Conclusion

……
……
……
……
……

X Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions to ensure the achievement of identified CO.

1. Create a basic web page using HTML that displays your name, department, and a welcome message. Save it as index.html.
2. Access the hosted application URL from your browser and take a screenshot of the output.
3. What are the permissions required to make a file publicly accessible on Google Cloud Storage?

(Space for Answer)

XI References / Suggestions for further Reading

1. **https://cloud.google.com/storage/docs/hosting-static-website**
2. **https://cloud.google.com/appengine/docs/standard**
3. **https://cloud.google.com/sdk/docs/install**
4. **https://docs.aws.amazon.com/AmazonS3/latest/userguide/WebsiteHosting.html**

XII Assessment Scheme

The given performance indicators should serve as a guideline for assessment regarding process and product related marks. Faculty must fill only the table at bottom.

Performance indicators		Weightage
Process related (15 Marks)		**70%**
1	Logic formation	30%
2	Debugging ability	30%
3	Follow ethical practices	10%
Product related (10 Marks)		**30%**
4	Expected output	10%
5	Timely Submission	10%
6	Answer to sample questions	10%
	Total (25 Marks)	100%

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 6: Configure Cloud using JustCloud

I Practical Significance

Apache Hadoop's HDFS (Hadoop Distributed File System) is an essential part. It guarantees excellent efficiency and data dependability while enabling the storage of big datasets across remote computers. Since many cloud storage solutions in actual distributed cloud settings operate on similar concepts, it is important to understand HDFS.

II Industry/Employer Expected outcome(s)

Manage Cloud based services.

III Course Level Learning outcome(s)

CO3 - Maintain storage system and services in Cloud.

IV Laboratory Learning outcome(s)

LLO 6.1 Create a File system on Cloud.

V Relevant Affective Domain Related Outcomes

Demonstrates discipline in executing the steps of HDFS installation and usage in a systematic manner

VI Relevant Theoretical Background

- HDFS:

A file system called HDFS was created to function on common hardware. Its architecture is master/slave, with:
NameNode: Controls the file system's metadata.
DataNodes: Hold the actual parts of data.

- Important attributes:

1. Excellent fault tolerance
2. Ideal for uses involving big data sets
3. The "write once, read often" pattern
4. chunks of data are stored (by default, 128 MB).

- HDFS Structure

- /user/hadoop/input
- /user/hadoop/output

- Steps

Step 1: Install Java
- sudo apt update
- sudo apt install openjdk-8-jdk -y
- java -version

Step 2: Download and Extract Hadoop
- wget https://downloads.apache.org/hadoop/common/hadoop-3.3.6/hadoop-3.3.6.tar.gz
- tar -xvzf hadoop-3.3.6.tar.gz
- sudo mv hadoop-3.3.6 /usr/local/Hadoop

Step 3: Configure Hadoop Environment Variables
- export HADOOP_HOME=/usr/local/Hadoop

- export PATH=$PATH:$HADOOP_HOME/bin:$HADOOP_HOME/sbin

Reload:

- source ~/.bashrc

Step 4: Edit Configuration Files

4.1. core-site.xml

```
<configuration>
  <property>
    <name>fs.defaultFS</name>
    <value>hdfs://localhost:9000</value>
  </property>
</configuration>
```

4.2. hdfs-site.xml

```
<configuration>
  <property>
    <name>dfs.replication</name>
    <value>1</value>
  </property>
  <property>
    <name>dfs.namenode.name.dir</name>
    <value>file:///usr/local/hadoop/hadoop_data/hdfs/namenode</value>
  </property>
  <property>
    <name>dfs.datanode.data.dir</name>
    <value>file:///usr/local/hadoop/hadoop_data/hdfs/datanode</value>
  </property>
</configuration>
```

Step 5: Format the HDFS Filesystem

- hdfs namenode -format

Step 6: Start Hadoop Services

- start-dfs.sh

Check running Java processes:

- jps

Step 7: Create Directories in HDFS

- hdfs dfs -mkdir /user
- hdfs dfs -mkdir /user/hadoop

VII Resources required (Additional)

Sr.No	Name of Resource	Broad Specification	Quantity	Remrks(If any)
1.	Hadoop	Hadoop 2.x	1	Internet for package installation

VIII Precautions to be followed

1. Follow precautionary measures.
2. Follow naming conventions.
3. Follow ethical practices.

IX Conclusion

……..
……
……
……..

X Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions to ensure the achievement of identified CO.

1. What is the role of the NameNode and DataNode?
2. How does HDFS handle fault tolerance?
3. Why does HDFS use large block sizes?

(Space for Answer)

……

XI References / Suggestions for further Reading

1. https://www.digitalregenesys.com/blog/what-is-hadoop-in-cloud-computing
2. https://www.databricks.com/glossary/hadoop-distributed-file-system-hdfs
3. https://cloud.google.com/learn/what-is-hadoop

XII Assessment Scheme

The given performance indicators should serve as a guideline for assessment regarding process and product related marks. Faculty must fill only the table at bottom.

Performance indicators		Weightage
Process related (15 Marks)		**70%**
1	Logic formation	30%
2	Debugging ability	30%
3	Follow ethical practices	10%
Product related (10 Marks)		**30%**
4	Expected output	10%
5	Timely Submission	10%
6	Answer to sample questions	10%
	Total (25 Marks)	100%

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 7: Work in Codenvy to show Provisioning and Scaling of a website

I Practical Significance

To create a workspace platform for cloud-based development using Codenvy and demonstrate provisioning and scaling of a website.

II Industry/Employer Expected outcome(s)

Manage Cloud based services.

III Course Level Learning outcome(s)

CO3 - Maintain storage system and services in Cloud.

IV Laboratory Learning outcome(s)

LLO 7.1 Create a workspace platform for development.

V Relevant Affective Domain Related Outcomes

Demonstrates curiosity and interest in exploring cloud-based development tools and environments.

VI Relevant Theoretical Background

Using a web browser on any device, developers can create, build, and debug programs using Codenvy, a cloud-based integrated development environment (IDE). It facilitates automatic provisioning, collaborative coding, and application and development workspace capacity.

➔ Procedure:

1. Sign Up / Log In to Codenvy

- Navigate to https://www.eclipse.org/codenvy/ after opening the browser.
- Click on Get Started or Sign Up and create a free account or log in if you already have one.

2. Create a New Workspace

- After logging in, click on Create Workspace.
- Choose a stack/template (e.g., Node.js, Java, Python) for your project.
- Name your workspace (e.g., MyFirstWorkspace) and click Create.

3. Explore the IDE

- The online IDE interface will load, showing the file explorer, editor, terminal, and other tools.
- Create or upload project files (HTML, CSS, JavaScript for a simple website).

4. Provisioning the Workspace

- Click on the Run button to start the workspace environment.
- Codenvy provisions the necessary container resources automatically in the cloud.

5. Run the Application

- Use the built-in terminal to run your web application (e.g., npm start for Node.js).

- Open the preview or the application URL to see your website live.

6. Scaling (Conceptual)

- While Codenvy does not provide manual scaling options in the free tier, discuss the concept of provisioning additional containers to handle increased workload.
- Mention how enterprise solutions automate scaling by adding more workspace instances or increasing resources dynamically.

7. Stop and Delete Workspace

- After completion, stop the workspace to free cloud resources.
- Delete the workspace to clean up your account.

VII Resources required (Additional)

Sr.No	Name of Resource	Broad Specification	Quantity	Remrks(If any)
1.	Codenvy	Codenvy IDE	1	-
2.	GitHub	GitHub/Docker CLI	1	-

VIII Precautions to be followed

1. Follow precautionary measures.
2. Follow naming conventions.
3. Follow ethical practices.

IX Conclusion

……
……
……

X Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions to ensure the achievement of identified CO.

1. How do you start and stop a workspace in Codenvy?
2. Mention any challenges you faced during this practical and how you resolved them.
3. How does Codenvy provision resources for your application?

(Space for Answer)

……
……
……
……
……
……
……
……
……
……
……

……
……
……
……
……
……
……
……
……

XI References / Suggestions for further Reading

1. https://blog.codenvy.com/release-notes-codenvy-5-367a8f1dd802
2. https://www.eclipse.org/codenvy/

XII Assessment Scheme

The given performance indicators should serve as a guideline for assessment regarding process and product related marks. Faculty must fill only the table at bottom.

Performance indicators		Weightage
Process related (15 Marks)		**70%**
1	Logic formation	30%
2	Debugging ability	30%
3	Follow ethical practices	10%
Product related (10 Marks)		**30%**
4	Expected output	10%
5	Timely Submission	10%
6	Answer to sample questions	10%
	Total (25 Marks)	100%

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 8: Implement Identity Management and Access Management using OpenStack

I Practical Significance

To monitor user access and permissions in a cloud environment by implementing identity and access management (IAM) using OpenStack services.

II Industry/Employer Expected outcome(s)

Manage Cloud based services.

III Course Level Learning outcome(s)

CO4 - Apply Security in Cloud Computing.

IV Laboratory Learning outcome(s)

LLO 8.1 Implement Identity Management and Access Management using Cloud computing infrastructure.

V Relevant Affective Domain Related Outcomes

To implement Identity and Access Management (IAM) in OpenStack using Keystone service to manage users, roles, and permissions.

VI Relevant Theoretical Background

OpenStack Keystone is the identity service used for authentication and high-level authorization. It provides:

- User authentication
- Role-based access control (RBAC)
- Service catalog management

IAM in OpenStack is like user permission management. It lets admins create users, assign roles, and allow or restrict access to services like Nova, Glance, Neutron, etc.

Important terms:

- Tenant/Project: Group of users (like departments).
- Role: Defines what a user can do.
- User: Person accessing services.
- Service: OpenStack components (e.g., Nova = compute).

One essential function of cloud platforms is Identity and Access Management (IAM), which establishes who has access to what resources and how. The Keystone service, which manages user authentication, role assignments, projects (tenants), and secure access control policies, is in charge in OpenStack.

Procedure:

- Login to OpenStack Dashboard (Horizon) or access terminal as admin.

- Create a new Project (Tenant)

➔ openstack project create myproject --domain default

- Create a new User

➔ openstack user create --domain default --password-prompt myuser

- Assign Role to User in a Project

➔ openstack role add --project myproject --user myuser member

- Verify Role Assignment

➔ openstack role assignment list --user myuser --project myproject –names

- Try Logging in with the New User

➔ Open the OpenStack Horizon Dashboard in a browser.

➔ Log in with the newly created user credentials.

VII Resources required (Additional)

Sr.No	Name of Resource	Broad Specification	Quantity	Remrks(If any)
1.	OpenStack	OpenStack DevStack	1	-
2.	PC	PC with 16GB+ RAM	1	-

VIII Precautions to be followed

1. Follow precautionary measures.
2. Follow naming conventions.
3. Follow ethical practices.

IX Conclusion

……
……
……..

X Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions to ensure the achievement of identified CO.

1. Can you give an example of when role-based access would be critical in a real-world cloud system?
2. What is the purpose of the --domain flag in the user creation command?
3. Which command is used to create a user in OpenStack?
4. What is Horizon in OpenStack, and how is it used for IAM?

(Space for Answer)

……
……
……
……
……
……
……
……
……
……

……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……

XI References / Suggestions for further Reading

1. https://docs.openstack.org/newton/admin-guide/identity-management.html
2.https://docs.redhat.com/en/documentation/red_hat_openstack_platform/16.0/html/security_and_hardening_guide/identity_and_access_management

XII Assessment Scheme

The given performance indicators should serve as a guideline for assessment regarding process and product related marks. Faculty must fill only the table at bottom.

Performance indicators		Weightage
Process related (15 Marks)		**70%**
1	Logic formation	30%
2	Debugging ability	30%
3	Follow ethical practices	10%
Product related (10 Marks)		**30%**
4	Expected output	10%
5	Timely Submission	10%
6	Answer to sample questions	10%
	Total (25 Marks)	100%

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 9: Configure Server using CFEngine or any other open-source tool

I Practical Significance

To configure and automate server management tasks using CFEngine (or an equivalent configuration management tool like Ansible, Puppet, or Chef).

II Industry/Employer Expected outcome(s)

Manage Cloud based services.

III Course Level Learning outcome(s)

CO4 - Apply Security in Cloud Computing.

IV Laboratory Learning outcome(s)

LLO 9.1 Configure server for security.

V Relevant Affective Domain Related Outcomes

Manual server configuration is prone to mistakes. Configuration management tools ensure that systems remain in a consistent state.

VI Relevant Theoretical Background

CFEngine is an open-source configuration management tool that automates the configuration and maintenance of servers. It uses policy files to define desired system states and ensures systems comply with those policies.

Procedure using CFEngine:

Step 1: Install CFEngine on your system

➔ sudo apt update

wget https://cfengine.com/pub/gpg.key

sudo apt-key add gpg.key

echo "deb https://cfengine.com/pub/deb/ stable main" | sudo tee /etc/apt/sources.list.d/cfengine-community.list

sudo apt update

sudo apt install cfengine-community

Step 2: Verify installation

➔ cf-agent --version

Step 3: Create a simple policy file

➔ Create a file called hello.cf with this content:

```
body common control {
bundlesequence => { "main" };
}
bundle agent main {
reports:
"Hello from CFEngine!";
}
```

Step 4: Run the policy

➔ sudo cf-agent -f ./hello.cf

Step 5: Observe output

➔ R: Hello from CFEngine!

VII Resources required (Additional)

Sr.No	Name of Resource	Broad Specification	Quantity	Remrks(If any)
1.	CFEngine	CFEngine	1	-

VIII Precautions to be followed

1. Follow precautionary measures.
2. Follow naming conventions.
3. Follow ethical practices.

IX Conclusion

……..
……
……..

X Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions to ensure the achievement of identified CO.

1. How do you install CFEngine on Ubuntu??
2. What is the role of cf-agent?
3. How do you run a CFEngine policy file

(Space for Answer)

…..……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……

XI References / Suggestions for further Reading

1. https://cfengine.com/
2. https://www.techtarget.com/searchitoperations/feature/CFEngine-configuration-

XII Assessment Scheme

The given performance indicators should serve as a guideline for assessment regarding process and product related marks. Faculty must fill only the table at bottom.

Performance indicators		Weightage
Process related (15 Marks)		**70%**
1	Logic formation	30%
2	Debugging ability	30%
3	Follow ethical practices	10%
Product related (10 Marks)		**30%**
4	Expected output	10%
5	Timely Submission	10%
6	Answer to sample questions	10%
	Total (25 Marks)	100%

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 10: Design an application based on IoT using Arduino or Raspberry Pi.

I Practical Significance

To **design and implement an IoT-based application** using **Arduino** or **Raspberry Pi** for collecting sensor data and controlling devices.

II Industry/Employer Expected outcome(s)

Manage Cloud based services.

III Course Level Learning outcome(s)

CO5 - Use various Cloud Platforms.

IV Laboratory Learning outcome(s)

LLO 10.1 Design IoT based application.

V Relevant Affective Domain Related Outcomes

Demonstrates how sensors, microcontrollers, and networks form IoT solutions.

VI Relevant Theoretical Background

Internet of Things (IoT) is a system of interrelated devices connected via the Internet that can collect, send, and act on data. In this practical, we use a microcontroller (Arduino) or a microprocessor (Raspberry Pi) to:

- Read data from sensors.
- Process or transmit the data.
- Control actuators (like turning on an LED or fan).

This forms a basic IoT application.

⇨ Procedure (Using Arduino + DHT11 Example)

Step 1: Connect the Components Wiring for DHT11 with Arduino:

- VCC → 5V on Arduino
- GND → GND
- Data → Digital Pin 2
- (Use 10kΩ resistor between VCC and Data line if needed)

Step 2: Install Arduino IDE & Libraries

- Install Arduino IDE
- Install DHT sensor library:
  - Go to Sketch > Include Library > Manage Libraries
  - Search for "DHT sensor library" by Adafruit and install it.

Step 3: Write & Upload Code

```
#include "DHT.h"

#define DHTPIN 2     // Digital pin connected to the sensor
#define DHTTYPE DHT11   // DHT11 or DHT22

DHT dht(DHTPIN, DHTTYPE);

void setup() {
  Serial.begin(9600);
  dht.begin();
}
```

```
void loop() {
  float temp = dht.readTemperature();
  float hum = dht.readHumidity();

  if (isnan(temp) || isnan(hum)) {
    Serial.println("Failed to read from DHT sensor!");
    return;
  }

  Serial.print("Temperature: ");
  Serial.print(temp);
  Serial.print(" °C, Humidity: ");
  Serial.print(hum);
  Serial.println(" %");

  delay(2000); // Wait for 2 seconds
}
```

Step 4: View Serial Output

- Open Serial Monitor in Arduino IDE
- Observe live temperature and humidity readings

Step 5 (Optional): Send Data to Cloud Platform

- Use Wi-Fi Module (e.g., ESP8266 with Arduino or inbuilt Wi-Fi on Raspberry Pi)
- Send sensor data to cloud platforms like:
    - ThingSpeak (via HTTP)
    - Firebase
    - Blynk (for mobile control)

VII Resources required (Additional)

Sr.No	Name of Resource	Broad Specification	Quantity	Remrks(If any)
1.	Device/ Arduino	Arduino Uno / Raspberry Pi,Sensors (temperature, IR, etc.)	1	-

VIII Precautions to be followed

1. Follow precautionary measures.
2. Follow naming conventions.
3. Follow ethical practices.

IX Conclusion

……
……
……..

X Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions to ensure the achievement of identified CO.

1. What library is required to interface DHT11 with Arduino?
2. What is the role of delay(2000); in the loop?
3. What precautions do you take while powering the Arduino/Raspberry Pi?
4. Which pin did you use for sensor input, and why?

(Space for Answer)

XI References / Suggestions for further Reading

1. IoT Projects and Tutorials using Arduino, Raspberry Pi, ESP8266 & NodeMCU
2. Top 6 Smart & Simple IOT Projects 2021 Using Arduino & Raspberry Pi
3. IoT Design and Simulation - Arduino and Raspberry Pi - Proteus

XII Assessment Scheme

The given performance indicators should serve as a guideline for assessment regarding process and product related marks. Faculty must fill only the table at bottom.

Performance indicators		Weightage
Process related (15 Marks)		**70%**
1	Logic formation	30%
2	Debugging ability	30%
3	Follow ethical practices	10%
Product related (10 Marks)		**30%**
4	Expected output	10%
5	Timely Submission	10%
6	Answer to sample questions	10%
	Total (25 Marks)	100%

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 11: Design any automated application using RFID

I Practical Significance

To design and implement an automated application using RFID technology integrated with a cloud platform for data monitoring and analysis.

II Industry/Employer Expected outcome(s)

Manage Cloud based services.

III Course Level Learning outcome(s)

CO5 - Use various Cloud Platforms.

IV Laboratory Learning outcome(s)

LLO 11.1 Design Cloud based application.

V Relevant Affective Domain Related Outcomes

An automated RFID-based application that logs data to a cloud platform. This demonstrates real-time data acquisition and monitoring using IoT and Cloud Computing integration.

VI Relevant Theoretical Background

RFID (Radio Frequency Identification) is a wireless tracking system that uses radio signals to identify and track tags attached to objects. Each RFID tag contains a unique ID.

This experiment integrates RFID with a cloud platform to store and analyze data in real-time. When an RFID tag is scanned, the data (tag ID and timestamp) is sent to the cloud for logging or triggering automated actions like attendance marking or access control.

Procedure:

1. Hardware Setup:

Connect the RFID reader to the Arduino or Raspberry Pi.

Example (for Arduino + RC522):

SDA → D10
SCK → D13
MOSI → D11
MISO → D12
RST → D9
GND → GND
3.3V → 3.3V

2. Code Development:

⇨ Install necessary libraries (e.g., MFRC522, SPI) in Arduino IDE.
⇨ Write code to read tag ID.
⇨ Integrate cloud functionality using services like:

- Firebase: via ESP8266/ESP32
- ThingSpeak: via HTTP requests
- Google Sheets: via IFTTT + Webhooks

3. Sample Arduino Code Snippet (RFID Read):

```
#include <SPI.h>
#include <MFRC522.h>
```

```
#define SS_PIN 10
#define RST_PIN 9
MFRC522 rfid(SS_PIN, RST_PIN);

void setup() {
  Serial.begin(9600);
  SPI.begin();
  rfid.PCD_Init();
  Serial.println("Scan RFID tag...");
}

void loop() {
  if (!rfid.PICC_IsNewCardPresent()) return;
  if (!rfid.PICC_ReadCardSerial()) return;
  Serial.print("Tag ID: ");
  for (byte i = 0; i < rfid.uid.size; i++) {
    Serial.print(rfid.uid.uidByte[i], HEX);
  }
  Serial.println();
  delay(1000);
}
```

VII Resources required (Additional)

Sr.No	Name of Resource	Broad Specification	Quantity	Remrks(If any)
1.	IDE	Arduino IDE	1	-

VIII Precautions to be followed

1. Follow precautionary measures.
2. Follow naming conventions.
3. Follow ethical practices.

IX Conclusion

……
……
……
……
……

X Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions to ensure the achievement of identified CO.

1. Which libraries are required to work with the RC522 module in Arduino IDE?
2. How do you connect the RFID system to a cloud platform?
3. What are webhooks and how are they used to send data to Google Sheets?

(Space for Answer)

……

XI References / Suggestions for further Reading

1. https://smartmakers.io/en/rfid-anwendungen-in-verschiedenen-branchen/
2. https://how2electronics.com/rfid-technology-design-types-working-applications/

XII Assessment Scheme

The given performance indicators should serve as a guideline for assessment regarding process and product related marks. Faculty must fill only the table at bottom.

Performance indicators		Weightage
Process related (15 Marks)		**70%**
1	Logic formation	30%
2	Debugging ability	30%
3	Follow ethical practices	10%
Product related (10 Marks)		**30%**
4	Expected output	10%
5	Timely Submission	10%
6	Answer to sample questions	10%
	Total (25 Marks)	100%

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	