RQF LEVEL 5

Cloud Computing Services

TRAINER'S MANUAL

CLOUD COMPUTING SERVICES

2024

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This training manual was developed:

TABLE OF CONTENT

ACRONYMS

AWS: Amazon Web Services

AZ: Availability Zone

CAPTCHA: Complete Automated Public Turing Computers Humans Apart.

CDN: Content Delivery Network

CEO: Chief Executive Officer

CPU: Central Processing Unit

CSA: Computer System and Architecture

CSPM: Cloud Security Posture Management

DLP: Data Loss Prevention

EBS: Elastic Block Store

EC2: Elastic Compute Cloud

ELB: Elastic Load Balancer

GCP: Google Cloud Platform

GCS: Google Cloud Service

GRC: Governance Risk Compliance

I/O: Input output

Iaas: Infrastructure as a Service

IAM: identity Access Management

IT: Information Technology

Paas: Platform as a Service

PAYG: Pay-As-You-Go

RAM: Random Access Memory

RCE: Remote Code Execution

RDS: Relational Database Service

RTB: Rwanda TVET Board

S3: Simple Storage Service

Saas: Software as a Service

SLA: Service Level Agreement

SQL: Structured Query Language

SSO: Single Sign-On

TQUM Project: TVET Quality Management Project

TVET: Technical and Vocation Education and Training

VM: Virtual Machine

VPC: Virtual Private Cloud

INTRODUCTION

This trainer's manual includes all the methodologies required to effectively deliver the module titled **"Cloud Computing Services"** Trainees enrolled in this module will engage in practical activities designed to develop and enhance their competencies.

The development of this training manual followed the Competency-Based Training and Assessment (CBT/A) approach, offering ample practical opportunities that mirror real-life situations.

The trainer's manual is organized into Learning Outcomes, which is broken down into indicative content that includes both theoretical and practical activities. It provides detailed information on the key competencies required for each learning outcome, along with the objectives to be achieved.

As a trainer, you will begin by asking questions related to the activities to encourage critical thinking and guide trainees toward real-world applications in the labor market. The manual also outlines essential information such as learning hours, didactic materials, and suggested methodologies.

This manual outlines the procedures and methodologies for guiding trainees through various activities as detailed in their respective trainee manuals. The activities included in this training manual are designed to offer students opportunities for both individual and group work. Upon completing all activities, you will assist trainees in conducting a formative assessment known as the end learning outcome assessment. Ensure that trainees review the key reading and the points to remember section.

MODULE CODE AND TITLE: GENCC501 CLOUD COMPUTING SERVICES

Learning Outcome 1: Create Cloud Computing Account
Learning Outcome 2: Manage Cloud Computing Resources
Learning Outcome 3: Perform Maintenance
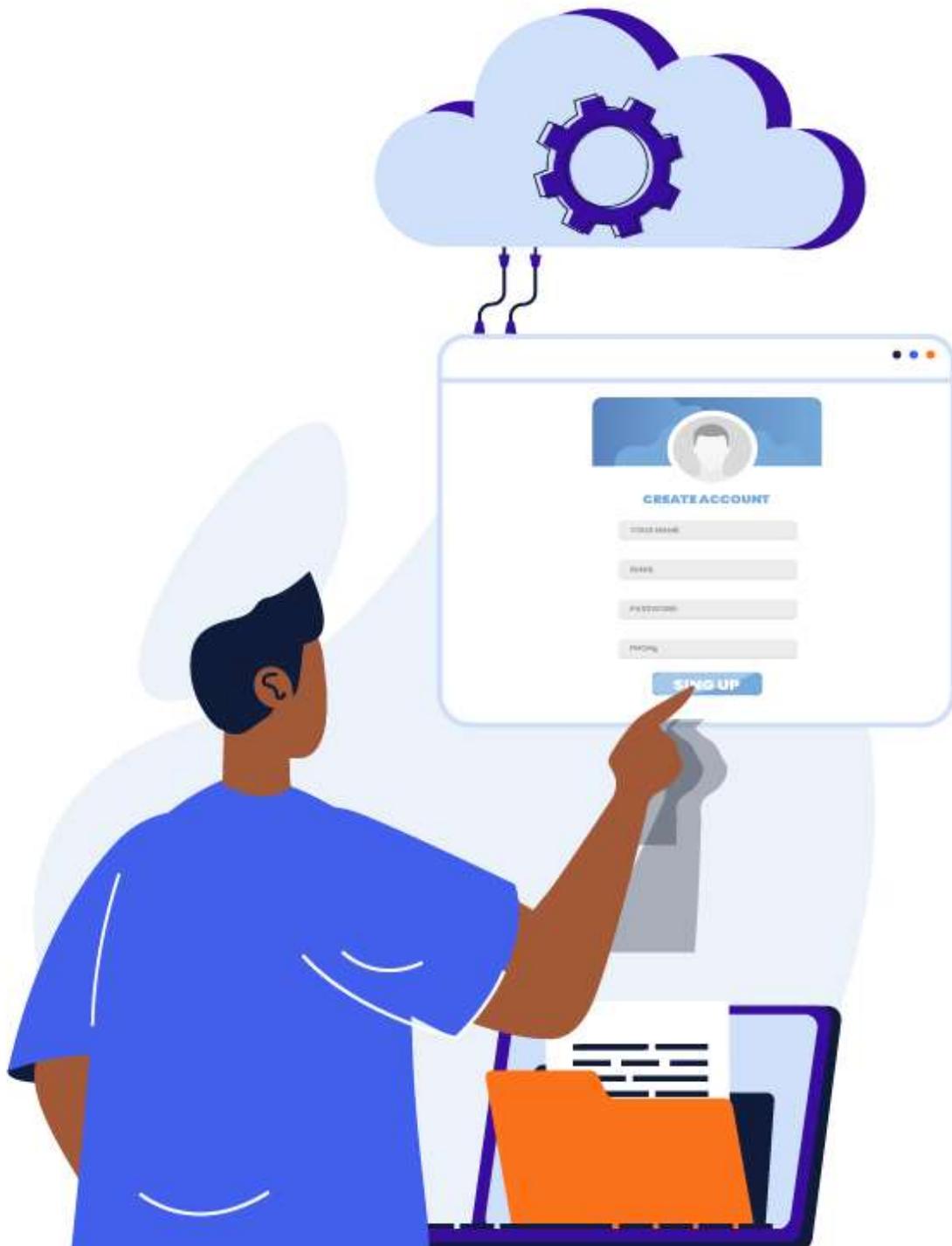
Indicative contents
1.1 Selection of Cloud Computing Services Models
1.2 Selection of Cloud Computing Service Provider
1.3 Management off Customer's Account

Key Competencies for Learning Outcome 1: Create an Account with Cloud Service Providers.

Knowledge	Skills	Attitudes
• Description of cloud computing service models. • Description of Service Level Agreement • Description of cloud computing service providers. • Description of customer's account in cloud computing. • Description of Identity and Access Management (IAM)	• Selecting cloud computing service providers. • Creating customer's account on cloud computing. • Creating Identity and Access Management (IAM). • Performing Backup and Disaster Recovery	• Being passionate • Being attentive • Being creative. • Being innovative. • Having critical thinking skills.

Duration: 15 hrs

Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe correctly cloud computing service models as used in cloud computing.

2. Describe clearly Service Level Agreement in cloud computing.

3. Describe effectively cloud computing service providers based on Service Level Agreement.

4. Select appropriately cloud computing service providers based on Service Level Agreement.

5. Describe clearly customer's account in cloud computing.

6. Create correctly customer's account in cloud computing

7. Create correctly Identity and Access Management (IAM) based on service deployment models and user needs.

8. Perform effectively backup and disaster recovery of resources as used in cloud computing.

Resources

Equipment	Tools	Materials
● Computers	● Web browser	● Internet connection

Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Avail computer lab with Internet connection.
- Avail valid Email address
- Avail valid credit or Visa card number

Indicative content 1.1: Selection of Cloud Computing Models

 Duration: 4 hrs

 Theoretical Activity 1.1.1: Description of Cloud Computing Service Models.

 Notes to the trainer:

- Trainer may use small groups of trainees to describe cloud computing service models.

 Key steps:

Step 1: As a trainee in Computer System and architecture, you are tasked to answer the following questions regarding the description of cloud computing models:

    i.   What do you understand by cloud computing?

    ii.   What do you understand by service model in cloud computing services?

    iii.   Discuss the following cloud computing service models:

        a) Infrastructure as a Service (IaaS)

        b) Platform as a Service (PaaS)

        c) Software as a Service (SaaS)

    iv.   Discuss the following criteria for selecting cloud computing service models:

        a) User needs

        b) Pricing

        c) Operation

Step 2: Ask trainees to write the answers and monitor group activities.

Step 3: Ask trainees to present their findings to the trainer or to the whole class.

Step 4: Provide an expert view and clarification where necessary.

Step 4: Ask trainees to read key readings 1.1.1 in their manuals.

 Points to Remember

- **Cloud computing** is defined as the delivery of computing services, such as servers, storage, databases, networking, software, and analytics, over the internet (the cloud).

- **Cloud service model** refers to the different ways or methods in which cloud computing services can be provided to customers or organizations.
- Common **cloud computing service models** include Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).
- **Cloud computing service model** are selected based on the user needs, pricing, and operation.
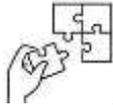
Application of learning 1.1

There is a local business that needs to set up a small e-commerce website for its businesses. The website will have basic functionality, including product listings, a shopping cart, and an order processing system. The business owner has heard about cloud computing and wants to know how it can benefit their website. The business owner is looking for an IT who can explain topics clearly to assist him in making decision to move his website to the cloud computing services. As an IT in cloud computing services, assist him to answer the following questions:

1. Explain the following terms:
    i. Cloud computing
    ii. Cloud computing service model

2. Explain three different cloud computing service models.

3. Explain the criteria you can be based on for selecting cloud computing model.

Solution:

The main point to check	Yes	No
1. Cloud computing is clearly defined		
2. Cloud computing service model is well defined		
3. Cloud computing service models are properly described		
4. Criteria of selecting cloud computing service model are properly described		

Indicative content 1.2: Selection of Cloud Computing Service Provider

Duration: 4hrs

Theoretical Activity 1.2.1: Description of Service Level Agreement

Notes to the trainer:

● Trainer may use small groups of trainees to describe service level agreement.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: As a trainee in Computer System and Architecture, you are tasked to answer the following questions regarding the description of service level agreement:

  i.   What do you understand by service level agreement?
  ii.   What are the components of service level agreement?
  iii. Discuss the types of service level agreement
  iv.   Discuss the benefits of service level agreement

Step 2: Ask trainees to write the answers and monitor group activities.

Step 3: Ask trainees to present their findings to the trainer or to the whole class.

Step 4: Provide an expert view and clarification where necessary.

Step 5: Ask trainees to read key readings 1.2.1 in their manuals.

Points to Remember

- **Service level agreement (SLA)** is defined as the bond for performance negotiated between the cloud services provider and the client.
- **Components of service level agreement**
  1. Service Definition
  2. Performance Metrics
  3. Service Credits
  4. Reporting and Monitoring
  5. Dispute Resolution
  6. Term and Termination

7. Confidentiality
8. Force Majeure

- **Types of service level agreement**
    1. Basic SLA
    2. Tiered SLA
    3. Customized SLA
    4. Financial SLA
    5. Operational SLA
    6. Hybrid SLA
- **Benefits of service level agreement**

I. **For Cloud Service Providers:**
1. Improved Service Quality
2. Risk Mitigation
3. Competitive Advantage

II. **For Cloud Customers**
1. Guaranteed Service Quality
2. Reduced Risk:
3. Cost Control
4. Legal Protection

Theoretical Activity 1.2.2. Description of cloud computing service providers

Notes to the trainer:

- Trainer may use small groups of trainees to describe cloud computing service providers.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: As a trainee in Computer System and architecture, you are tasked to answer the following questions regarding the description of service level agreement:

    i. Define cloud computing service provider as defined in cloud computing services

    ii. Discuss the types of cloud computing service provider

    iii. Discuss advantages and disadvantages of cloud computing service provider

    iv. Discuss the following criteria for selecting a cloud computing service provider:

      a. user needs

      b. pricing

      c. operations

Step 2: Ask trainees to write the answers and monitor group activities.

Step 3: Ask trainees to present their findings to the trainer or to the whole class.

**Step 4:** Provide an expert view and clarification where necessary.

Step 5: Ask trainees to read key readings 1.2.2 in their manuals.

Points to Remember

- **Cloud computing service providers** refer to the companies that deliver cloud computing services over the internet.
- **Types of cloud computing service provider**
  1. Public Cloud Providers
  2. Private Cloud Providers
  3. Hybrid Cloud Providers
  4. Multi-Cloud Providers
  5. Community Cloud Providers
- **Advantages of cloud computing service provider**
  1. Scalability
  2. Cost-Effectiveness
  3. Flexibility:
  4. Efficiency:
  5. Innovation
  6. Accessibility
- **Disadvantages of cloud computing service provider**
  1. Dependency
  2. Security Concerns
  3. Vendor Lock-in:
  4. Control and Customization
  5. Internet Connectivity
- **Criteria for selecting cloud computing service model** are User needs, cost and operations

Practical Activity 1.2.3: Selecting Cloud Computing Service Provider based on the SLA

Notes to the trainer

● This activity should take place in the computer lab with internet connection where trainees should select cloud computing service provider.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to read the task:

As a trainee from Computer System Architecture, you are asked to select a cloud service provider based on the Service Level Agreement in computer lab.

Step 2: Explain the task and provide clear working instructions that will be followed.

Step 3: Demonstrate how to select cloud service provider based on the Service Level Agreement. While demonstrating, explain each step.

Step 4: Ask trainees to select cloud service provider based on the SLA and monitor them.

Step 5: Verify whether the cloud service provider is selected based on the SLA and provide clarification if any.

Step 6: Ask trainees to read the key readings 1.2.2 in their manuals.

Points to Remember

Steps for selecting cloud providers through their SLAs include:

1. Identification Your Requirements
2. Review the SLA Terms
3. Assess Compliance & Security Commitments
4. Evaluation of Performance Metrics
5. Review Legal and Termination Clauses
6. Compare SLAs across Providers
7. Negotiate SLA Terms
8. Monitor SLA Performance

Application of learning 1.2

You are the IT manager of a mid-sized e-commerce company, TechMath, which is planning to migrate its infrastructure to the cloud. Your company relies heavily on a 24/7 online storefront with high traffic during seasonal sales. As the IT manager, you are requested to select the best cloud computing service provider based on their SLA after navigating to the different cloud service providers websites.

Checklist:

Criteria	Indicators	Observation	
		Yes	**No**
Cloud Computing Service Provider is well selected based on SLA.	Availability & Uptime is considered		
	Data Security & Compliance are considered		
	Performance metrics are evaluated		
	Support & Response Times are considered		
	Legal and Termination Clauses are reviewed		
	SLAs Across Providers are compared		
	Negotiation on SLA Terms is evaluated		

Indicative content 1.3: Management of Customer's Account

Duration: 7hrs

Theoretical Activity 1.3.1: Description of Customer's Account

Notes to the trainer:

● Trainer may use small groups of trainees to describe customer's account.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: As a trainee in Computer System and architecture, you are tasked to answer the following questions regarding the description of customer's account:

i. Discuss types of customer's account in cloud computing.
ii. Explain usage and billing in cloud computing.
iii. Discuss security and access control in cloud computing.

Step 2: Ask trainees to write the answers and monitor group activities.

Step 3: Ask trainees to present their findings to the trainer or to the whole class.

Step 4: Provide an expert view and clarification where necessary.

Step 5: Ask trainees to read key readings 1.3.1 in their manuals.

Points to Remember

● **Types of customer's account:** Free Tier Account, Pay-As-You-Go (PAYG), Prepaid or Reserved Instances, Enterprise or Business, Developer and Educational, Trial or Promotional

● **Usage and billing** in cloud computing are key components that determine how customers are charged for the services they use**.** The primary criterion that impact billing include: Compute Power, Storage, Data Transfer (Bandwidth), Networking Services, and Database Services.

● **Security and access control** in cloud computing refers to the components to protect data, applications, and services from unauthorized access**.** It includes

Shared Responsibility Model, Identity and Access Management (IAM), Data Protection and Encryption, Network Security, etc

Practical Activity 1.3.2: Creating cloud computing account

Notes to the trainer

- This activity should take place in the computer lab with internet connection where trainees should create cloud computing accounts.
- Avail one of the cloud computing service provider's platform such as Amazon Web Service (AWS), Microsoft Azure, Google Cloud Service (GCS), etc.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to read the task:

As a trainee from Computer System Architecture, you are asked to create customer's account on Amazon Web Services (AWS) in computer lab.

Step 2: Explain the task and provide clear working instructions that will be followed.

Step 3: Demonstrate how to create customer's account on Amazon Web Services (AWS). While demonstrating, explain each step.

Step 4: Ask trainees to create customer's account on Amazon Web Services (AWS) and monitor them.

Step 5: Verify whether the customer's account is well created and provide clarification if any.

Step 6: Ask trainees to read the key readings 1.3.2

Points to Remember

- Popular cloud computing providers include AWS, GCP, and Azure.
  Steps to create account on Amazon Web Services.
    1. Go to AWS Sign Up.
    2. Click on "Create a Free Account."
    3. Enter your personal details (name, email, password).

4. Select the Free Tier option.
5. Provide payment information.
6. Verify your identity via phone.

Step 1:   Agree to the AWS terms and conditions.

Step 2:   Receive confirmation and log in to the AWS Management Console to start using AWS services.

Theoretical Activity 1.3.3: Description of Identity and Access Management (IAM)

Notes to the trainer:

● Trainer may use small groups of trainees to describe identity and access management.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: As a trainee in Computer System and architecture, you are tasked to answer the following questions regarding the description of identity and access management (IAM):

  i. Define Identity and Access Management (IAM)
  ii. Discuss the components of IAM.
  iii. Discuss the benefits of IAM.

Step 2: Ask trainees to write the answers and monitor group activities.

Step 3: Ask trainees to present their findings to the trainer or to the whole class.

Step 4: Provide an expert view and clarification where necessary.

Step 5: Ask trainees to read key readings 1.3.3 in their manuals.

Points to Remember

● **Identity and Access Management (IAM)** refers to policies, processes, and technologies used to manage and control digital identities and regulate who has access to what resources within an organization.

● **Components of IAM** include Identification, authentication, authorization, and accountability.

- **Benefits of IAM** include security, efficiency, compliance, and user experience.

Practical Activity 1.3.4: Creating Identity and Access Management (IAM)

Notes to the trainer

- Avail computers with Internet connection.
- Trainees should have cloud computing services accounts created.
- Avail sample videos or images to be used as didactic materials.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to read the task:

As a trainee from Computer System Architecture, you are asked to create Identity and Access Management on Amazon Web Services (AWS) in computer lab.

Step 2: Explain the task and provide clear working instructions that will be followed.

Step 3: Demonstrate how to create IAM's account on Amazon Web Services (AWS). While demonstrating, explain each step.

Step 4: Ask trainees to create IAM's account on Amazon Web Services (AWS) and monitor them.

Step 5: Verify whether the IAM's account is well created and provide clarification if any.

Step 6: Ask trainees to read the key readings 1.3.4 in their manuals.

Points to Remember

- **Steps to Create IAM User in AWS.**
  1. Login to AWS Management Console and Navigate to IAM
  2. Click on Users in the IAM Dashboard
  3. Click Add user
  4. Fill Up the Details
  5. Provide Required Permission to the User
  6. Add a tag to your user(Optional)
  7. Review User Details and Click Create user
  8. Login as IAM User (Actual IAM user will do this)

Practical Activity 1.3.5: Performing Backup and Disaster Recovery

Notes to the trainer

● This activity should take place in the computer lab

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the topic and ask trainees to perform the following task:
As a trainee from Computer System Architecture, you are asked to create an on-demand backup job of an Amazon EC2 instance. Then, you will use a backup plan to protect EC2 resources in computer lab.

Step 2: Provide instructions that will be followed.

Step 3: Demonstrate how you can perform backup and disaster recovery. While demonstrating, explain the steps.

Step 4: Ask trainees to perform the task of can creating an on-demand backup job of an Amazon EC2 instance and protecting EC2.

Step 5: Verify whether the tasks are clearly performed

Step 6: Ask trainees to read the key readings 1.3.5 in their manuals.

Points to Remember

● Steps to create an on-demand backup job of an Amazon EC2 instance and protect EC2.

1. Login into AWS account
2. Go to the AWS Backup console.
3. Configure an on-demand AWS Backup job of an Amazon EC2 instance.
4. Configure an automatic AWS Backup job of an Amazon EC2 instance.
5. Restore an Amazon EC2 instance using AWS Backup.

Theoretical assessment

I.   **Circle the letter corresponding to the correct answer.**

1. **What is the primary characteristic of cloud computing?**

    A) Running applications on a local computer

    B) Delivering computing services like servers, storage, databases, and software over the internet

    C) Building physical servers for data storage

    D) Running applications without any network connection

Answer: B) Delivering computing services like servers, storage, databases, and software over the internet

2. **Which of the following is NOT a typical service model of cloud computing?**

    A) Infrastructure as a Service (IaaS)

    B) Platform as a Service (PaaS)

    C) Hardware as a Service (HaaS)

    D) Software as a Service (SaaS)

Answer: C) Hardware as a Service (HaaS)

3. **What is the key feature of the Infrastructure as a Service (IaaS) model?**

    A) Provides access to fully developed software applications over the internet

    B) Offers virtualized computing resources like servers, storage, and networking

    C) Allows developers to build applications without managing the underlying infrastructure

    D) Delivers end-user applications that run directly on customer devices

Answer: **B) Offers virtualized computing resources like servers, storage, and networking**

4. **In the Platform as a Service (PaaS) model, what is the primary service provided?**

    A) Direct access to hardware resources such as CPU and memory

    B) A platform that allows developers to build, test, and deploy applications

    C) Pre-installed business applications for end users

    D) Unlimited data storage for large enterprises

Answer: **B) A platform that allows developers to build, test, and deploy applications**

5. **Which of the following best describes Software as a Service (SaaS)?**

    A) It provides users with software applications hosted and managed by a service provider

    B) It gives users access to virtual machines and storage to run their applications

    C) It allows users to develop and test applications on a cloud platform

    D) It delivers networking and firewall services to users

Answer: **A) It provides users with software applications hosted and managed by a service provider**

II. Fill-in-the-blank space the correct words from choices

1. When creating an account on a cloud service platform, it is essential to set up _____ to add an extra layer of security. (Password hint, Two-factor authentication, CAPTCHA, Secret question)

    Answer: b) Two-factor authentication

2. During the account creation process, you will typically need to provide a valid _____ to receive account notifications and verification links. (Username, Credit card number, Email address, Physical address)

    Answer: Email address

3. Cloud providers may require users to agree to the _____ before completing the account setup to outline the terms of service. (Service Level Agreement (SLA), Privacy Policy, Acceptable Use Policy, License Agreement)

Answer: Service Level Agreement (SLA)

4. For pay-as-you-go cloud services, you typically need to provide _____ information during account registration for billing purposes. (Contact, Technical, Payment, Identity)

Answer: Payment

Practical assessment

Your company, is an online retailer, is migrating its IT infrastructure to the cloud computing services to improve scalability, security, and disaster resilience. You are assigned to set up a cloud environment that meets the company's needs. The goals are to:

1. After evaluating different cloud computing service providers based on their SLAs, select the best one to work with.
2. Create a cloud account on the selected cloud service provider.
3. Create Identity and Access Management (IAM) users to ensure secure and controlled access.
4. Set up a robust backup and disaster recovery plan to ensure business continuity in case of failure.

Checklist

SN	Criteria	Indicators	Observation	
			Yes	No
1	Cloud computing service provider is appropriately selected.	1.1 Availability & Uptime is considered		
		1.2 Data Security & Compliance are considered		
		1.3 Performance metrics are evaluated		
		1.4 Support & Response Times are considered		
		1.5 Legal and Termination Clauses are reviewed		
		1.6 SLAs Across Providers are compared		
		1.7 Negotiation on SLA Terms is evaluated		
2	Cloud computing account is well	2.1 AWS website is visited.		
		2.2 Personal or Business Information is		

	created	provided		
		2.3 Billing Information is provided		
		2.4 Contact information is provided		
		2.5 Payment method is provided		
		2.6 Security Setup is performed		
		2.7 Identity Verification is done		
3	IAM setup is correctly configured	3.1 IAM User is created.		
		3.2 IAM Group is created		
		3.3 IAM Role creation is set		
		3.4 Policy Creation is set		
4	Backup and disaster recovery is properly implemented	4.1 The services used with AWS Backup are configured.		
		4.2 On-demand backup job of an Amazon EC2 instance is created.		
		4.3 A backup plan for an Amazon EC2 instance is configured		
		4.4 Amazon EC2 instance using AWS Backup are restored.		

 Further information to the trainer

Books

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Learning Outcome 2: Manage Cloud Computing Resources

Key Competencies for Learning Outcome 2: Manage Cloud Computing Resources

Knowledge	Skills	Attitudes
• Description of cloud resources. • Description of assessment of Requirements for cloud computing resources provisioning. • Description of scaling strategies • Identification of cloud monitoring tools • Description of Cloud resources utilization optimization. • Description of cloud environment security measures.	• Performing cloud resources provisioning (selection &configure) • Deprosioning cloud resources. • Applying monitoring tools. • Applying Cloud resources utilization optimization	• Being passionate • Having patience • Being creative • Being Innovative • Being attentive

Duration: 20hrs

Learning outcome 2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe appropriately cloud resources as used in cloud computing services.
2. Describe appropriately the assessment of requirements for cloud computing resources provisioning as used in cloud computing services.
3. Perform effectively selection of cloud resources provisioning based on cloud computing resources.
4. Configure correctly cloud resources provisioning as used in cloud computing services.
5. Perform correctly cloud resources deprovisioning as used in cloud computing services.
6. Describe clearly scaling strategies based on cloud resources as used in cloud computing services.
7. Identify accurately cloud monitoring tools as used in cloud computing services.
8. Apply correctly cloud monitoring tools as used in cloud computing services.
9. Description of Cloud resources utilization optimization.
10. Apply correctly Cloud resources utilization optimization as used in cloud services.
11. Describe effectively the cloud environment security measures as used in cloud services.

Resources

Equipment	Tools	Materials
● Computer	● Browser ● Cloud computing service provider Credentials	● Internet connection

Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Avail computer lab with Internet connection.
- Avail cloud computing service provider's credentials.

Indicative Content 2.1: Provisioning Cloud Resources

Duration: 5hrs

Theoretical Activity 2.1.1: Description of Cloud Resources

Notes to the trainer:

- Trainer may use small groups of trainees to describe cloud resources.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: As a trainee in Computer System and architecture, you are tasked to answer the foll
owing questions regarding the description of cloud computing resources:
  i. Define cloud-computing resources
  Ii. Discuss the types of cloud computing resources.

Step 2: Ask trainees to write the answers and monitor group activities.

Step 3: Ask trainees to present their findings to the trainer or to the whole class.

Step 4: Provide an expert view and clarification where necessary.

Step 5: Ask trainees to read key readings 2.1.1 in their manuals.

Points to Remember

- **Cloud computing resources** refer to the various types of computational services, infrastructure, and tools provided over the internet that allow users to access and utilize computing power, storage, and software without owning physical hardware.

- **Types of cloud computing resources** include compute resources (like VMs CPU and memory), storage resources (like disk space), and network resources (like bandwidth), database services, application and software services, and security resources.

Theoretical Activity 2.1.2: Description of Assessment of Requirements for cloud resources provisioning

Notes to the trainer:

● Trainer may use small groups of trainees to describe the assessment of requirements for cloud resources provisioning.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: As a trainee in Computer System and architecture, you are tasked to answer the following questions regarding the description of the assessment of requirements for cloud resources provisioning:

i. What is the role of the assessment of requirements for cloud resource s provisioning?

ii. Discuss the key factors for the assessment of requirements for cloud r esources provisioning.

Step 2: Ask trainees to write the answers and monitor group activities.

Step 3: Ask trainees to present their findings to the trainer or to the whole class.

Step 4: Provide an expert view and clarification where necessary.

Step 5: Ask trainees to read key readings 2.1.2 in their manuals.

Points to Remember

● Role of Assessing the requirements for cloud resources provisioning

is a critical step in ensuring that you allocate the right amount of resources to meet performance, cost, scalability, and security needs.

● Key Factors to consider while Assessing Requirements for Cloud Resources Provisioning include type of Workload, Compute Resource Requirements, Storage Requirements, Network and Connectivity, Security and Compliance, Cost Constraints, Scalability and Availability.

Practical Activity 2.1.3: Selection of cloud resources

Notes to the trainer

● This activity should take place in the computer lab with Internet connection where trainees should   select cloud resources.

● Avail one of the cloud computing service provider's platform such as Amazon Web Service (AWS), Microsoft Azure, Google Cloud Service (GCS), etc.

Key steps: :

While delivering this activity, pass through the following steps:

Step 1:   Introduce the topic and ask trainees to perform the following task:

As a trainee from Computer System Architecture, you are asked to select cloud resources in computer lab on the AWS.

Step 2: Provide instructions that will be followed.

Step 3: Demonstrate how you can select cloud resources. While demonstrating, explain each step.

Step 4: Ask trainees to perform the task of selecting cloud resources.

Step 5: Verify whether the tasks are clearly performed

Step 6: Ask trainees to read the key reading 2.1.3 in their manuals.

Points to Remember

● **Steps for Selecting cloud resources**

  1. Go to AWS Console at https://console.aws.amazon.com/
  2. In the TOP Navigation Pane, click Resource Groups Dropdown
  3. Click Tag Editor
  4. Select all regions from the dropdown. Then we can select actual resources which we want to search or we can also click on individual resources.

2.1.4: Configuring cloud resources

Notes to the trainer

● This activity should take place in the computer lab with internet connection where trainees should configure cloud computing resources.

● Avail one of the cloud computing service provider's platform such as Amazon Web Service (AWS), Microsoft Azure, Google Cloud Service (GCS), etc.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to read the task:

As a trainee from Computer System Architecture, you are asked to configure cloud computing resources on Amazon Web Services (AWS) in computer lab.

Step 2: Explain the task and provide clear working instructions that will be followed.

Step 3: Demonstrate how to configure cloud resources on Amazon Web Services (AWS). While demonstrating, explain each step.

Step 4: Ask trainees to configure cloud computing resources on Amazon Web Services (AWS) and monitor them.

Step 5: Verify whether the resources are well configured and provide clarification if any.

Step 6: Ask trainees to read the key readings 2.1.4 in their manuals

Points to Remember

- **Steps involved to configure cloud resources include:**
  1. Configure Virtual Machines (VMs)
  2. Configure Storage Resources
  3. Configure Networking Resources
  4. Configure managed Databases (e.g., Amazon RDS, Azure SQL, Google Cloud SQL)

Practical Activity 2.1.5: Applying cloud resources deprovisioning

Notes to the trainer

- This activity should take place in the computer lab with internet connection where trainees should apply deprovisioning of cloud computing resources.
- Avail one of the cloud computing service provider's platform such as Amazon Web Service (AWS), Microsoft Azure, Google Cloud Service (GCS), etc.

Key steps:

While delivering this activity, pass through the following steps:

Step 1:   Introduce the activity and ask trainees to read the task:
As a trainee from Computer System Architecture, you are asked to apply the deprosioning of cloud computing resources on Amazon Web Services (AWS) in computer lab.

Step 2:   Explain the task and provide clear working instructions that will be followed.

Step 3:   Demonstrate how to apply the deprovisioning of cloud computing resources on Amazon Web Services (AWS). While demonstrating, explain each step.

Step 4:   Ask trainees to apply the deprovisioning of cloud recources on Amazon Web Services (AWS) and monitor them.

Step 5:   Verify whether the cloud resources are well deprovisioned and provide clarification if any.

Step 6:   Ask trainees to read the key readings 2.1.5 in their manuals

Points to Remember

- **Deprovisioning cloud resources** is a step in cloud management to ensure cost optimization, free up unnecessary resources.
- **Steps to deprovision cloud resources** include:
    1. Identify Resources to Deprovision,
    2. Terminate Compute Resources
    3. Delete Unused Storage Resources
    4. Tear Down Virtual Networks (VPC)
    5. Delete Unused Databases

Application of learning 2.1.

You are assigned to deploy a high-availability web application on AWS. The application needs to run across multiple Availability Zones (AZs) to ensure uptime in case of hardware or network failure. The application should automatically scale up during traffic points and scale down during off-peak times.

You are required to Select cloud resources, configure those resources, and preform the deprovisioning unnecessary cloud resources.

Checklist

SN	Criteria	Indicators	Observation	
			Yes	No
1	Cloud computing resources are correctly selected.	1.1 Virtual Machines (VM) is selected.		
		1.2 Block Storage like AWS EBS is selected.		
		1.3 Auto Scaling Configured		
		1.4 EC2 instance type such as t2 is configured.		
2	Cloud resources are well configured	2.1 Operating System (OS) is configured to EC2 instance type		
		2.2 Auto Scaling Group policies are configured		
		2.3 Elastic Block Store (EBS) volumes are configured		
3	Cloud resources deprovisioning is well performed	3.1 Auto Scaling Group Termination Policies		
		3.2 EBS volumes attached to EC2 instances are deleted		
		3.3 Unused EC2 instances are deleted		

Indicative content 2.2: Monitoring Cloud Resources

Duration: 8 hrs

Theoretical Activity 2.2.1: Identification of cloud monitoring tools.

Notes to the trainer:

● Trainer may use small groups of trainees to identify cloud monitoring tools.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Involve trainees to formulate groups.

i. As a trainee in Computer System and architecture, you are tasked to answer the following questions regarding cloud computing tools monitoring:

a) Define cloud-monitoring tools
b) Discuss Digital Ocean monitoring and uptime
c) Discuss AWS Cloud watch
d) Discuss the Microsoft Azure monitor
e) Discuss the Google cloud operations

Step 2: Ask trainees to write the answers and monitor group activities.

Step 3: Ask trainees to present their findings to the trainer or to the whole class.

Step 4: Provide an expert view and clarification where necessary.

Step 5: Ask trainees to read key readings 2.2.1 in their manual

Points to Remember

● **Digital Ocean monitoring and uptime** are set of built-in monitoring tools to track the performance of Droplets (VMs), databases, and Kubernetes clusters.
● **CloudWatch:** is an essential service for monitoring, managing, and automating AWS infrastructure and applications.
● **Microsoft Azure Monitor** is a comprehensive monitoring and observability service provided by **Microsoft Azure**.

- **Google Cloud Operations** (formerly known as Stackdriver) is a comprehensive suite of tools for monitoring, managing, and debugging infrastructure and applications on **Google Cloud Platform (GCP)**

Theoretical Activity 2.2.2: Description of scaling strategies

Notes to the trainer:

- Trainer may use small groups of trainees to Describe scaling strategies.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: As a trainee in Computer System and architecture, you are tasked to answer the following questions regarding the description of scaling strategies as used in cloud computing:

  i.What is scaling strategies in terms of cloud computing?

  ii.Discuss Horizontal and vertical scaling strategies in terms of cloud computing.

Step 2: Ask trainees to write the answers and monitor group activities.

Step 3: Ask trainees to present their findings to the trainer or to the whole class.

Step 4: Provide an expert view and clarification where necessary.

Step 5: Ask trainees to read key readings 2.2.2 in their manuals.

Points to Remember

- In cloud computing, **scaling strategies** refer to the approaches used to increase or decrease cloud resources to handle changing workloads effectively.
- **Vertical Scaling (Scaling Up/Down)**
- Vertical scaling involves adding more power (CPU, RAM, storage) to an existing server or virtual machine (VM).
- **Horizontal Scaling (Scaling Out/In):**
- Horizontal scaling involves adding more instances (servers, VMs, containers) to handle increased demand.

Practical Activity 2.2.3: Applying Cloud Monitoring Tools.

Notes to the trainer

- This activity should take place in the computer lab with Internet connection where trainees should apply cloud monitoring tools.
- Avail one of the cloud computing service provider's platform such as Amazon Web Service (AWS), Microsoft Azure, Google Cloud Service (GCS), etc.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to read the task:

As a trainee from Computer System Architecture, you are asked to apply cloud-monitoring tools in computer lab on Amazon Web Services (AWS) in computer lab.

Step 2: Explain the task and provide clear working instructions that will be followed.

Step 3: Demonstrate how to apply cloud monitoring tools to set monitoring metrics. While demonstrating, explain each step.

Step 4: Ask trainees to perform the task of applying cloud monitoring tools set monitoring metrics and monitor them.

Step 5: Verify whether the application of cloud monitoring tools is well done and provide clarification if any.

Step 6: Ask trainees to read the key readings 2.2.3 in their manuals

Points to Remember

- **Cloud monitoring** involves the collection and analysis of metrics, logs, and other data points from cloud resources to detect issues, optimize performance, and ensure compliance with operational requirements.
- **Steps to set up CloudWatch Monitoring for AWS Services:**
    1. Open the CloudWatch Console in the AWS Management Console at https://console.aws.amazon.com/cloudwatch/

2. Navigate to Metrics and find the default metrics for your AWS services (e.g., EC2, RDS).
3. Use these default metrics to monitor your instances without creating custom metrics, as default metrics are free and included in basic monitoring.
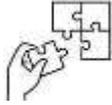
Application of learning 2.2.

MegaTech, is an online e-commerce company, is running its web application on AWS. The company uses Amazon EC2 instances, an RDS database, an Elastic Load Balancer (ELB), and an S3 bucket for static content delivery. The application is critical to the business, so maintaining uptime, performance, security, and cost efficiency is crucial. The company faces the following challenges:

Application performance degrades when there's a traffic spike; the company is facing unexpected AWS bills due to underutilized or idle resources; security is a concern as unauthorized access attempts need to be detected quickly; the operations team needs real-time insights into system health to troubleshoot issues proactively.

You are required to apply AWS CloudWatch to monitor metrics such as CPU Utilization, Memory Usage, Disk I/O & Storage, Network Traffic, Latency and Response Time and more to ensure that the application is running smoothly, stays within budget, and meets SLAs for performance and availability.

Checklist:

SN	Criteria	Indicators	Observation	
			Yes	**No**
1	Cloud monitoring tools are correctly applied.	1.1 EC2 instances with CPU, and memory usage is analysed by AWS cloud Watch.		
		1.2 Custom metrics for application such as latency, response time are analysed by AWS cloud Watch.		
		1.3 Alarms for failed login attempts are set and working.		
		1.4 Alarms for idle or underutilized resources such as EC2 instances with low CPU are set and working.		

Duration: 4 hrs

Theoretical Activity 2.3.1: Description of Cloud Resources Utilization

Notes to the trainer:

● Trainer may use small groups of trainees to identify cloud resources utilization optimization.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: As a trainee in Computer System and architecture, you are tasked to answer the foll owing questions regarding the identification of cloud resources utilization optimization:

    i. Discus strategies of cloud resources utilization optimization

    ii. Discuss best practices for cloud resources utilization optimization

Step 2: Ask trainees to write the answers and monitor group activities.

Step 3: Ask trainees to present their findings to the trainer or to the whole class.

Step 4: Provide an expert view and clarification where necessary.

Step 5: Ask trainees to read key readings 2.3.1 in their manuals.

Points to Remember

● **Cloud resource utilization optimization strategies** are right-sizing resources, using autoscaling, leveraging serverless architectures, and eliminating unused

● **Best practices of Cloud resource utilization optimization** involve applying the above methods right-sizing resources, using auto-scaling, leveraging serverless architectures, and eliminating unused resources.

Practical Activity 2.3.2: Application of cloud resources utilization

Notes to the trainer

- This activity should take place in the computer lab with Internet connection where trainees should apply cloud resources utilization optimization.
- Avail one of the cloud computing service provider's platform such as Amazon Web Service (AWS), Microsoft Azure, Google Cloud Service (GCS), etc.

Key steps:

While delivering this activity, pass through the following steps:

Step 1:   Introduce the activity and ask trainees to read the task:

As a trainee from Computer System Architecture, you are asked to apply cloud resources utilization optimization strategies on Amazon Web Services (AWS) in computer lab.

Step 2:   Explain the task and provide clear working instructions that will be followed.

Step 3:   Demonstrate how to apply cloud resources utilization optimization strategies on Amazon Web Services (AWS). While demonstrating, explain each step.

Step 4:   Ask trainees to apply cloud resources utilization optimization strategies on Amazon Web Services (AWS) and monitor them.

Step 5:   Verify whether the cloud resources utilization optimization strategies are well applied and provide clarification if any.

Step 6:   Ask trainees to read the key readings 2.3.2 in their manuals

Points to Remember

Cloud resource utilization optimization involves various strategies to maximize performance and minimize costs in cloud environments. The application cloud resources utilization optimization includes the following steps:

1. **Rightsizing Resources**: Adjust resource allocations (CPU, memory)
2. **Auto-scaling**: Automatically adjust resource levels (horizontally or vertically).

3. **Workload Scheduling**: Use cost-efficient resources like spot instances or schedule workloads during non-peak times.
4. **Containerization and Orchestration**: Utilize containers (e.g., Docker, Kubernetes) to optimize resource use and streamline deployments.

Step 1: **Monitoring and Cost Management**: Continuously monitor cloud usage and costs to identify optimization opportunities.

Step 2: **Storage Optimization**: Implement tiered storage and lifecycle policies to efficiently manage and archive data.

Step 3: **Network Optimization**: Reduce latency and costs through CDNs, load balancing, and optimized network configurations.

Step 4: **Serverless Architectures**: Use serverless models (e.g., AWS Lambda) to pay only for compute time, reducing idle resource costs.
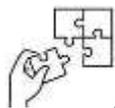
Application of learning 2.3.

Your company provides a SaaS platform that serves multiple clients with varying usage patterns. Some clients use the platform heavily during business hours, while others access it sporadically throughout the day. Despite this variation, your cloud infrastructure is over-provisioned, leading to high costs during low-usage periods. You need to optimize cloud resources to reduce costs while ensuring scalability for peak usage. Apply rightsizing, auto-scaling and Storage Optimization strategies to reduce costs while maintaining performance and scalability.

Checklist

SN	Criteria	Indicators	Observation	
			Yes	**No**
1	Cloud resources utilization optimization are effectively applied	1.1 Rightsizing Resources are performed		
		1.2 Auto-scaling is implemented		
		1.3 Storage Optimization is performed		
		1.4 Workload Scheduling is set		
		1.5 Network Optimization is done		

Indicative content 2.4: Description of Cloud Environment Security Measures

Duration: 3 hrs

 Theoretical Activity 2.4.1: Description of cloud environment security measures

 Notes to the trainer:

- Trainer may use small groups of trainees describe cloud environment security measures as used in cloud computing services.

 Key steps:

While delivering this activity, pass through the following steps:

Step 1: As a trainee in Computer System and architecture, you are tasked to answer the following questions regarding the description of cloud environment security measures as used in cloud computing services:

    i. Define security measures as used in cloud computing services.
    ii. Discuss types of security measures as used in cloud computing services.
    iii. Discuss the benefits of cloud measures as used in cloud computing services
    iv. Discuss cloud environment security Measures as used in cloud computing services

Step 2: Ask trainees to write the answers and monitor group activities.

Step 3: Ask trainees to present their findings to the trainer or to the whole class.

Step 4: Provide an expert view and clarification where necessary.

Step 5: Ask trainees to read key readings 2.4.1 in their manuals.

 Points to Remember

In cloud computing**, security measures** refer to the protocols, policies, technologies, and practices implemented to protect cloud-based systems, data, and infrastructure from unauthorized access, cyberattacks, data breaches, and other security threats.
- **Types of security measures include:**
 Physical Security, Network Security, Data security, Identity and Access Management (IAM), Application Security, Operational Security, Disaster Recovery and Business Continuity.

- **Benefits of security measures include:**

Data Protection & Privacy, Compliance with Regulatory Standards, A. Identity and Access Management (IAM), Threat Detection & Prevention, Automated Security Patching & Updates, Disaster Recovery and Backup, Centralized Security Management, Cost Efficiency

- **Cloud environment security measures include:**

Identity and Access Management (IAM), Data Encryption, Network Security

Security Information and Event Management (SIEM), Data Loss Prevention (DLP), Application Security, Automated Patching and Updates, Disaster Recovery and Business Continuity

Zero Trust Security Model, Distributed Denial of Service (DDoS) Protection, Endpoint Security, Cloud Security Posture Management (CSPM), Governance, Risk, and Compliance (GRC).
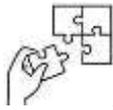
 Application of learning 2.4

A local business needs to set up a small e-commerce website for its businesses. The website will have basic functionality, including product listings, a shopping cart, and an order processing system. The business owner has heard about cloud computing and wants to know about the security of cloud environment. The business owner is looking for an IT who can assist him to answer the following questions:

1. Identify the cloud environment security measures.
2. Identify the benefits cloud environment security measures.

Solution

The main point to check	Yes	No
1. Cloud environment security measures are identified		
2. The benefits cloud environment security measures are identified		
Observation		

Written assessment

I.   **Answer by True to the correct statements and False to the wrong statements**

1. Provisioning of cloud resources refers to the process of allocating computing resources such as CPU, memory, and storage to users or applications as needed………..

   Answer: True: Cloud resource provisioning is the process of allocating resources to meet user or application demands.

2. Cloud resource provisioning only happens during the initial setup of cloud infrastructure and cannot be adjusted later…………………..

   Answer: False: Cloud resource provisioning is dynamic and can be adjusted based on changing workloads or user demands.

3. In cloud computing, provisioning refers to both the initial setup of resources and the ongoing management of those resources………………..

   Answer: True: Provisioning includes both the initial allocation and ongoing management of resources based on demand.

II.   **Circle the letters of correct answer.**

1. What is the first step in assessing the requirements for cloud resource provisioning?

   A) Setting up security protocols

   B) Evaluating workload demands and usage patterns

   C) Choosing a cloud service provider

   D) Implementing monitoring tools

Answer: B) Evaluating workload demands and usage patterns

2. Which factor is most important when determining storage requirements for cloud provisioning?

   A) The number of users accessing the system

B) The type of cloud deployment (Public, Private, Hybrid)

C) The data volume and access frequency

D) The geographical location of the cloud provider

Answer: C) The data volume and access frequency

3. When assessing compute resources for cloud provisioning, which of the following is a key consideration?

A) Network latency

B) CPU and memory requirements for applications

C) Geographic redundancy

D) Cloud provider's compliance certifications

Answer: B) CPU and memory requirements for applications

4. What is the primary purpose of cloud monitoring tools like Amazon CloudWatch?

A) To automate application deployment

B) To monitor and provide insights on resource usage, application performance, and system health

C) To provide version control for software development

D) To create virtual machines in a cloud environment

Answer: B) To monitor and provide insights on resource usage, application performance, and system health

5. Which of the following cloud monitoring tools is integrated with Microsoft Azure and used to monitor applications and infrastructure?

A) Azure Monitor

B) Prometheus

C) Kubernetes

D) Ansible

Answer: A) Azure Monitor

Practical assessment

Your company runs a web application hosted on a cloud platform that experiences unpredictable traffic spikes. The current provisioning strategy either leaves resources underutilized during low traffic periods or struggles to meet demand during peak times. Additionally, you lack visibility into real-time resource usage and performance metrics. You need to rework the cloud resource provisioning strategy, apply monitoring tools, and optimize resource utilization to improve cost efficiency and application performance.

As an IT in cloud computing services, you are required to perform the following tasks:

1. Select cloud computing resources
2. Configure cloud computing resources
3. Applying cloud resources deprovisioning
4. Apply cloud monitoring tools
5. Apply cloud resources utilization optimization.

Checklist:

SN	Criteria	Indicators	Observation	
			Yes	No
1	Cloud computing resources are effectively selected.	1.1 Virtual Machines (VM) is selected.		
		1.2 Block Storage like AWS EBS is selected.		
		1.3 Auto Scaling Configured		
2	Cloud computing resources are correctly configured	2.1 EC2 instance type such as t2 is configured.		
		2.2 Operating System (OS) is configured to EC2 instance type		
		2.3 Auto Scaling Group policies are configured		
		2.4 Elastic Block Store (EBS) volumes are configured		
3	Cloud resources deprovisioning is applied	3.1 Auto Scaling Group Termination Policies		
		3.2 EBS volumes attached to EC2 instances		

		are deleted		
		3.3 Unused EC2 instances are deleted		
4	Cloud monitoring tools are effectively applied.	4.1 EC2 instances with CPU, and memory usage is analysed by AWS cloud Watch.		
		4.2 Custom metrics for application such as latency, response time are analysed by AWS cloud Watch.		
		4.3 Alarms for failed login attempts are set and working.		
		44 Alarms for idle or underutilized resources such as EC2 instances with low CPU are set and working.		
		4.5 Rightsizing Resources are performed		
5	Cloud resources utilization optimization is effectively applied.	5.1 Auto-scaling is implemented		
		5.2 Storage Optimization is performed		

Further information to the trainer

Books:

Lachance, D. (2017) *Architecting on AWS: Redshift*. Nashua, NH: Skillsoft Ireland Limited.

Sequeira, A. (2019) *AWS Certified Solutions Architect: Associate (Saa-Co1) Cert Guide*. Indianapolis: Pearson IT Certification.

Wilkins, M. (2023) *AWS Certified Solutions Architect: Associate (SAA-C03) Cert Guide*. Harlow, England: Pearson.

Web links:

(No date a) Getting started with Amazon EC2 spot instances. Available at: https://aws.amazon.com/ec2/spot/spot-getting-started/

(No date a) Getting started with auto scaling | amazon web services. Available at: https://aws.amazon.com/autoscaling/getting-started/

GeeksforGeeks (2023) Create a windows EC2 instance and connect using RDP, GeeksforGeeks. Available at: https://www.geeksforgeeks.org/create-a-windows-ec2-instance-and-connect-using-rdp/

N, P. by A. and N, A. (2021) Move Amazon EC2 instance to another AZ, VPC or region, MSP360 Blog |. Available at: https://www.msp360.com/resources/blog/how-to-move-amazon-ec2-to-different-availability-zone-vpc-region/

	Indicative contents
	3.1 Applying Cloud Resources Backup Strategies
	3.2 Applying Patches
	3.3 Fixing Errors in Cloud Computing Services

Key Competencies for Learning Outcome 3: Apply Cloud Resources Backup Strategies

Knowledge	Skills	Attitudes
● Description of backup ● Description of patches ● Description of cloud errors	● Implementing cloud backup strategies ● Implementing different types of patches ● Applying error and fixing solutions	● Being patient ● Being innovative ● Being creative ● Being passionate ● Being attentive ● Having critical thinking.

Duration: 15hrs

Learning outcome 3 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe clearly backup as used in cloud computing services.
2. Implement properly cloud backup strategies in cloud computing.
3. Describe appropriately patches in cloud computing services.
4. Implement correctly different patches in cloud computing services.

5. Describe clearly errors occurs in cloud computing services.
6. Apply correctly solutions to fix errors in cloud computing services.

Resources

Equipment	Tools	Materials
● Computers ● Projector	● Web browser	● Internet connection

Advance Preparation:

Before delivering this learning outcome, you are recommended to:

● Avail computer lab with Internet connection.

● Avail Email address

● Avail credit card number/ Visa card number

Indicative content 3.1: Applying Cloud Resources Backup Strategies

Duration: 4 hrs

Theoretical Activity 3.1.1: Description of cloud backup

Notes to the trainer:

- Trainer may use small groups of trainees to describe cloud backup in cloud computing

Key steps:

While delivering this activity, pass through the following steps:

Step 1:   Introduce the activity and ask trainees to answer the following questions:

   i. Describe the following concepts of cloud backup

   a. What do you understand by cloud backup?
   b. Describe types of cloud backup
   c. Discuss benefits of cloud backup
   ii. Identify different backup strategies.

Step 2:   Ask trainees to write answers and monitoring group activities

Step 3:   Ask trainees to present their findings to the trainer or to the whole class.

Step 4:   Provide an expert view and clarification where necessary.

Step 5:   Ask trainees to read key readings 3.1.1 in their manuals.

Points to Remember

Cloud backup is defined as the process of storing copies of data on remote servers hosted on the internet (the "cloud").

- **Types of cloud backup** include Full backup, Incremental backup, Differential backup, Mirror Backup, Hybrid Backup, and Cloud-to-Cloud Backup.
- **Benefits of cloud backup** include Accessibility, Scalability, Reliability, Security, Cost-Effectiveness, Efficiency, and Compliance.
- **Identification of backup strategies** include Assess Your Cloud Backup Needs, Define Recovery Objectives, Evaluate Cloud Backup Methods, Consider Key Cloud Backup Features, Implement and Test, Monitor and Maintain, Backup Policies and Procedures.

Practical Activity 3.1.2: Implementing cloud backup strategies

Notes to the trainer

● This activity should take place in the computer lab where trainees should implement cloud backup strategies on cloud computing.

● Avail computer lab with Internet connection.

● Avail one of the among service providers such as AWS, Microsoft azure, Google cloud, etc

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to read the tasks:

As a Computer System Architecture trainee, you are asked to implement cloud backup strategies in computer lab

Step 2: Explain the task and provide clear working instruction that will be followed.

Step 3: Demonstrate how to implement cloud backup strategies While demonstrating, explain each step.

Step 4: Ask trainees to implement cloud backup strategies and monitor them.

Step 5: Verify whether cloud backup strategies are well implemented and Provide clarification if any.

**Step 6:** Ask trainees to read key readings 3.1.2

Points to Remember

Implementing cloud backup strategies involves deploying and configuring solutions that ensure your data is securely backed up to the cloud, and can be quickly restored when needed.

● **Steps to implement cloud backup strategies**
1. Assess Your Data Needs.
2. Select a Cloud Backup Solution.

3. Design Your Backup Plan.
4. Automate Backup Processes.
5. Implement Security Measures.
6. Regularly Test Backups.
7. Document Backup Procedures.
8. Monitor and maintain.
9. Ensure Compliance.
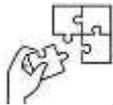
 Application of learning 3.1

You are the IT manager of a mid-sized e-commerce company, Shop Now Online, which processes hundreds of customer transactions daily. The company stores customer data, order history, payment information, and product inventories on its local servers. Recently, the company experienced a system failure due to a hardware malfunction, which led to a significant data loss and downtime.

As the IT manager of the company, you are tasked to implement cloud backup strategies to prevent future data loss and ensure business continuity.

Checklist

SN	Criteria	Indicators	Observation	
			Yes	**No**
1	Cloud backup strategies are properly impemented	1.1 Data needs are assessed.		
		1.2 Cloud backup service provider is selected.		
		1.3 Backup plan is designed.		
		1.4 Data are well encrypted		
		1.5 Backup is regularly tested		
		1.6 Backup document is well created		
		1.7 Backup is well performed		
		1.8 Backup strategies are well verified		

Indicative content 3.2: Applying Patches

Duration: 4 hrs

Theoretical Activity 3.2.1: Description of patches in cloud computing services

Notes to the trainer:

- Trainer may use small groups of trainees to describe patches in cloud computing services.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following questions:

   a) What do you understand by patch in cloud computing service?
   b) Describe types of patches in cloud computing services.
   c) Describe the working operations of patches.

Step 2: Ask trainees to write answers and monitoring group activities.

Step 3: Ask trainees to present their findings to the trainer or to the whole class.

Step 4: Provide an expert view and clarification where necessary.

Step 5: Ask trainees to read key readings 3.2.1. in manuals.

Points to Remember

- **a patch** defined as software update that fixes bugs, security vulnerabilities, or adds new features to a system**.**
- **Types of patches include** Operating System Patches, Application Patches, Firmware Patches, Security Patches, Performance Patches, Feature Updates**.**

Working operations

   1. Patch Detection and Identification

   2. Patch Management Tools

3. Patch Testing and Validation

4. Patch Deployment (Scheduling and Rollout)

5. Patch Application

6. Patch Monitoring and Compliance

7. Rollback and Recovery

Practical Activity 3.2.2:   Implementing different types of patches

Notes to the trainer

● This activity should take place in the computer lab where trainees should implement cloud backup strategies on cloud computing.
● Avail computer lab with Internet connection.
● Avail one of the among patch management service providers such as AWS, Microsoft azure, Google cloud, etc

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to read the tasks:

As a Computer System Architecture trainee, you are asked to implement different types of patches in computer lab.

Step 2: Explain the task and provide clear working instruction that will be followed.
Step 3:   Demonstrate how to implement different types of patches while demonstrating, explain each step.
Step 4: Ask trainees to implement different types of patches and monitor them
Step 5: Verify whether types of patches are well implemented.
Step 6: Ask trainees to read key readings 3.2.2 in their manuals

Points to Remember

Security patch: Address vulnerabilities that could be exploited by attackers.

● **Steps to implement different types of patches (security patch)**
1. Identify and Assess Patch Requirements.

2. Plan and Schedule Patching.
3. Automate Patch Deployment.
4. Apply Security Patches.
5. Monitor Patch Deployment.
6. Validate Patch Installation.
7. Document and Report.
8. Review and Refine Policies.
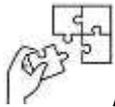
Application of learning 3.2.

You are the Security Operations Manager at a cloud service provider that hosts applications for several financial institutions. Recently, your security team received a notification about a **critical vulnerability** in the web application framework used by many of your clients' applications. This vulnerability could lead to **remote code execution (RCE)**, allowing attackers to execute malicious code on the affected servers, posing a significant risk to sensitive financial data.

As Security Operations Manager, you are requested to implement different types of patches in the cloud computing services to prevent the above stated issues.

Checklist

SN	Criteria	Indicators	Observation	
			Yes	No
1	Different patches are properly impemented.	1.1 Patch requirements are assessed		
		1.2 Patches are planned and scheduled.		
		1.3 Security patches are applied.		
		1.4 Document and report are provided.		
		1.5 Policies are reviewed.		

Indicative content 3.3: Fixing Errors on Cloud Computing Services

Duration: 7hrs

Theoretical Activity 3.3.1: Description of errors in cloud computing services

⚠ **Notes to the trainer:**

● Trainer may use small groups of trainees to describe errors in cloud computing services.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following questions:
    i. Define cloud computing service error
    ii. Describe types of errors in cloud computing services
    iii. Describe the following error fixing solutions:
    a) Automated Remediation solution
    b) Manual Troubleshooting
    c) Software Updates and Patching
    d) Scaling Resources
    e) Data Recovery and Backup Restoration
    I. Explain the following error solution Documentation
    a) Root cause of errors on cloud computing services
    b) The procedures of errors on cloud computing services
    c) The Solution on the errors in cloud computing services

Step 2: Ask trainees to present their findings to the trainer or to the whole class.
Step 3: Provide an expert view and clarification where necessary.
Step 4: Ask trainees to read key readings 3.3.1 in their manual.

Points to Remember

● A **cloud computing service error** is defined as any issue or malfunction that occurs when a cloud service is unable to perform as expected.

- **Types of cloud computing service errors** include Service Availability Error, Authentication and Authorization Errors, Resource Limits Exceeded, Configuration Errors, Service-Specific Errors.

- **Error fixing solutions** include Automated Remediation, Manual troubleshooting, Software updates and patching, Scaling resources, and Data recovery and backup restoration.

- **Error solution Documentation** include Root Cause, Procedures, Procedures, and solution

Practical Activity 3.3.2: Applying error fixing solutions

Notes to the trainer

- Avail computer lab with Internet connection.
- Avail valid email address
- Avail one of the monitoring and logging tools of service providers such as AWS, Microsoft azure, Google cloud, etc

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to read the following tasks:

As a trainee from Computer System Architecture, you are asked to apply error-fixing solutions in cloud computing services in computer lab.

Explain the task and provide clear working instruction that will be followed.

Step 2: Demonstrate how to apply error-fixing solutions in cloud computing services. While demonstrating, explain each step.

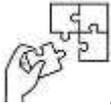**Step 3:** Ask trainees to apply error-fixing solutions and monitor them.

Step 4: Verify whether errors are fixed corrected and provide clarification if any.

Step 5: Ask trainees to read key readings 3.3.2. in their manuals

Points to Remember

- **Steps to apply errors on cloud computing services.**
    1. Identify the Error
    2. Diagnose the Cause
    3. Fix the solution

Application of learning 3.3.

As a cloud systems engineer at a growing e-commerce company, you are responsible for maintaining the company's cloud-based infrastructure hosted on a major cloud provider (AWS, Azure, or GCP). Recently, customers have reported intermittent downtime and slow performance on the website during peak hours, impacting the user experience and revenue.

As a cloud system engineer, you are required to apply error-fixing solutions to fix the above stated issues.

SN	Criteria	Indicators	Observation	
			Yes	No
1	Error fixing solutions are properly applied in cloud computing services.	1.1 Logs and Monitoring are viewed		
		1.2 Auto-scaling Misconfiguration is realized		
		1.3 Network Latency is well checked		
		1.4 Tuning Auto-scaling is well adjusted		
		1.5 Database is well optimized		
		1.6 Content delivery network is well configured		

Theoretical assessment

I. Circle the letter corresponding to the correct answer

1. The purpose of incremental backups in cloud backup services is:

    a. Back up the entire dataset each time

    b. Only back up data that has changed since the last backup

    c. Automatically restore all previous versions of data

    d. Compress and encrypt all files before uploading

Answer: **B) Only back up data that has changed since the last backup**

2. Cloud backup solutions typically store data in which of the following locations:

    a. A client's local data centre

    b. Third-party, offsite data centres managed by cloud providers

    c. External hard drives managed by IT teams

    d. On personal computers of users

Answer: **B) Third-party, offsite data centres managed by cloud providers.**

3. How does cloud computing help businesses scale their operations?

    a. Requires purchasing more servers

    b. Automatically adjusts resources based on demand

    c. Increases downtime for resource allocation

    d. Reduces flexibility in resource management

Answer: **B) Automatically adjusts resources based on demand**

4. which type of backup requires the least storage space but has the longest restore time?

    a. Full back up

    b. Differential backup

    c. Incremental backup

    d. Continuous backup

Answer: C) Incremental backup

5. Full backup in cloud computing services is:

    a. A backup that only stores changes made since the last backup

    b. A backup that copies the entire dataset, regardless of any changes

    c. A backup that stores only metadata

    d. A backup that runs continuously throughout the day

Answer: B) A backup that copies the entire dataset, regardless of any changes.

II. Match the Backup strategy in column A with its corresponding characteristics in column B and write the answers in the provided space.

Answers	Backup strategy (column A)	Characteristics (column B)
1. ……………	1.Full Backup	A. Creates a backup by copying only data that has changed since the last full backup.
2. …………	2. Incremental Backup	B. Copies all data from the system regardless of whether it has been modified.
3………….	3. Mirror Backup	C. A real-time backup that copies current data without version history or archiving.
		D. Copies single data from the system regardless of whether it has been modified

Answers:

Answers	Backup strategy (column A)	Characteristics (column B)
1. B	1.Full Backup	A. Creates a backup by copying only data that has changed since the last full backup.
2. A	2. Incremental Backup	B. Copies all data from the system regardless of whether it has been modified.
3. C	3. Mirror Backup	C. A real-time backup that copies current data without version history or archiving.
		D. Copies single data from the system regardless of whether it has been modified

III. Answer by TRUE to the correct statement or FALSE to the wrong statement

a. Cloud service providers are solely responsible for fixing all errors that occur in a cloud environment
   Answer: False
b. Monitoring and logging tools in cloud services help detect and resolve errors faster
   Answer: **True**
c. Applying security patches is an important part of fixing vulnerabilities in cloud computing
   Answer: **True**

d. Automated scaling in cloud environments can prevent performance-related errors caused by high demand
    Answer: **True**
e. Configuration errors in cloud services cannot be fixed without restarting the entire system
    Answer: **False**

VI. Fill-in-the- blank space with correct words from choices **security**, **performance**, **connectivity**, **Service Outage, Scaling**

1**.** _____ errors happen when users are unable to connect to cloud services due to issues such as network outages or incorrect configurations.

Answer: Connectivity.

2._____ error occurs when there is unauthorized access to cloud services, often due to misconfigured security policies or compromised credentials.

Answer: Security

3._____ errors refer to issues where an application or system performs slowly due to under-provisioned resources, inefficient code, or overloaded servers.

Answer: Performance

4. _____ errors occur when cloud service providers experience downtime or outages, preventing users from accessing services.

Answer: Service Outage

5. _____ errors happen when cloud applications fail to scale automatically or on-demand due to incorrect configuration of autoscaling settings.

Answer: Scaling

Practical assessment

You are the cloud operations manager for an e-commerce company that hosts its website and backend services on a cloud platform. Recently, users have experienced slow load times, especially during peak shopping hours. To perform maintenance to optimize performance and ensure system reliability without causing significant downtime for users you are required to perform the following tasks:

1. Implement Cloud backup strategies.
2. Implement different patches.
3. Apply error - fixing solutions in cloud computing services.

Checklist

SN	Criteria	Indicators	Observation	
			Yes	**No**
1	Cloud backup strategies are properly implemented	1.1 Data needs are assessed.		
		1.2 Cloud backup service provider is selected.		
		1.3 Backup plan is designed.		
		1.4 Data are well encrypted		
		1.5 Backup is regularly tested		
2	Different patches are properly impemented.	2.1 Patch requirements are assessed		
		2.2 Patches are planned and scheduled.		
		2.3 Security patches are applied.		
		2.4 Document and report are provided.		
		2.5 Policies are reviewed.		
		2.6 Logs and Monitoring are viewed		
		2.7 Auto-scaling Misconfiguration is realized		
		2.8 Network Latency is well checked		
		2.9 Tuning Auto-scaling is well adjusted		
		2.10 Database is well optimized		

Further information to the trainer

Books

Jaynes, J. (2021). *Cloud Operations: A Guide for Monitoring and Managing Public Cloud E* Jaynes, J. (2021). *Cloud Operations: A Guide for Monitoring and Managing Public Cloud Environments.* New Jersey, Hoboken , USA: John Wiley & Sons.

John Arundel, J. D. (2019). *Cloud Native DevOps with Kubernetes: Building, Deploying, and Scaling Modern Applications in the Cloud.* Sebastopol , California, USA: O'Reilly Media.

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