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Course Title:
Cloud Engineering Fundamentals

Course Description:
This course introduces the fundamental concepts, principles, and best practices of cloud engineering. Students will explore key cloud services and architectures across major providers (AWS, Azure, Google Cloud), while gaining hands-on experience in deploying, managing, and securing cloud infrastructure.

Course Level:
Intermediate (with basic knowledge of computing, data, AI and networking required)

Duration:
40 hours (lectures, hands-on labs, projects)

Course Objectives:
By the end of this course, learners will:

- Understand the foundational concepts of cloud computing and service models (IaaS, PaaS, SaaS).
- Develop practical skills for deploying and managing cloud infrastructure.
- Design scalable, reliable, and cost-effective cloud solutions.
- Implement security best practices and ensure compliance in cloud environments.
- Automate cloud resource management using Infrastructure as Code (IaaC) and CI/CD pipelines.
- Gain proficiency in cloud provider services (AWS, Azure, Google Cloud).

Module 1: Introduction to Cloud Computing

Learning Outcomes:

- Understand cloud computing concepts, deployment models (public, private, hybrid), and service models (IaaS, PaaS, SaaS).

Topics:

- What is Cloud Computing?

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- Benefits and challenges of cloud adoption.
- Overview of service models and deployment models.
- Popular cloud providers and their market share.

Hands-On Lab:

- Set up a free-tier account on AWS, Azure, or Google Cloud.
- Explore the cloud provider console and identify key services (compute, storage, networking).

Module 2: Cloud Infrastructure and Services

Learning Outcomes:

- Gain familiarity with core cloud services such as compute, storage, networking, and databases.

Topics:

- Compute services (EC2, Lambda, Azure VMs, Google Compute Engine).
- Storage services (S3, Blob Storage, Google Cloud Storage).
- Networking in the cloud (VPCs, subnets, load balancers, DNS services).
- Managed databases (RDS, DynamoDB, Azure SQL, Big Query).

Hands-On Lab:

- Launch a virtual machine in the cloud.
- Set up and configure object storage for data.
- Connect your VM to a database service.

Module 3: Architecting and Designing Cloud Solutions

Learning Outcomes:

- Design scalable, cost-effective, and highly available architectures using cloud best practices.

Topics:

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- Designing for scalability and high availability.
- Microservices and serverless architectures.
- Understanding load balancing and auto-scaling.
- Designing cost-optimized cloud solutions.

Hands-on Lab:

- Design and deploy a simple multi-tier web application.
- Set up auto-scaling policies and monitor the app's performance.

Module 4: Cloud Deployment and Automation

Learning Outcomes:

- Deploy and manage cloud resources efficiently using automation tools and Infrastructure as Code (IaaC).

Topics:

- Introduction to CI/CD pipelines.
- Overview of Infrastructure as Code (Terraform, AWS CloudFormation, Azure ARM templates).
- Configuration management (Ansible, Chef, Puppet).

Hands-on Lab:

- Create an automated deployment pipeline using GitHub Actions or Jenkins.
- Write Terraform scripts to deploy cloud resources.

Module 5: Cloud Security and Compliance

Learning Outcomes:

- Understand and implement key security practices in cloud environments.

Topics:

- Identity and Access Management (IAM) – AWS IAM, Azure Active Directory.

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- Data encryption and protection strategies.
- Security compliance (GDPR, HIPAA).
- Monitoring and incident response in the cloud.

Hands-On Lab:

- Set up IAM roles and policies for an application.
- Implement encryption for data at rest and in transit.
- Set up monitoring and alerts using AWS CloudWatch or Azure Monitor.

Module 6: Advanced Cloud Concepts

Learning Outcomes:

- Explore advanced cloud concepts and specialized services.

Topics:

- Containers and Kubernetes (Amazon EKS, Google Kubernetes Engine).
- Edge computing and IoT services in the cloud.
- Big Data and analytics services (AWS Athena, Azure Synapse, Google Big Query).
- AI/ML services (SageMaker, Azure AI, Google AI Platform).

Hands-On Lab:

- Deploy a containerized application using Kubernetes.
- Explore an AI/ML service to perform image recognition or predictive analytics.

Module 7: Hands-On Projects and Case Studies

Learning Outcomes:

- Apply your skills to real-world cloud engineering projects.

Project Options:

- Design a fault-tolerant, auto-scaling architecture for an e-commerce platform.
- Implement a serverless data pipeline using AWS Lambda, S3, and DynamoDB.

- Create a monitoring and alerting system for cloud infrastructure.

Recommended Resources:

Books:

- "Architecting the Cloud" by Michael J. Kavis
- "Cloud Native Infrastructure" by Justin Garrison and Kris Nova
- "AWS Certified Solutions Architect Official Study Guide" by Joe Baron et al.

Online Courses:

- *AWS Certified Solutions Architect* (Udemy, Coursera).
- *Microsoft Azure Fundamentals* (Microsoft Learn).
- *Google Cloud Platform Fundamentals* (Coursera).