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|------|-----------------|----------------------------------|-----------|---------|
| CUTM | CTCU2030 | Cloud Technology | 18 | 4--8--6 |
| | CUCT2030 | AWS Solution Architect (SAA-CO2) | 6 | 2+4+0 |
| | CUCT2031 | AWS Developer (DVA-CO1) | 6 | 2+4+0 |
| | CUCT2032 | Project | 6 | 0+0+6 |

Course Outline

| Code | Course Title | T-P-Pj (Credit) | Prerequisite |
|-------------|------------------------|------------------------|---------------------|
| CUCT2030 | AWS Solution Architect | 2-4-0(6) | NIL |

Objective

- To learn architectural principles and services of AWS
- Able to develop scalable and secure Cloud applications

Course outcome

- Get skills to Design and deploy scalable, highly available, and fault-tolerant systems on AWS

Course Content

Module I : Overview of AWS

(10 Hrs)

On Premise Data Center , What is Cloud Computing, Cloud Computing Offerings - Public, Private and Hybrid Cloud, AWS as the Public Cloud IaaS Leader, AWS Global Infrastructure - Regions and Availability Zones, Elastic Compute Cloud (EC2) Foundation, Create your first EC2 instance, VPC Components - Implied Router and Route Tables,Configuring VPC, IP Addressing - Internet Gateway - Subnet Types, VPC - Network ACLs and Security Groups, Configuring Security groups and NACL, VPC Security Scenarios - Applying Security Group and NACLs, VPC - Network Address Translation – NAT

Practice:

- Launching an EC2 instance
- Configuring Security groups and NACL
- IP Addressing
- Subnetting

Module II: Virtual Private Cloud (VPC)

(14 Hrs)

VPC Peering, Transit Gateway, VPC Virtual Private Networks (VPN), VPC Direct, Implementing AWS Direct Connect, Connect Knowledge - Direct Connect Routing and Link Aggregation Groups (LAGs), Hybrid Connectivity, AWS Direct Connect Gateway, AWS Direct Connect Limits, AWS VPC, Creating a VPC, VPC Endpoints - Gateway Endpoint, AWS VPC - VPC Gateway Endpoint, Configuring VPC gateway, Troubleshooting VPC Endpoints and gateways, AWS VPC - VPC Interface Endpoint, Egress Only Internet Gateway (for IPv6), VPC Flow log and DHCP Option Sets

Practice:

- Configuring VPC
- Troubleshooting EC2 and VPC
- Creating a VPC
- Implementing AWS Direct Connect
- Configuring VPC gateway
- Troubleshooting VPC Endpoints and gateways

Module III: Elastic Block Store, Elastic Network Interfaces

(14 Hrs)

Elastic Block Store Types, EC2 Enhanced Networking and Placement Groups, EC2 Placement Groups, EC2 Status Checks and Monitoring, EC2 Instance States, EC2 Instance Termination and Termination Protection, EC2 Instance Metadata and User, EC2 Instance Launch Modes VPC and EC2, Instance Tenancy Attribute, Elastic Compute Cloud - Elastic Network Interfaces (ENIs, Elastic Network Interface (ENI) - IP Addressing, NAT instance Source/Destination Check, Public IPv4 address auto assignment, Configuring Elastic Block Store, Monitoring and checking health of EC2 instances, Elastic Network Interface, Troubleshooting ENI, Configuring and troubleshooting with EBS

Practice:

- Configuring Elastic Block Store
- Monitoring and checking health of EC2 instances
- Configuring and troubleshooting with EBS

Module IV: Elastic Load Balancer (10 Hrs)

Introduction, How ELB works, ELB health checks, ELB Cross Zone Load Balancing, ELB Positioning - Internet-facing vs Internal ELB, Refresher for TCP IP Packet flow, ELB - Security Group and ELB - Network ACLs, ELB - Layer 4 TCP/SSL Listeners, ELB - Layer 7 HTTP/HTTPS Listeners, Attaching Elastic load balancer to instances, ELB Health check and ELB Security groups, NACL configuration, troubleshooting ELB - Application and Network

Practice:

- Attaching Elastic load balancer to instances
- ELB Health check
- ELB Security groups
- NACL configuration

- Troubleshooting ELB - Application and Network

Module V: Auto Scaling, Simple Notification Service

(10 Hrs)

Auto Scaling Components, Auto Scaling Features, Auto Scaling Availability Zone Rebalance feature, Adding/Detaching EC2 instances to/from Auto Scaling Groups, Auto Scaling and Elastic Load Balancing Service, Auto Scaling Health Checks, Simple Notification Service, SNS Notifications & Merging Auto Scaling groups, Implementing Auto Scaling, Troubleshooting Autoscaling with new EC2 instances

Practice:

- Implementing Auto Scaling
- Adding/Detaching EC2 instances to/from Auto Scaling Groups
- Auto Scaling health checks
- Simple Notification Service
- Troubleshooting Autoscaling with new EC2 instances

Module VI: AWS Elastic File System (EFS)

(16 Hrs)

Introduction to the Service and Mount Targets, AWS EFS - Use Cases, Use in On Premise Servers, Storage Classes, Pricing, AWS EFS - Data Encryption, EFS Data backup, EFS and AWS Datasync, Monitoring EFS, AWS FSx for Windows File Server - Introduction, Deployment options & Encryption, Amazon FSx - Data Protection, Backup/Restore, Access, Monitoring and Security, Amazon FSx for Lustre, Amazon EFS vs FSx for Windows vs FSx for Lustre, Creating Elastic File System, Monitoring EFS, Implementing Data Encryption, Setting up AWS FSx Windows File Server

Practice:

- Creating Elastic File System
- Monitoring EFS
- Implementing Data Encryption
- Setting up AWS FSx Windows File Server

Module VII: Elastic Map Reduce

(10 Hrs)

Amazon Elastic Map Reduce Introduction, AWS EMR - Clusters, Nodes, and deployment in an AZ, Amazon ElastiCache Introduction, Amazon ElastiCache - Caching Strategies, Amazon ElastiCache for Memcached, Amazon ElastiCache for Redis, Amazon CloudFormation, Implementing AWS EMR, Deployment in Availability Zone, Amazon ElastiCache, Amazon ElastiCache for Redis, Amazon CloudFormation

Practice:

- Implementing AWS EMR
- Deployment in Availability Zone
- Amazon ElastiCache

- Amazon Elasticache for Redis
- Amazon CloudFormation

Online Resource: <http://aws.amazon.com/training/awsacademy>
<http://aws.amazon.com/awsseducate>

Course Outline

| Code | Course Title | T-P-Pj (Credit) | Prerequisite |
|----------|---------------|-----------------|--------------|
| CUCT2031 | AWS Developer | 2-4-0(6) | NIL |

Objective

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| <ul style="list-style-type: none"> • Get skills to use resources in Cloud |
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Course outcome

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| <ul style="list-style-type: none"> • Able to develop scalable and secure Cloud applications |
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Course Content

Module I: IAM and EC2

(14 Hrs)

IAM Introduction, IAM Hands-On, EC2, Connect to SSH using Linux / Mac and Windows and Troubleshooting, Security Groups, Private vs Public vs Elastic IP, Configuring Webserver - Apache and Tomcat, Elastic Network Interfaces

ELB and ASG: High Availability and Scalability, Elastic Load Balancing (ELB), Classic Load Balancer (CLB), Application Load Balancer (ALB), Network Load Balancer (NLB), Elastic Load Balancer - Cross Zone Load Balancing, Elastic Load Balancer - SSL Certificates, Elastic Load Balancer - Connection Draining, Auto Scaling Groups - Scaling Policies

EBS and EFS: EBS Volume Types Deep Dive, EBS vs Instance Store

RDS ,Aurora and ElastiCache: AWS RDS Overview, RDS Read Replicas vs Multi AZ, RDS Encryption and Security, Aurora, ElastiCache and its Strategies

Practice:

- Launching EC2 instance and Connect to SSH using Linux / Mac and Windows

- Configuring Webserver - Apache and Tomcat
- Implementing Elastic Load Balancing
- Configuring EBS volume
- Create database using AWS Aurora

Module II: Route53

(10 Hrs)

Route 53: EC2 Setup, Route 53 - TTL, CNAME vs Alias, Routing Policy - Simple, Weighted, Latency Route 53 Health Checks, Routing Policy - Failover, Geolocation, Multi Value

VPC: VPC, Subnets, IGW and NAT, NACL, SG, VPC Flow Logs, VPC Peering, Endpoints, VPN, DX, VPC Cheat Sheet & Closing Comments, Three Tier Architecture.

AWS CLI, SDK, IAM Roles & Policies: AWS CLI Setup, Configuration on Windows and Linux, CLI Installation Troubleshooting, Using CLI - EC2, S3, IAM Roles and Policies, AWS Policy Simulator, AWS CLI Dry Run AWS CLI STS Decode, AWS EC2 Instance Metadata, AWS CLI Profiles, AWS CLI with MFA, AWS SDK, Exponential Backoff & Service Limit Increase, AWS Credentials Provider & Chain, AWS Signature v4 Signing

Practice:

- Route 53
- Create Amazon VPC
- AWS CLI Setup and Configuration on Windows and Linux
- CLI Installation Troubleshooting
- AWS CLI with MFA and AWS SDK

Module III: AWS S3

(10 Hrs)

Amazon S3: Amazon S3 - S3 Buckets and Objects, S3 Versioning and Encryption, S3 Security & Bucket Policies, S3 Consistency Model

S3 and Athena: S3 MFA Delete, S3 Default Encryption, S3 Access Logs, S3 Replication (Cross Region and Same Region), S3 Pre-signed URLs, S3 Storage Tiers + Glacier, S3 Lifecycle Policies, S3 Performance, S3 & Glacier Select, S3 Event Notifications, Athena, S3 Lock Policies & Glacier Vault Lock

CloudFront: CloudFront - CloudFront Caching & Caching, CloudFront Security, CloudFront Signed URL / Cookies

Practice:

- Creation of S3 bucket and uploading of objects to it
- S3 Versioning and Encryption
- S3 Replication and S3 glacier
- Application of CloudFront with S3

Module IV: AWS ECR

(14 Hrs)

ECS, ECR, Fargate - Docker in AWS: ECS, What is Docker, ECS Clusters, ECS Task Definition, ECS Service, ECS Service with Load Balancers, ECR, Fargate, ECS IAM Deep Dive & Hands On, ECS Task Placement and Constraints, ECS Auto Scaling

Elastic Beanstalk: AWS Elastic Beanstalk, Beanstalk First Environment, Second Environment, Beanstalk Deployment Modes, Beanstalk CLI and Deployment Process, Beanstalk Lifecycle Policy

Beanstalk Extensions, Beanstalk & CloudFormation, Beanstalk Cloning, Beanstalk Migrations, Beanstalk with Docker, Beanstalk Advanced Concepts, Code Commit, Code Pipeline, Code Build in VPC, Code Deploy for EC2 and ASG, AWS Code Star

CloudFormation: AWS CloudFormation - Create Stack, Update and Delete Stack, YAML, Resources, Parameters, Mappings, Outputs, Conditions, Intrinsic Functions, RollBacks, ChangeSets, Nested Stacks & StackSet

Practice:

- ECS Service with Load Balancers
- ECS Auto Scaling
- Elastic Beanstalk CLI and Deployment Process
- Applying Code Commit and Code Pipeline
- Implementing AWS CloudFormation

Module V: Monitoring and Audit

(10 Hrs)

Monitoring and Audit: AWS Monitoring, AWS CloudWatch Metrics, Alarms and Logs, CloudWatch Agent, Logs Metric Filters, CloudWatch Events, EventBridge Overview, X-Ray, X-Ray: Instrumentation and Concepts, Sampling Rules, APIs, Beanstalk, AWS CloudTrail, CloudTrail vs CloudWatch vs X-Ray

Integration and Messaging - SQS, SNS and Kinesis: AWS Integration & Messaging, AWS SQS, Dead Letter Queue, SQS CLI, FIFO Queues, SQS Advanced, AWS SNS, AWS Kinesis, KCL, Kinesis Security, Firehose and Analytics, SQS vs SNS vs Kinesis, Data Ordering for Kinesis vs SQS FIFO

Practice:

- Monitoring and checking health of the resource
- Application of AWS X-Ray
- Messaging using SNS and SQS
- Streaming of Data using AWS Kinesis

Module VI: Serverless Using Lambda

(18 Hrs)

Serverless Using Lambda: AWS Lambda, Lambda Synchronous Invocations, Lambda & Application Load Balancer, AWS Lambda@Edge, Lambda Asynchronous Invocations & DLQ, Lambda & CloudWatch Events / Event Bridge, Lambda - S3 Event Notifications, Lambda Event Source Mapping, Lambda Destinations, Lambda Permissions - IAM Roles & Resource Policies, Lambda Monitoring & X-Ray Tracing, Lambda in VPC, Lambda Function Performance, Lambda Concurrency, Lambda External Dependencies, Lambda and CloudFormation, Lambda Layers, Versions and Aliases, CodeDeploy, Limits

Serverless using DynamoDB: DynamoDB - Throughput, Basic APIs, Indexes (GSI + LSI), Optimistic Concurrency, DAX, Streams, TTL, CLI, DynamoDB Transactions, Session State, Partitioning Strategies, Conditional Writes, Concurrent Writes & Atomic Writes, Patterns with S3, Operations and Security

Serverless using API Gateway: API Gateway - API Gateway Stages and Deployment, Canary Deployments, Integration Types & Mappings, Swagger & Open API, Caching, Usage Plans & API Keys, Monitoring, Logging and Tracing, Authentication and Authorization, REST API vs HTTP API vs WebSocket API

Serverless Application Model: SAM, Installing the SAM CLI, Creating first SAM Project, Deploying SAM Project, API Gateway, DynamoDB, CloudFormation Designer and Application Repository, Policy Templates, CodeDeploy

Practice:

- Creating AWS lambda functions
- Lambda Permissions - IAM Roles & Resource Policies
- Creating and Maintaining database using DynamoDB
- API Gateway configuration
- Deploying Serverless Application

Module VII: AWS cognito

(08 Hrs)

Cognito: Cognito, User Pools, Identity Pools, Cognito User Pools vs Cognito Identity Pools, Sync

Security and Encryption: AWS Security, Encryption 101, KMS, KMS using CLI, KMS Encryption Patterns and Envelope Encryption, Limits, S3 Security Advanced, SSM Parameter Store Overview, Secrets Manager, SSM Parameter Store vs Secrets Manager, CloudWatch Logs Encryption, CodeBuild Security

Practice:

- Implementation of AWS Cognito
- AWS Key Management Service
- Key Management Service Encryption Patterns

Online Resource: <http://aws.amazon.com/training/awsacademy>
<http://aws.amazon.com/awsseducate>

Course Outline

| Code | Course Title | T-P-Pj (Credit) | Prerequisite |
|-------------|---------------------|------------------------|---------------------|
| CUCT2032 | Project | 0-0-6(6) | NIL |

- Locally Debug a Serverless App
- Build a Serverless Web Application
- Design a database for a mobile app with Amazon DynamoDB
- Create a Load Balanced WordPress website
- Building serverless applications
- Add Voice to Your WordPress Site
- Deploy a Python Web App
- Migrate a Git Repository to AWS
- Build a Drupal Website
- Build a Modern Application
- Build, Train, and Deploy a Machine Learning Model
- Handle Errors in Serverless Applications
- Create and Manage a Nonrelational Database
- Launch and Configure a LAMP Website
- Deploy and Host a ReactJS App
- Set Up a Compliant Archive
- Host a Static Website
- Launch a Linux Virtual Machine
- Launch a WordPress Website
- Remotely Run Commands on an EC2 Instance
- Launch a Windows Virtual Machine
- Create and Query a NoSQL Table
- Introduction to Deep Learning
- Train a Deep Learning model
- Create a machine learning model automatically with Amazon SageMaker Autopilot
- Setting up a Document Database With Amazon DocumentDB (with MongoDB compatibility) and AWS Cloud9
- Detect, Analyze, and Compare Faces
- Create an AWS DeepLens Project
- Provision Desktops in the Cloud
- Publish Amazon SNS Messages Privately
- Deploy WordPress with Amazon RDS
- Create and Manage a Nonrelational Database
- Create an Audio Transcript

Gate Process for Project

- Gate 0:** Planning
- Gate 1:** Analysis
- Gate 2:** Design
- Gate 3:** Implementation
- Gate 4:** Testing
- Gate 5:** Deployment

Course Outline Prepared by: Prof. K.V. Kalyan/ Prof. Raj Kumar Mohanta

Courseware link: <http://courseware.cutm.ac.in/courses/domain-cloud-domain/>