

**Subject Code: 01CY0116**

**Subject Name: Cloud Architecture and Security**

**M. Tech. Year – I**

**Objective:** This course introduces students to the foundational concepts of cloud computing, including cloud types (Public, Private, Hybrid), service models (IaaS, PaaS, SaaS), and virtualization in scalable cloud architecture. Learners will explore key AWS services such as EC2, S3, IAM, Lambda, VPC, and DynamoDB for deploying and managing cloud-based applications. The course also covers networking, security groups, and monitoring for secure and efficient cloud infrastructure. Students will gain insight into cloud security principles like the CIA triad, encryption, hashing, digital certificates, and defenses like firewalls and IDS/IPS. Additionally, it emphasizes automation, DevOps practices, Infrastructure as Code (IaC), governance, and cost optimization for effective cloud management.

**Credits Earned:** 4 Credits

**Course Outcomes:** After completion of this course, student will be able to

- **Understand** the foundational concepts of cloud computing by describing its types, platforms, service and deployment models, and explaining how networking and virtualization support scalable cloud environments.
- **Apply** the concepts of Amazon Web Services (AWS) by configuring cloud services like EC2, S3, IAM, VPC, and Lambda, and **demonstrate** their roles in deployment, networking, monitoring, and web development.
- **Implement** security solutions in cloud environments by **applying** access control, CIA triad, and security principles, and **utilize** tools such as server logs, firewalls, IDS, and IPS to enhance system protection.
- **Analyze** encryption and cryptographic techniques by **differentiating** between symmetric and asymmetric methods, and **examine** secure API strategies using digital certificates, hashing, and cipher mechanisms.
- **Apply** DevOps and cloud automation tools like Terraform, CloudFormation, Docker, and Kubernetes to **deploy** infrastructure, and **analyze** monitoring, cost control, and compliance strategies to ensure optimized and secure cloud operation

**Pre-requisite of course:**

1. Basic Knowledge of Computer Networks
2. Fundamentals of Operating Systems
3. Introductory Programming Skills

**Teaching and Examination Scheme**

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	Mid Sem (M)	Internal (I)	Viva (V)	Termwork (TW)	
3	0	2	4	50	30	20	25	25	150

**Contents:**

Unit	Topics	Contact Hours
1	<b>Understanding about cloud &amp; cloud concepts</b> Introduction to Cloud Computing, Need and Use of Cloud, Types of Cloud Models, Cloud Platforms Overview (Key players and platforms in the cloud industry (AWS, Azure, GCP)), Benefits & Challenges (Elasticity, flexibility, vendor lock-in, data privacy, and latency), Service Models (IaaS, PaaS, SaaS) , Deployment Models (Public, Private, Hybrid – comparison and use cases), Cloud Services and Technologies (Virtualization, containers, microservices, APIs), Research Challenges in Cloud (Security, interoperability, migration, service availability), Cloud Computing Architecture (Layers: infrastructure, platform, application), Networking for Cloud (Cloud-based networking fundamentals and connectivity options), Virtualization in Cloud (Role of hypervisors, VMs, and containers in cloud scalability)	12
2	<b>Introduction to AWS Cloud Platform &amp; Applications</b> Understanding of AWS, It's Need Advantages, Services of AWS , Introduction to EC2 & AMI, Introduction to S3, What is Network & it's Role in Cloud, Network Security Group with Ports, Description of Sub nets, Description of IAM, Use of Key Pair Login, Use of Cloud Front, Use of Lambda, What is VPC , Monitoring, AWS in Web Development, Amazon RedShift, Aws Key Management Service, Aws Kinesis, Aws DynamoDB	12
3	<b>Security Challenges in cloud</b> Introduction to Cloud, Use of Cloud & Need of Cloud, Types of Cloud, Different Types of Cloud Platform, Benefits & Challenges of Cloud, Service Model and Deployment Model, Cloud Services and Technologies, Research Challenges, Cloud Computing Architecture, Network for Cloud Computing, Role of Cloud with the Virtualization.	12
4	<b>Securing Cloud Communications and APIs</b> Encryption security, Symmetric encryption, Stream cipher, Block cipher, Asymmetric encryption, RSA algorithm, Elliptic Curve, Cryptography, Symmetric/asymmetric comparison and synergies, Hashing MD5 SHA, Public key Infrastructure, Signed certificates versus self-signed certificates, Cipher security, Designing a redundant environment for your APIs.	12

5	<p><b>Cloud Automation, DevOps &amp; Compliance</b> Introduction to Cloud Automation (Importance of automation in scalable cloud environments), DevOps Concepts in Cloud (Collaboration between development and operations using cloud-native tools), Infrastructure as Code (IaC), Terraform, Ansible, AWS Cloud Formation, CI/CD Pipelines (Automating build, test, and deployment phases), Containerization (Using Docker for packaging applications), Orchestration with Kubernetes (Managing containers at scale with high availability), Monitoring and Logging (Tools and strategies for real-time performance monitoring and alerting), Cost Management (Resource optimization and billing management in cloud), Policy Enforcement &amp; Governance (Cloud policies, tagging, access controls, and automation), Compliance Standards (GDPR, ISO 27001, HIPAA, and ensuring regulatory alignment)</p>	12
<b>Total Hours</b>		60

**References:**

1. “**Cloud Computing: Concepts, Technology & Architecture**” by Thomas Erl
2. “**Cloud Security and Privacy**” by Tim Mather, Subra Kumaraswamy, Shahed Latif
3. “**Amazon Web Services in Action**” by Michael Wittig & Andreas Wittig
4. “**Cloud Computing Security: Foundations and Challenges**” by John R. Vacca, CRC Press

**Suggested Theory distribution:**

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyse	Evaluate	Create
-- %	5%	5%	30%	40%	20%

**Suggested List of Experiments:**

Sr. No.	Topics	Contact Hours
1	<b>Create an AWS Account</b> Set up a new account on <b>Amazon Web Services Cloud</b> by filling in all the necessary details, including billing information and a valid payment method.	2
2	<b>Launch an EC2 Instance</b> Deploy a virtual server (EC2 instance) by following all required steps such as selecting the OS, instance type, key pair, storage, and security group.	2
3	<b>Set Up S3 with 8GB Storage</b> Create an S3 bucket with 8GB of storage. Upload one image and one video to the bucket and test access. Enable auto-scaling and configure its properties	2
4	<b>Use Amazon Athena</b> Deploy Amazon Athena by performing all necessary configurations, including setting up a data source, writing queries, and analyzing the results.	2
5	<b>Create Lambda Function and DynamoDB Table</b> Build a serverless function using AWS Lambda and set up a DynamoDB table. Complete all required steps for integration and functionality.	2
6	<b>Configure IAM (Identity and Access Management)</b> Create IAM roles, users, and policies. Check the permissions and credentials assigned to them for access control.	2
7	<b>Set Up Amazon SNS (Simple Notification Service)</b> Create an SNS topic and test the notification service by sending an email alert to your registered email ID.	2
8	<b>Deploy Amazon Lex</b> Build a chatbot using Amazon Lex. Fill in all the required information such as intents, utterances, and responses to complete the setup.	2
9	<b>Connect a Load Balancer with Application Code</b> Set up a load balancer and connect it to your application written in a language like Python or Java. Ensure proper routing and load distribution	2
10	<b>Launch Amazon RedShift</b> Deploy Amazon RedShift by completing all setup steps such as cluster configuration, database setup, and user access.	2

**Instructional Method:**

- a) The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black

board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

- b) The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- c) Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- d) Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

#### Supplementary Resources:

- a) **AWS Official Documentation** (<https://docs.aws.amazon.com>)
- b) **Coursera – “AWS Fundamentals Specialization” by Amazon Web Services** (<https://www.coursera.org/specializations/aws-fundamentals>)
- c) **Fundamentals of Cloud Computing**, CENGAGE Learning