System Design & Architecture Course Syllabus

Course Title: Introduction to System Design & Architecture

Duration: 5 Days (8 hours per day)

Mode: Instructor-led

Prerequisites: Basic knowledge of programming, databases, and web development

Day 1: Introduction to System Design

• Understanding System Design
- What is system design?
- Importance of scalability and performance
- System design vs. software architecture

• Key Terminologies & Concepts
- Latency vs. Throughput
- Consistency vs. Availability (CAP Theorem)
- Horizontal vs. Vertical Scaling

🔷 Hands-on Exercise: Analyze how a simple web application handles requests

Day 2: Architectural Patterns & Design Principles

• Common System Design Patterns
- Monolithic vs. Microservices Architecture
- Event-Driven Architecture
- Serverless Computing

• Principles of Scalable System Design
- Load Balancing
- Caching Strategies
- API Rate Limiting

🔷 Hands-on Exercise: Design a basic load-balanced architecture

Day 3: Networking & Communication Between Services

• Networking Basics for System Design
 - HTTP vs. WebSockets vs. gRPC
 - REST APIs vs. GraphQL vs gRPC

• Message Queues & Event Streaming
 - Apache Kafka vs. RabbitMQ vs. Amazon SQS
 - Pub/Sub Messaging Model

🔷 Hands-on Exercise: Implement an API using REST and WebSockets

Day 4: Databases & Storage Design + Scalability & High Availability Strategies

Databases / Storage Design

• Relational vs. NoSQL Databases
 - When to use SQL (PostgreSQL, MySQL) vs. NoSQL (MongoDB, Cassandra)

• Database Sharding & Replication
 - Partitioning Strategies
 - Leader-Follower Replication

🔷 Hands-on Exercise: Design a database schema

Scalability & High Availability Strategies

• Scaling Systems Efficiently
 - Load Balancers (Nginx, AWS ELB)
 - Content Delivery Networks (CDN)

• High Availability & Disaster Recovery
 - Redundancy & Failover Strategies
 - Handling Database Failures

🔷 Hands-on Exercise: Design a scalable web application infrastructure

Day 5: Case Studies & Real-World System Design

• System Design of Large-Scale Applications
  - Architecture Overview
  - Scalability Strategies

• Breaking Down a System Design Interview
  - How to approach design questions
  - Step-by-step framework for system design

🔷 Hands-on Exercise: Mock system design interview on designing