MERCURY

Cloud Containers, Kubernetes Architecture, Deployment, and Operations

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Introduction

Modern organizations increasingly rely on cloud-native architectures to accelerate application delivery, improve scalability, and achieve operational resilience. Container technologies have fundamentally transformed software development and deployment by enabling consistent, portable, and lightweight application environments across multiple infrastructures.

This advanced program provides an understanding of containerized platforms and enterprise orchestration using Cloud Containers and Kubernetes, covering the complete lifecycle of modern cloud-native applications—from container creation and cluster architecture to security, automation, monitoring, performance optimization, and advanced troubleshooting. It combines architectural concepts with operational best practices, enabling participants to design, deploy, secure, operate, and optimize production-grade container platforms.

Target Audience

This program is designed for:

- Cloud Architects.
- Infrastructure Engineers.
- Platform Engineers.
- DevOps Engineers.
- Site Reliability Engineers.
- System Administrators.
- Cloud Operations Engineers.
- Kubernetes Administrators.
- Application Deployment Engineers.
- Enterprise Technology Specialists.
- IT Infrastructure Managers.
- Digital Transformation Professionals.

Training Objectives

By the end of this program, participants will be able to:

- Understand enterprise containerization strategies.
- Design scalable container platforms.
- Build and manage production-ready Kubernetes clusters.
- Deploy highly available containerized workloads.
- Configure enterprise networking and storage.
- Implement secure access and workload isolation.
- Manage application configuration and secrets securely.
- Automate deployments using industry best practices.
- Implement resilient scaling and self-healing mechanisms.
- Monitor, troubleshoot, and optimize Kubernetes environments.
- Apply governance, operational standards, and lifecycle management across cloud-native infrastructures.

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- Design enterprise-grade Kubernetes environments.
- Deploy resilient cloud-native applications.
- Manage container lifecycles efficiently.
- Configure production networking and storage.
- Implement secure authentication and authorization models.
- Optimize cluster utilization and workload scheduling.
- Perform advanced monitoring and log analysis.
- Troubleshoot complex production incidents.
- Automate deployments using modern tools from the Kubernetes ecosystem.
- Improve operational reliability and platform performance.

Targeted Competencies

At the end of this course, participants will be able to:

- Cloud-Native Architecture.
- Container Platform Administration.
- Kubernetes Operations.
- Infrastructure Automation.
- Cluster Management.
- Platform Security.
- Resource Optimization.
- Application Orchestration.
- High Availability.
- Disaster Recovery Readiness.
- Performance Monitoring.
- Operational Troubleshooting.

Course Content

Unit 1: Foundations of Containerization and Kubernetes Architecture

- Containerization Fundamentals:
  - Evolution of application deployment models.
  - Benefits of container-based architectures.
  - Virtual Machines versus containers.
  - Container lifecycle management.
  - Enterprise container adoption strategies.
- Container Images:
  - Image architecture.
  - Layered image design.
  - Image optimization techniques.
  - Version management.
  - Image repositories.
  - Secure image distribution.
- Container Runtime:
  - Runtime architecture.
  - Container execution lifecycle.
  - Runtime isolation mechanisms.
  - Resource allocation.
  - Runtime security considerations.
- Kubernetes Architecture:

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- Enterprise platform overview.
- Cluster architecture.
- Node roles and responsibilities.
- Control Plane components.
- Cluster communication model.

Unit 2: Kubernetes Core Workloads and Resource Management

- Pod Management:
  - Pod architecture.
  - Multi-container Pods.
  - Pod lifecycle.
  - Health probes.
  - Resource management.
- Deployment and Replica Management:
  - Deployment strategies.
  - ReplicaSet architecture.
  - Rolling updates.
  - Rollback procedures.
  - Version control.
- Namespaces:
  - Environment isolation.
  - Multi-team management.
  - Resource organization.
  - Administrative boundaries.
- Labels and Selectors:
  - Workload categorization.
  - Resource discovery.
  - Service targeting.
  - Operational organization.
- Scheduling, Scaling, and Self-Healing:
  - Scheduling principles.
  - Resource-aware scheduling.
  - Automatic scaling.
  - Horizontal scaling.
  - Workload recovery.
  - High availability mechanisms.

Unit 3: Networking, Storage, Configuration, and Security

- Service Architecture:
  - Service discovery.
  - Internal communication.
  - Load balancing.
  - Service exposure models.
- Ingress Management:
  - External traffic routing.
  - HTTP and HTTPS management.
  - Routing rules.
  - TLS integration.
- Configuration Management:
  - ConfigMap implementation.
  - Environment configuration.

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    - Dynamic configuration updates.
- Secret Management:
    - Secure credential storage.
    - Encryption practices.
    - Secret lifecycle management.
    - Security governance.
- Enterprise Storage:
    - Persistent Volume architecture.
    - Persistent Volume Claim management.
    - Storage classes.
    - Stateful workloads.
    - Data persistence strategies.
- Kubernetes Security:
    - Platform hardening.
    - Workload isolation.
    - Identity management.
    - Network protection.
    - Security policies.
- RBAC Implementation:
    - Role-based authorization.
    - User permissions.
    - Service account management.
    - Least-privilege principles.

Unit 4: Automation, Platform Operations, and Observability

- Helm Package Management:
    - Chart architecture.
    - Application packaging.
    - Version control.
    - Release management.
    - Deployment automation.
- Kubernetes Operators:
    - Operator architecture.
    - Custom resource management.
    - Operational automation.
    - Lifecycle automation.
    - Platform extensibility.
- Monitoring:
    - Cluster health monitoring.
    - Performance metrics.
    - Resource utilization.
    - Capacity planning.
    - Alert management.
- Logging:
    - Centralized logging.
    - Log aggregation.
    - Event analysis.
    - Operational auditing.
    - Incident investigation.

Unit 5: Advanced Operations, Performance Optimization, and Enterprise Troubleshooting

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- Advanced Troubleshooting:
    - Cluster diagnostics.
    - Pod failure analysis.
    - Network troubleshooting.
    - Storage issue resolution.
    - Scheduling problem analysis.
    - Performance bottleneck identification.
- Production Operations:
    - Operational best practices.
    - Platform maintenance.
    - Upgrade planning.
    - Cluster lifecycle management.
    - Change management.
- Performance Optimization:
    - Resource optimization.
    - Cost optimization.
    - Workload efficiency.
    - Capacity optimization.
    - Scalability enhancement.
- Enterprise Best Practices:
    - Governance frameworks.
    - Operational standards.
    - Security compliance.
    - Reliability engineering.
    - Cloud-native operational maturity.
    - Production readiness assessment.