**Duration:**30 classroom hours + 30 lab hours

**Objective:** To introduce the student to Basic Networking, Cloud Computing & Operations

**Prerequisites:** Knowledge of Operating systems and computer Networks.

**Evaluation method:** Theory exam – 40% weightage

Lab exam – 40% weightage

Internal Assessment – 20% weightage

**List of Books / Other training material**

**Courseware:** Data Communications and Networking, Behrouz A. Forouzan, McGraw

Hill Education; Fifth edition

**Reference Books:**

1. Cloud Computing Black Book by Kailash Jayaswal, Dreamtech
2. Mastering Cloud Computing by Rajkumar/ McGraw Hill Education
3. Cloud Computing a practical Approach by AnthonyT Velte/ McGraw Hill Education
4. Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SAAS, PaaS, and IAAS)
5. Cloud Computing
6. An Introduction to Parallel Computing: Design and Analysis of Algorithms (Authors: Vipin Kumar, Ananth Grama, Anshul Gupta, George Karypis)
7. High Performance Cluster Computing: Architectures & Systems (Volume-1) by Rajkumar Buyya, Pearson
8. Parallel Programming in C with MPI and Open MPI, Michael, TMH
9. High-Performance Computing on Complex Environments

## *Note: Each session mentioned is for theory and of 2 hours duration.*

## *Lab assignments are indicatives, faculty need to assign more assignments for better practice.*

**Session 1:**

**Lecture**

* Introduction to communication system
* Issues in Computer Networking
* Internetworking
* OSI model
* Internet Protocol
* TCP/IP model

**Session 2:**

**Lecture**

* Static Routing
* Dynamic Routing
* Routing Protocols
* IP Subnetting & variable Length Subnet Masking
* Implementing of Routing Protocols

**Lab Assignments:**

* Implementation of Static Routing, RIP, IGRP, EIGRP, OSPF

**Session 3:**

**Lecture**

* Introduction to cloud
* What computing paradigms are there?
* Characteristics and benefits
* Understanding Cloud Vendors (AWS/Azure/GCP)
* Definition
* Characteristics
* Components

**Lab Assignments:**

* Study about cloud and other similar configuration
* Explore available solutions
* Cloud Architecture

**Session 4:**

**Lecture**

* Introduction to SAAS
* Pros and Cons of SAAS Model
* Traditional Packaged software Vs SAAS
* SAAS examples
* Introduction to IAAS
* Examples
* Introduction to virtualization
* Types and Uses of Virtualization
* Virtual Machine Provisioning
* Virtual Machine Migration Services
* Private Cloud Computing Deployment
* Introduction to PaaS
* Storage as Service (RAID)
* Challenges of cloud environment
* Hypervisor
* Comparisons of web services
* Organizational Scenarios of Clouds

**Lab Assignments:**

* Provide a solution on cloud as SAAS using available systems.

**Session 5:**

**Lecture**

* Administering & Monitoring cloud services
* Benefits and limitations
* Deploy application over cloud.
* Comparison among SAAS, PAAS, IAAS
* Cloud Computing Basics
* Cloud Products and Solutions
* Cloud Pricing
* Compute Products and Services.

**Sessions 6:**

**Lecture**

* Introduction to AWS
* Introduction Virtual Private Cloud (VPC) Setup
* Services provided by AWS: EC2, Lambda, S3
* Google App Engine
* Microsoft Azure Utility Computing
* Challenges of cloud environment
* HPC in the cloud
* Why Cloud HPC?
* Cloud HPC Technology

**Lab Assignments:**

* + Create AWS EC2 instance
  + Create AWS Lambda
  + Create AWS S3 bucket
  + Create AWS VPC

**Sessions 7 & 8:**

**Lecture**

Introduction to Web-Services

* Functions of Web Services
* Components of Web Service
* Compare SOAP and REST Web services,
* AJAX and mashups-Web services: SOAP and REST
* Compare SOAP and REST
* AJAX: asynchronous 'rich' interfaces
* Mashups: user interface services

**Lab-Assignment**:

* + Develop a payment gateway based upon RESTful web service for any E-commerce based application vizOnline shopping.

**Session 9:**

**Lecture**

* Introduction to Virtualization
* Types of Hypervisors

**Lab Assignments:**

* + What is virtualization?
  + Why we need virtualization?
  + Benefits of virtualization?
  + What are the different types of hardware virtualization list it and write notes on it?
  + Install, configure and setup cloud using OpenStack

**Session 10:**

**Lecture**

* Need of Virtualization Provisioning
* Work flow of Virtualization Provisioning
* Challenges in Virtualization
* VM-Specific Security techniques

**Lab-Assignment**:

* What is virtualization provisioning
* What are the file types that makes virtual machine?
* What are the devices that can be added on running virtual machine?
* Advantages of thick provisioning of storage over thin provisioning with virtual machine
* How storage and VM sprawl and security impact the virtual data centre.

**Session 11:**

* Types of Multi tenancy in Cloud computing
* Multi-tenant models for cloud services
* Multi-tenant Data Architecture

**Lab-Assignment**:

* What is the Relationship of Clouds and Multi tenancy?
* What are the degrees of multi tenancy?
* How to choose your multi tenants’ degree?

**Session 12:**

**Lecture**

* Introduction of virtualization
* Virtualization types: type1, type2
* Virtualization, Hardware Virtualization, Para-Virtualization, Cloning, Snapshot and Template
* Operating System Virtualization
* Cluster Architecture
* Cluster Requirements
* Virtual machine provisioning
* Virtualization applications in enterprises
* Pitfalls of virtualization

**Assignment –LAB:**

* Create and configure VM using VBox.
* Deploy code on VM

**Session 13:**

**Lecture**

* Version Control system
* Infrastructure as Code
* Containerization with Docker,
* Container Orchestration: Kubernets, Dockerswam
* Micro Service Deployment

**IoT Concepts: -**

**Session 14:**

**Lecture**

* Introduction to IOT
* Evolution of IOT, History
* M2M and/or IOT
* Applications and uses of IOT
* Use cases of IOT
* IoT Physical devices and Endpoint
* Modern IoT framework / Platforms
* Node-RED
* Thingspeak IoT platform

**Assignment –LAB:**

* MQTT Protocol - NodeRED
* Header, Packet Structure
* Publish Subscribe mechanism
* Topic rules, QoS Levels

**Session 15:**

**Lecture**

* IoT Servers/Cloud Platforms

- Functionality

- API Models

* Need for gateway/middleware solutions
* Role of IoT gateway
* IOT-A Architecture Reference Model (ARM)
* Things in IOT
* IOT Functional Blocks
* Case studies on connected cars and Self Driving cars
* Case studies on Smart Manufacturing

**Assignment –LAB:**

* MQTT Protocol –NodeRED
* Sessions, Persistence
* LWT Messages
* Keep Alive tracking

**Assignment –LAB:**

* MQTT Protocol – NodeRED
* Brokers, pub-sub clients - mosquitto
* Platform connectivity examples: Thingspeak, Thinger.io