

Teaching Guidelines for  
**Concepts of Operating Systems & Software Development Methodologies**  
PG-DAC September 2023

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**Duration: 72 hours (50 theory hours + 22 lab hours)**

**Evaluation:** 100 marks

**Weightage:** Theory exam – 40%, Lab exam – 30%, Internals – 30%

### Concepts of Operating Systems

**Duration: 26 hours (18 theory hours + 8 lab hours)**

**Objective:** To introduce Operating System concepts with Linux environment, and to learn Shell Programming.

**Prerequisites:** Knowledge of computer fundamentals

**Evaluation: 35 marks (CCEE: 15 + Lab exam: 10 + Internals: 10)**

**Text Books:**

- Operating Systems Principles by Abraham Silberschatz, Peter Galvin & Greg Gagne / Wiley
- Unix Concepts and Applications by Sumitabha Das / McGraw Hill

**References:**

- Modern operating Systems by Andrew Tanenbaum & Herbert Bos/ Pearson
- Principles of Operating Systems by Naresh Chauhan / Oxford University Press
- Beginning Linux Programming by Neil Matthew & Richard Stones / Wrox
- Operating System : A Design-Oriented Approach by Charles Crowley / McGraw Hill

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(Note: Each Session is of 2 hours)

**Session 1: Introduction to OS**

**Lecture:**

- What is OS; How is it different from other application software; Why is it hardware dependent?
- Different components of OS
- Basic computer organization required for OS.
- Examples of well-known OS including mobile OS, embedded system OS, Real Time OS, desktop OS server machine OS etc. ; How are these different from each other and why
- Functions of OS
- User and Kernel space and mode; Interrupts and system calls

**No Lab**

**Session 2: Introduction to Linux**

**Lecture:**

- Working basics of file system
- Commands associated with files/directories & other basic commands. Operators like redirection, pipe
- What are file permissions and how to set them?

- Permissions (chmod, chown, etc); access control list; network commands (telnet, ftp, ssh, sftp, finger)
- System variables like – PS1, PS2 etc. How to set them

### **Shell Programming**

- What is shell; What are different shells in Linux?
- Shell variables; Wildcard symbols
- Shell meta characters; Command line arguments; Read, Echo

### **Lab: (4 hours)**

- Working with various OS commands
- Shell programs related to Session 2

## **Session 3: Shell Programming**

### **Lecture:**

- Decision loops (if else, test, nested if else, case controls, while...until, for)
- Regular expressions; Arithmetic expressions
- More examples in Shell Programming

### **Lab: (4 hours)**

- Shell Programs related to Session 3

## **Sessions 4 & 5: Processes**

### **Lecture:**

- What is process; preemptive and non-preemptive processes
- Process management; Process life cycle
- What are schedulers – Short term, Mediumterm and Long term.
- Process scheduling algorithms – FCFS, Shortest Job First, Priority, RR, Queue. Belady's Anomaly
- Examples associated with scheduling algorithms to find turnaround time to find the better performing scheduler.
- Process creation using fork; waitpid and exec system calls; Examples on process creation; Parent and child processes
- Orphan and zombie processes

### **No Lab**

## **Sessions 6 & 7:**

### **Lecture:**

### **Memory Management**

- What are different types of memories; What is the need of Memory management
- Continuous and Dynamic allocation
- First Fit, Best Fit, worst Fit
- Compaction
- Internal and external fragmentation
- Segmentation – What is segmentation; Hardware requirement for segmentation; segmentation table and its interpretation
- Paging – What is paging; hardware required for paging; paging table; Translation look aside buffer
- Concept of dirty bit
- Shared pages and reentrant code
- Throttling

### **No Lab**

**Session 8:****Lecture:****Virtual Memory**

- What is virtual memory
- Demand paging
- Page faults
- Page replacement algorithms

**No Lab****Session 9:****Lecture:****Deadlock**

- Necessary conditions of deadlock
- Deadlock prevention and avoidance
- Semaphore
- Mutex
- Producer consumer problem
- Dead-lock vs Starvation

**No Lab**

## Software Development Methodologies

**Duration: 46 hours** (32 theory hours + 14 lab hours)**Objective:** To build knowledge of Software development methodologies.**Evaluation: 65 marks (CCEE: 25 + Lab exam: 20 + Internals: 20)****Reference Books:**

- Software Engineering by Chandramouli / Pearson
- Software engineering by Ian Sommerville / Pearson
- Object-Oriented Analysis and Design Using UML - An Introduction to Unified Process and Design Patterns by Mahesh P. Matha / PHI
- Clean Code: A Handbook of Agile Software Craftsmanship by Robert C. Martin / Prentice Hall
- The Mythical Man-Month: Essays on Software Engineering by Frederick P. Brooks Jr. / Addison Wesley
- User Stories Applied: For Agile Software Development by Mike Cohn / Addison Wesley
- DevOps: Continuous Delivery, Integration, and Deployment with DevOps by Sricharan Vadapalli / Packt
- Git for Teams by Emma Westby / O'Reilly

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(Note: Each Session is of 2 hours)

### Git (4 hours)

**Session 1****Lecture**

- Developing an application in a team
- Issues developers face when working in a team
- Introduction to code versioning system
- History of code versioning system
  - o Different tools available for versioning

- o Software development workflow
- Introduction to git
- Introduction to git repository and git structure
- Adding code to git
- Creating and merging different git branches

#### **Lab**

- Create a local git repository
- Commit the initial code
- Update the code
- Use git commands to
  - o Get the updated files
  - o List the changes
  - o Create branch
  - o Merge branch

### **Software Engineering (10 hours)**

#### **Sessions 2, 3 & 4**

##### **Lecture**

- Introduction to software engineering
  - o Software Process
  - o Software Process Model
  - o Software Product
- Importance of Software engineering
- Software Development Life Cycles
- Requirements Engineering
  - o Types of Requirements
  - o Steps involved in Requirements Engineering
  - o Requirement Analysis Modelling
- Design and Architectural Engineering
  - o Characteristics of Good Design
  - o Function Oriented vs Object Oriented System
  - o Modularity, Cohesion, Coupling, Layering
  - o Design Models
  - o UML
- Coding
  - o Programming Principles
  - o Coding Conventions
- Object Oriented Analysis and Design

##### **No Lab**

#### **Sessions 5 & 6**

##### **Lecture**

- Introduction to Agile development model
- Agile development components
- Benefits of Agile
- Introduction to different tools used for agile web development
- Scrum and Extreme Programming
- Introduction to Atlassian Jira
  - o Add Project
  - o Add Tasks and sub-tasks
  - o Create sprints with tasks
- Case study of developing web application using agile methodology

**No Lab**

## **DevOps (16 hours)**

### **Sessions 7 & 8**

#### **Lecture**

- Introduction to Microservices
- Microservices Architecture
- Fragmentation of business requirement
- Deployment pattern
- API gateway
- Service Discovery
- Database Management for Microservices

**No Lab**

### **Sessions 9 & 10**

#### **Lecture**

- Introduction to DevOps
- DevOps ecosystem
- DevOps phases
- Introduction to containerisation
- Introduction to docker
- Creating docker images using Dockerfile
- Container life cycle

#### **Lab**

- Install and configure docker
- Create docker image using Dockerfile
- Start docker container
- Connect to docker container
- Copy the website code to the container
- Use docker management commands to
  - List the images
  - List the containers
  - Start and stop container
  - Remove container and image

### **Session 11**

#### **Lecture**

- Introduction to YAML
- Introduction to Docker Swarm and Docker Stack
- Introduction to Kubernetes
- Creating Kubernetes cluster
- Creating service in Kubernetes
- Deploying an application using dashboard

#### **Lab**

- Configure Kubernetes
- Configure Kubernetes Dashboard
- Setup a Kubernetes cluster
- Access application using Kubernetes service
- Deploy the website using Dashboard

## **Testing & Integration (16 hours)**

## Session 12

### Lecture

- Introduction to software testing
- Why testing code is important
- Verification and validation
- Quality Assurance vs Quality Control vs Testing
- Principles of software testing

### Assignment

- Read more testing concepts used in the industry

## Session 13

### Lecture

- Introduction to STLC and V Model
- Types of testing: manual and automation
- Tools used for automation testing
- Introduction to testing methods: white-box, black-box and grey-box
- Introduction to functional testing: (\* students are supposed to learn the concepts)
- Introduction to non-functional testing: (\* students are supposed to learn the concepts)

### Assignment

- Create a test plan for project
- Document the use cases
- Create test case document for different sprints (designed in SE)

## Sessions 14 & 15

### Lecture

- Introduction to Selenium (use Eclipse IDE)
- Load web driver
- Create selenese commands: locators: by ID, name, class, tag name, XPath
- Add interactions: text box, radio button selection, check box selection, drop down item selection, keyboard actions, mouse actions, multi select

### Lab

- Download and configure Selenium
- Create a test suite
- Add commands and interactions

## Session 16

### Lecture

- Introduction to delivery pipeline
- Introduction to Jenkins
- Jenkins management
- Adding slave node to Jenkins
- Building a delivery pipeline
- Selenium integration with Jenkins

### Lab

- Install and configure Jenkins
- Build a pipeline job using Jenkins
- Create a maven project for Selenium
- Add Selenium test suite in the project
- Integrate it with Jenkins