Teaching Guidelines for

Concepts of Operating Systems & Software Development Methodologies

PG-DAC August 2024

Duration: 74 hours (50 theory hours + 24 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 (telenet, 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
- Difference between process and thread
- 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
- IO management

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: 48 hours (32 theory hours + 16 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 SricharanVadapalli/ Packt
- Git for Teams by Emma Westby / O'Reilly

(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

    - Different tools available for versioning
    - 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
    - Get the updated files
    - List the changes
    - Create branch
    - Merge branch

Software Engineering & DevOps (28 hours)

Sessions 2, 3, 4 & 5

Lecture

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

No Lab

Sessions 6, 7 & 8

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 AtlassianJira
    - Add Project
    - Add Tasks and sub-tasks

- Create sprints with tasks
- Case study of developing web application using agile methodology

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 (4 hours)

- 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 theconcepts)

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 selense 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