



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

## COMPUTER SCIENCE AND ENGINEERING

### COURSE DESCRIPTOR

|                          |  |                  |                |                   |                |
|--------------------------|--|------------------|----------------|-------------------|----------------|
| <b>Course Title</b>      | <b>LINUX PROGRAMMING</b>   |                  |                |                   |                |
| <b>Course Code</b>       | ACS010   |                  |                |                   |                |
| <b>Programme</b>         | B.Tech   |                  |                |                   |                |
| <b>Semester</b>          | VI   | CSE              |                |                   |                |
| <b>Course Type</b>       | Core   |                  |                |                   |                |
| <b>Regulation</b>        | IARE - R16   |                  |                |                   |                |
| <b>Course Structure</b>  | <b>Theory</b>  |                  |                | <b>Practical</b>  |                |
|                          | <b>Lectures</b>  | <b>Tutorials</b> | <b>Credits</b> | <b>Laboratory</b> | <b>Credits</b> |
|                          | 3  | 1                | 4              | 3                 | 2              |
| <b>Chief Coordinator</b> | Ms. K Radhika, Assistant Professor, CSE  |                  |                |                   |                |
| <b>Course Faculty</b>    | Mr. P Anjaiah, Assistant Professor, CSE<br>Ms. G.Sulakshana, Assistant Professor, CSE<br>Ms. N M Deepika, Assistant Professor, CSE |                  |                |                   |                |

#### I. COURSE OVERVIEW:

The main objective of this course is to present the fundamental idea about the Linux operating system and network programming concepts. It explores on the Linux file system, system calls, Implementation of shell scripts in BASH Shell environment. Designing and developing client/server applications in Linux using major methods of Inter Process Communication (IPC) and concurrent programming by handling different signals.

#### II. COURSE PRE-REQUISITES:

| Level | Course Code | Semester | Prerequisites        | Credits |
|-------|-------------|----------|----------------------|---------|
| UG    | ACS001      | I        | Computer Programming | 4       |
| UG    | ACS007      | IV       | Operating systems    | 4       |

#### III. MARKS DISTRIBUTION:

| Subject           | SEE Examination | CIA Examination | Total Marks |
|-------------------|-----------------|-----------------|-------------|
| Linux Programming | 70 Marks        | 30 Marks        | 100         |

#### IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

|   |                        |   |          |   |              |   |        |
|---|------------------------|---|----------|---|--------------|---|--------|
| ✗ | Chalk & Talk           | ✓ | Quiz     | ✓ | Assignments  | ✗ | MOOCs  |
| ✓ | LCD / PPT              | ✓ | Seminars | ✗ | Mini Project | ✗ | Videos |
| ✗ | Open Ended Experiments |   |          |   |              |   |        |

#### V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

**Semester End Examination (SEE):** The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with “either” or “choice” will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

|      |  |
|------|--|
| 50 % | To test the objectiveness of the concept.  |
| 50 % | To test the analytical skill of the concept OR to test the application skill of the concept. |

#### Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

| Component | Theory   |            | Total Marks |
|-----------|----------|------------|-------------|
|           | CIE Exam | Quiz / AAT |             |
| CIA Marks | 25       | 05         | 30          |

#### Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8<sup>th</sup> and 16<sup>th</sup> week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

#### Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

## VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

|      | Program Outcomes (POs)   | Strength | Proficiency assessed by          |
|------|--|----------|----------------------------------|
| PO 1 | <b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.  | 3        | Assignments/Laboratory practices |
| PO 2 | <b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences  | 2        | Assignments                      |
| PO 3 | <b>Design/development of solutions:</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. | 2        | Seminar                          |
| PO 4 | <b>Conduct investigations of complex problems:</b> Use research- based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.   | 2        | Seminar/Laboratory practices     |

3 = High; 2 = Medium; 1 = Low

## VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

|      | Program Specific Outcomes (PSOs)   | Strength | Proficiency assessed by |
|------|--|----------|-------------------------|
| PSO1 | <b>Professional Skills:</b> The ability to research, understand and implement computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient analysis and design of computer-based systems of varying complexity. | 2        | Lectures, Assignments   |
| PSO2 | <b>Software Engineering Practices:</b> The ability to apply standard practices and strategies in software service management using open-ended programming environments with agility to deliver a quality service for business success.   | -        | -                       |

|      |   |   |   |
|------|---|---|---|
| PSO3 | <b>Successful career and entrepreneurship:</b> Successful Career and Entrepreneurship: The ability to employ modern computer languages, environments, and platforms in creating innovative career paths, to be an entrepreneur, and a zest for higher studies | - | - |
|------|---|---|---|

3 = High; 2 = Medium; 1 = Low

### VIII. COURSE OBJECTIVES:

|  |   |
|--|---|
| <b>The course should enable the students to:</b> |   |
| I  | Interpret the Linux utilities to control the resources.                                     |
| II   | Learn basic concepts of shell scripts and file structures.                                  |
| III  | Understand the concepts of process creation and interruption for multitasking applications. |
| IV   | Explore memory allocation and inter process communication methods.                          |
| V  | Provide support for distributed and network applications in Linux environment.              |

### IX. COURSE OUTCOMES(COs):

| COs  | Course Outcome   | CLOs   | Course Learning Outcome   |
|------|--|--------|---|
| CO 1 | Understand the basic commands of Linux operating system and Demonstrate Sed and awk scripting  | CLO 1  | Learn the importance of Linux architecture along with features.   |
|      |  | CLO 2  | Identify and use Linux utilities to create and manage simple file processing operations                           |
|      |  | CLO 3  | Apply the security features on file access permissions by restricting the ownership using advance Linux commands. |
|      |  | CLO 4  | Implement the SED Scripts, operation, addresses, and commands.  |
|      |  | CLO 5  | Implement the GREP and AWK commands for pattern matching and mathematical functions.                              |
| CO 2 | Demonstrate shell scripts and understand creation of file systems and directories and operate them   | CLO 6  | Understand the shell responsibilities of different types of shells  |
|      |  | CLO 7  | Develop shell scripts to perform more complex tasks in shell programming environment.                             |
|      |  | CLO 8  | Illustrate file processing operations such as standard I/O and formatted I/O.                                     |
|      |  | CLO 9  | Illustrate directory operations such as standard I/O and formatted I/O.   |
| CO 3 | Synthesis creation of background and fore ground processes management through system calls and Generalize signal functions to handle interrupts by using system calls. | CLO 10 | Understand process structure, scheduling and management through system calls.                                     |
|      |  | CLO 11 | Generalize signal functions to handle interrupts by using system calls.   |
| CO 4 | Demonstrate Inter process communication using shared   | CLO 12 | Illustrate memory management of file handling through file/region lock  |

|      |  |        |  |
|------|--|--------|--|
|      | memory segments, pipes, message queues                                     | CLO 13 | Design and implement inter process communication (IPC) in client server environment by using pipe.       |
|      |  | CLO 14 | Design and implement inter process communication (IPC) in client server environment by using named Pipes |
|      |  | CLO 15 | Illustrate client server authenticated communication in IPC through semaphores.                          |
|      |  | CLO 16 | Illustrate client server authenticated communication in IPC through shared memory.                       |
| CO 5 | Demonstrate various client server applications using TCP or UDP protocols. | CLO 17 | Demonstrate socket connections, socket attributes, socket addresses                                      |
|      |  | CLO 18 | Demonstrate various client server applications on network using TCP.                                     |
|      |  | CLO 19 | Demonstrate various client server applications on network using UDP protocols.                           |
|      |  | CLO 20 | Design custom based network applications using the sockets interface in heterogeneous platforms          |

#### X. COURSE LEARNING OUTCOMES(CLOs):

| CLO Code  | CLO's  | At the end of the course, the student will have the ability to:  | PO's Mapped     | Strength of Mapping |
|-----------|--------|--|-----------------|---------------------|
| ACS010.01 | CLO 1  | Learn the importance of Linux architecture along with features.  | PO 1            | 3                   |
| ACS010.02 | CLO 2  | Identify and use Linux utilities to create and manage simple file processing operations                          | PO 1,PO 2       | 2                   |
| ACS010.03 | CLO 3  | Apply the security features on file access permissions by restricting the ownership using advance Linuxcommands. | PO 1,PO 2       | 2                   |
| ACS010.04 | CLO 4  | Implement the SED Scripts, operation, addresses, and commands.   | PO 1,PO 2, PO 3 | 3                   |
| ACS010.05 | CLO 5  | Implement the GREP and AWK commands for pattern matching and mathematicalfunctions.                              | PO 3,PO 4       | 2                   |
| ACS010.06 | CLO 6  | Understand the shell responsibilities of different types of shells   | PO 1,PO 2, PO 3 | 3                   |
| ACS010.07 | CLO 7  | Develop shell scripts to perform more complex tasks in shell programming environment.                            | PO 1,PO 2, PO 3 | 3                   |
| ACS010.08 | CLO 8  | Illustrate file processing operations such as standard I/O and formatted I/O.                                    | PO 1,PO 2, PO 3 | 3                   |
| ACS010.09 | CLO 9  | Illustrate directory operations such as standard I/O and formatted I/O.  | PO 1,PO 2, PO 3 | 3                   |
| ACS010.10 | CLO 10 | Understand process structure, scheduling andmanagementthrough systemcalls.                                       | PO 1,PO 2, PO 3 | 3                   |
| ACS010.11 | CLO 11 | Generalize signal functions to handle interrupts by using system calls.  | PO 3,PO 4       | 2                   |
| ACS010.12 | CLO 12 | Illustrate memory management of file handling through file/region lock   | PO 1,PO 2,      | 2                   |

|           |        |  |                     |   |
|-----------|--------|--|---------------------|---|
| ACS010.13 | CLO 13 | Design and implement inter process communication (IPC) in client server environment by using pipe.       | PO 1 ,PO 3          | 3 |
| ACS010.14 | CLO 14 | Design and implement inter process communication (IPC) in client server environment by using named Pipes | PO 1,PO 2,<br>PO 3  | 1 |
| ACS010.15 | CLO 15 | Illustrate client server authenticated communication in IPC through messages queues, semaphores          | PO 1,PO 3           | 3 |
| ACS010.16 | CLO 16 | Illustrate client server authenticated communication in IPC through shared memory.                       | PO 1,PO 2,<br>PO 3  | 3 |
| ACS010.17 | CLO 17 | Demonstrate socket connections, socket attributes, socket addresses                                      | PO 1,PO 2,<br>PO 3  | 3 |
| ACS010.18 | CLO 18 | Demonstrate various client server applications on network using TCP.                                     | PO 1,PO 2,<br>PO 3, | 3 |
| ACS010.19 | CLO 19 | Demonstrate various client server applications on network using UDP protocols.                           | PO 1,PO 2,<br>PO 3, | 3 |
| ACS010.20 | CLO 20 | Design custom based network applications using the sockets interface in heterogeneous platforms          | PO 2,<br>PO 3, PO 4 | 3 |

**3 = High; 2 = Medium; 1 = Low**

#### **XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

| Course Outcomes (COs) | Program Outcomes (POs) |     |     |     | Program Specific Outcomes (PSOs) |      |      |
|-----------------------|------------------------|-----|-----|-----|----------------------------------|------|------|
|                       | PO1                    | PO2 | PO3 | PO4 | PSO1                             | PSO1 | PSO1 |
| CO 1                  | 3                      | 2   | 2   | 2   | 3                                |      |      |
| CO 2                  | 3                      | 2   | 2   |     | 2                                |      |      |
| CO 3                  | 3                      | 2   | 2   |     | 2                                |      |      |
| CO 4                  | 3                      | 2   | 2   |     | 2                                |      |      |
| CO 5                  | 3                      | 2   | 2   | 2   | 2                                |      |      |

**3 = High; 2 = Medium; 1 = Low**

#### **XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

| Course Learning Outcomes (CLOs) | Program Outcomes (POs) |     |     |     |     |     |     |     |     |      |      |      | Program Specific Outcomes (PSOs) |      |      |
|---------------------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|----------------------------------|------|------|
|                                 | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1                             | PSO2 | PSO3 |
| CLO 1                           | 3                      |     |     |     |     |     |     |     |     |      |      |      | 2                                |      |      |
| CLO 2                           | 3                      | 2   |     |     |     |     |     |     |     |      |      |      |                                  |      |      |
| CLO 3                           | 3                      | 2   |     |     |     |     |     |     |     |      |      |      |                                  |      |      |
| CLO 4                           | 3                      | 2   | 2   |     |     |     |     |     |     |      |      |      | 2                                |      |      |

|        |   |   |   |   |  |  |  |  |  |  |  |  |   |  |  |
|--------|---|---|---|---|--|--|--|--|--|--|--|--|---|--|--|
| CLO 5  |   |   | 2 | 2 |  |  |  |  |  |  |  |  | 2 |  |  |
| CLO 6  | 3 | 2 | 2 |   |  |  |  |  |  |  |  |  | 2 |  |  |
| CLO 7  | 3 | 2 | 2 |   |  |  |  |  |  |  |  |  | 2 |  |  |
| CLO 8  | 3 | 2 | 2 |   |  |  |  |  |  |  |  |  | 2 |  |  |
| CLO 9  | 3 | 2 | 2 |   |  |  |  |  |  |  |  |  | 2 |  |  |
| CLO 10 | 3 | 2 | 2 |   |  |  |  |  |  |  |  |  |   |  |  |
| CLO 11 |   |   | 2 | 2 |  |  |  |  |  |  |  |  | 2 |  |  |
| CLO 12 | 3 | 2 |   |   |  |  |  |  |  |  |  |  |   |  |  |
| CLO 13 | 3 |   | 2 |   |  |  |  |  |  |  |  |  | 2 |  |  |
| CLO 14 | 3 | 2 |   |   |  |  |  |  |  |  |  |  | 2 |  |  |
| CLO 15 | 3 |   | 2 |   |  |  |  |  |  |  |  |  | 2 |  |  |
| CLO 16 | 3 | 2 | 2 |   |  |  |  |  |  |  |  |  |   |  |  |
| CLO 17 | 3 | 2 | 2 |   |  |  |  |  |  |  |  |  | 2 |  |  |
| CLO 18 | 3 | 2 | 2 |   |  |  |  |  |  |  |  |  |   |  |  |
| CLO 19 | 3 | 2 | 2 |   |  |  |  |  |  |  |  |  | 2 |  |  |
| CLO 20 |   | 2 | 2 | 2 |  |  |  |  |  |  |  |  | 2 |  |  |

3 = High; 2 = Medium; 1 = Low

### XIII. ASSESSMENT METHODOLOGIES -DIRECT

| CIE Exams            | PO 1, PO 2, PO 3, PO4, PSO1 | SEE Exams    | PO 1,PO 2, PO 3, PO4, PSO1 | Assignments  | PO1,PO2 | Seminars      | PO3, PO4 |
|----------------------|-----------------------------|--------------|----------------------------|--------------|---------|---------------|----------|
| Laboratory Practices | PO 2                        | Student Viva | -                          | Mini Project | -       | Certification | -        |
| Term Paper           | -                           |              |                            |              |         |               |          |

### XIV. ASSESSMENT METHODOLOGIES -INDIRECT

|   |   |   |                                     |
|---|---|---|-------------------------------------|
| ✓ | Assessment of course outcomes (by feedback, once) | ✓ | Student feedback on faculty (twice) |
| ✓ | Assessment of mini projects by experts            |   |                                     |

## XV. SYLLABUS:

|  |  |
|--|--|
| <b>UNIT-I</b>  | <b>INTRODUCTION TO LINUX UTILITIES</b>                 |
| Linux utilities: A brief history of UNIX, architecture and features of UNIX, introduction to vi editor. General purpose utilities, file handling utilities, security by file permissions, process utilities, disk utilities, networking commands; Text processing and backup utilities: Text processing utilities and backup utilities; SED: Scripts, operation, addresses, commands; AWK: Execution, fields and records, scripts, operation, patterns, actions, associative arrays, string and mathematical functions, system commands in awk, applications.  |  |
| <b>UNIT-II</b>   | <b>WORKING WITH THE BOURNE AGAIN SHELL (BASH)</b>      |
| Shell: Shell responsibilities, types of shell, pipes and i/o redirection, shell as a programming language, here documents, running a shell script, the shell as a programming language, shell metacharacters, file name substitution, shell variables, command substitution, shell commands, quoting, test command, control structures, arithmetic in shell, interrupt processing, functions, and debugging scripts; File structure and directories: Introduction to file system, file descriptors, file types, file system structure; File metadata: Inodes; System calls for file I/O operations: open, create, read, write, close, lseek, dup2, file status information-stat family; File and record locking: fcntl function, file permissions, file ownership, links; Directories: Creating, removing and changing directories, obtaining current working directory, directory contents, scanning directories. |  |
| <b>UNIT-III</b>  | <b>PROCESS AND SIGNALS</b>                             |
| Process: Process identifiers, process structure: process table, viewing processes, system processes, process scheduling; Starting new processes: Waiting for a process, process termination, zombie processes, orphan process, system call interface for process management, fork, vfork, exit, wait, waitpid, exec. Signals: Signal functions, unreliable signals, interrupted system calls, kill, raise, alarm, pause, abort, system, sleep functions, signal sets.  |  |
| <b>UNIT-IV</b>   | <b>DATA MANAGEMENT AND INTER PROCESS COMMUNICATION</b> |
| Data Management: Managing memory: malloc, free, realloc, calloc; File locking: Creating lock files, locking regions, use of read and write with locking, competing locks, other lock commands, deadlocks; Inter process communication: Pipe, process pipes, the pipe call, parent and child processes, named pipes, semaphores, shared memory, message queues; Shared memory: Kernel support for shared memory, APIs for shared memory, shared memory example; Semaphores: Kernel support for semaphores, APIs for semaphores, file locking with semaphores.   |  |
| <b>UNIT-V</b>  | <b>SOCKETS</b>   |
| Introduction to sockets: Socket, socket connections, socket attributes, socket addresses, socket system calls for connection oriented protocol and connectionless protocol, socket Communications, comparison of IPC mechanisms.   |  |
| <b>Text Books:</b>   |  |
| <ol style="list-style-type: none"> <li>1. W. Richard, Stevens, Advanced Programming in the UNIX Environment, Pearson Education, 1<sup>st</sup> Edition, 2005.</li> <li>2. Sumitabha Das, Unix Concepts and Applications, Tata McGraw-Hill, 4<sup>th</sup> Edition, 2006.</li> <li>3. Neil Mathew, Richard Stones, Beginning Linux Programming, Wrox, Wiley India, 4<sup>th</sup> Edition, 2011.</li> </ol>   |  |
| <b>Reference Books:</b>  |  |
| <ol style="list-style-type: none"> <li>1. Sumitabha Das, Your Unix the Ultimate Guide, Tata McGraw-Hill, 4<sup>th</sup> Edition, 2007.</li> <li>2. W. R. Stevens, S. A. Rago, Advanced Programming in the Unix Environment Pearson Education, 2<sup>nd</sup> Edition, 2009</li> <li>3. B. A. Forouzan, R. F. Gilberg, Unix and Shell Programming, Cengage Learning, 3<sup>rd</sup> Edition, 2005.</li> </ol>   |  |



## XVI. COURSEPLAN:

The course plan is meant as a guideline. Probably there may be changes.

| Lecture No. | Topics to be covered   | Course Learning Outcomes (CLOs) | Reference                 |
|-------------|--|---------------------------------|---------------------------|
| 1-2         | A brief history of Linux, Architecture of Linux, features of Linux   | CLO 1                           | T2: 1.1, 2.1-2.2          |
| 3-4         | Linux Utilities-File handling utilities, Security by file permissions  | CLO 3                           | T2: 4.7-4.8, 5.3-5.4      |
| 5-6         | Process utilities, Disk utilities, Networking commands, Filters  | CLO 2                           | T2: 3.10, 15.6, 17.5-17.6 |
| 7-8         | Text processing utilities, Backup utilities  | CLO 2                           | T2: 12.3-12.9 15.9-15.10  |
| 9           | Sed – scripts, operation, addresses, commands, applications  | CLO 4                           | T2: 13.4                  |
| 10-11       | Awk – execution, fields and records, scripts, operation, patterns, actions, Functions using system commands in awk.  | CLO 5                           | T2: 18.1-18.12            |
| 12-13       | Working with the Bourne again shell(bash): Introduction, shell responsibilities, pipes and input Redirection, output redirection   | CLO 6                           | T2: 8.5                   |
| 14          | Here documents, running a shell script with an example   | CLO 6                           | T2: 14.14                 |
| 15          | The shell as a programming language, shell meta characters, file name substitution   | CLO 6                           | T2: 8.9                   |
| 16-17       | Shell variables, command substitution, shell commands, the environment, quoting, test command, control structures  | CLO 6                           | T2: 8.4, 8.10             |
| 18-19       | Arithmetic in shell, shell script examples, interrupt processing, functions, debugging shell scripts.  | CLO 7                           | T2: 14.5-14.17            |
| 20          | Files: File Concept, File System Structure, Inodes, File Attributes, File types, Library Functions   | CLO 8                           | T1: 4.1-4.14              |
| 21-22       | The standard I/O (fopen, fclose, fflush, fseek, fgets, getc, getchar, fputc, putc, putchar, fgets, gets etc.)  | CLO 8                           | T1:5.1-5.9                |
| 23          | Formatted I/O, stream errors, kernel support for files.  | CLO 8                           | T1:5.10-5.11              |
| 24-25       | File descriptors , low level file access - usage of open, creat, read, write, close, lseek, stat family, umask, dup, dup2  | CLO 8                           | T1:3.1-3.12, 4.2          |
| 26-28       | File and directory management- Directory file apis, Symbolic links and hard links.   | CLO 9                           | T1:4.20-4.22, 4.15-4.17   |
| 29-31       | Process – Process concept, Kernel support for process, process attributes, process hierarchy, process states, process composition, process control - process creation, waiting for a process, process termination. | CLO 10                          | T1:8.1-8.9                |
| 32-33       | Zombie process, orphan process. With an examples   | CLO 10                          | T1:: 8.6                  |
| 34          | Signals – Introduction to signals, Signal generation and handling, Kernel support for signals, Signal function.  | CLO 11                          | T1:10.1-10.3              |
| 35          | Unreliable signals, reliable signals, kill, raise , alarm, Pause, abort, and sleep functions.  | CLO 11                          | T1:10.4-10.19             |

| Lecture No. | Topics to be covered   | Course Learning Outcomes (CLOs) | Reference    |
|-------------|--|---------------------------------|--------------|
| 36-37       | Fcntl, file and record locking   | CLO 12                          | T1:3.13      |
| 38          | Interprocess Communication: Introduction to IPC, IPC between processes on a single computer system, IPC between processes on different systems, pipes. | CLO 13                          | T1:14.1-14.4 |
| 39          | Fifos named pipes and its system calls   | CLO 14                          | T1:14.5      |
| 40          | Introduction to three types of IPC (Linux)-message queues, semaphores and shared memory.   | CLO 14                          | T1:14.6      |
| 41          | Message Queues- Kernel support for messages, Linux apis for messages   | CLO 15                          | T1:14.7      |
| 42-43       | Client/server example message queues   | CLO 14                          | T1:14.7      |
| 44          | Semaphores- Kernel support for semaphores  | CLO 15                          | T1:14.8      |
| 45-46       | File locking with semaphores. Linux apis for semaphores  | CLO 15                          | T1:14.8      |
| 47          | Examples on pipes and named pipes  | CLO 13                          | T1:14.9      |
| 48          | Examples on locking files  | CLO 12                          | T1:14.9      |
| 49          | Linux API semaphore, shared memory   | CLO 17                          | T1:15.1      |
| 52          | Sockets: Introduction to Sockets, socket attributes  | CLO 18                          | T1:15.5      |
| 53          | Socket system calls for connection oriented protocol,  | CLO 19                          | T1:15.1      |
| 54          | Example-client/server programs on TCP, UDP   | CLO 20                          | T1:15.5      |

### XIII. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

| S NO | Description                          | Proposed actions                   | Relevance with POs | Relevance with PSOs |
|------|--------------------------------------|------------------------------------|--------------------|---------------------|
| 1    | Linux GNU tools introduction         | Seminars / NPTEL                   | PO 1, PO 2, PO 3   | PSO 1               |
| 2    | Case study of Linux Operating system | Seminars / NPTEL                   | PO 2, PO 5         | PSO1                |
| 3    | A Desktop Environment                | Assignments / Laboratory Practices | PO 1, PO 3, PO 4   | PSO 1               |

**Prepared by:**

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**HOD, CSE**

