**MANIPAL UNIVERSITY JAIPUR**Faculty of Engineering | School of Computer Science and Engineering

Department of CSE  
Course Hand-out

**Linux System and Shell Programming | CS4154 | 4 Credits | 3 0 0 3**

Session: July 23 – Nov 23 | Program: B.Tech. (CSE) | Semester: VII

Course Coordinator: **Dr. Dibakar Sinha**



1. **Introduction:** This course is offered by the department of CSE targeting students who wish to pursue development and research in industries or higher studies in the fields of Computer Science, IT and Communication Engineering. This course will form the base of computer science and hence this course is introduced at this level to make the students understand Linux system various ways of programming in shell scripting depending upon the application.
2. **Course Outcomes:** At the end of the course, students will be able to
3. Demonstrate capabilities for implementing general file system utilities, process trees, input/output redirection & for handling signals. (Level II. Understanding)
4. Illustrate use of pipe, socket API and Remote procedure calls for inter-process communication. (Level II. Understanding)
5. Apply concepts related to concurrency to achieve the same for cooperating processes. (Level III. Applying)
6. Outline skills to write device driver code. (Level II. Understanding)
7. Show skills to write advanced shell scripts. (Level II. Understanding)
8. **PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES** 
   1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
   2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
   3. **Design/development of solutions**: 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.
   4. **Conduct investigations of complex problems**: 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.
   5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
   6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
   7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
   8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices
   9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
   10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
   11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
   12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
9. **PROGRAM SPECIFIC OUTCOMES (PSOS)**

At the end of the B Tech CSE AIML program, the student:

1. Will be able to design, develop and implement efficient software for a given real life problem.
2. Will be able to apply knowledge of AI, Machine Learning and Data Mining in analysing big data for extracting useful information from it and for performing predictive analysis.
3. Will be able to design, manage and secure wired/ wireless computer networks for transfer and sharing of information.
4. **Assessment Plan:**

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| **Criteria** | **Description** | **Maximum Marks** |
| Internal Assessment (Summative) | Mid Term Exam (MTE) (Closed Book) | 30 |
| In class Quizzes (Two) | 10 |
| Assignments (Two) | 10 |
| MOOC course | 10 |
| End Term Exam  (Summative) | End Term Exam (Closed Book) | 40 |
|  | Total | 100 |
| Attendance  (Formative) | A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves. | |
| Homework/ Assignment/ Activity Assignment  (Formative) | There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded. | |

1. **SYLLABUS**

**Fundamentals**: Processes in Linux, I/O system calls, select and poll functions, Filters, and redirection,

Linux file system navigation, Directory access, File system implementation, Hard links, and symbolic

links**. Asynchronous Events:** Manipulating signal masks and signal sets, Catching, and ignoring signals, Waiting for signals. **Inter-Process Communication:** Sockets, Remote procedure calls, Network file system. **Concurrency:** POSIX thread attributes, Synchronization functions, Mutex locks, Condition variables, Signal handling and threads. **Character Device Driver Development:** Driver concepts, Writing character drivers, Interrupt handling, Interfacing with hardware. **Shell Scripting:** Loops, Conditional statements, Command line arguments, test command, expr command. **Advanced Scripting Techniques:** Providing command line options to scripts, exporting variables, Arrays, Remote shell execution, connecting to MySQL using shell, Essential system administration.

1. **TEXTBOOKS**

Dakic, Vedran, and Jasmin Redzepagic. "Linux command line and Shell scripting techniques: master practical aspects of the Linux command line and then use it as a part of the shell scripting process." Amazon Publisher ,2022.

1. **REFERENCE BOOKS**
2. W. R. Stevens, S. A. Rago, Advanced Programming in the UNIX Environment, (3e), Addison- Wesley, 2013.
3. R. Love, Linux System Programming: Talking Directly to the Kernel and C Library, O'Reilly, 2007.
4. S. Das, Unix Concepts and Applications, (4e), McGraw Hill, 2006.
5. W. R. Stevens, B. Fenner, UNIX Network Programming, Volume 1: The Sockets Networking API, (3e), Pearson, 2003.
6. K. A. Robbins, S. Robbins, Unix Systems Programming: Communication, Concurrency, and Threads, (2e), Prentice Hall, 2004.
7. **LECTURE PLAN**

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| Lec No | **Topics** | **Session Outcome** | **Mode of Delivery** | **Corresponding CO** | **Mode of Assessing the Outcome** |
| 1 | Introduction and Course Hand-out briefing | To acquaint and clear teachers expectations and understand student expectations | Lecture | NA | NA |
| 2 | Processes in Linux, Process system calls, Background processes and daemons | kernel data structures for process, syntax of process system calls, write system programs for creating different process trees | Lecture | 1551.1 | Quiz  MTE  Programming Assignment |
| 3 |  |  |  |  |  |
| 4,5 | Linux I/O, Device terminology, I/O system calls, select and poll Functions | Describe I/O system calls routines, device independence, Identify in-memory data structures after execution of system calls | Lecture | 1551.1 | Quiz  MTE  Programming Assignment |
| 6,7,8 | Filters and redirection, Linux File system navigation, Directory access, File system implementation, Hard links and symbolic links | Figure out how linux commands work and able to write system programs for the same | Lecture | 1551.1 | Quiz  MTE  Programming Assignment |
| 9,10 | Basic signal concepts, Generating signals, Manipulating signal masks and signal sets, Catching and ignoring signals, Waiting for signals, Handling signals, Programming with asynchronous I/O, POSIX times, Sleep functions | Identify the effect of signals related to process group and write system programs for catching signals | Lecture | 1551.1 | Quiz  MTE  Programming Assignment |
| 11,12,13 | Inter-process communication: Named and unnamed pipes | Identify the kernel data structures on execution of pipe and mkfifo system calls and write IPC programs using them | Lecture | 1551.2  1551.6 | Quiz  MTE  Programming Assignment |
| 14,15,16,17,18 | UDP Sockets, Iterative TCP Sockets, Concurrent TCP Sockets, Remote procedure calls, SUN RPC | Design, write and test programs that use the POSIX socket API and Remote procedure calls. | Lecture | 1551.2  1551.6 | In Class Quiz  End Term Project |
| 19, 20, 21 | Network file system | Configure NFS, describe its implementation, develop their own NFS code | Lecture | 1551.6 | In Class Quiz  End Term  Project |
| 22,23,24,25,26 | POSIX thread attributes, Synchronization functions, Mutex locks, Condition variables  Signal handling and threads | Apply concepts related to concurrency to achieve the same for cooperating processes | Lecture | 1551.3 | Class Quiz  End Term  Programming Assignment |
| 27,28,29,30 | Character device driver development: Driver concepts, Writing character drivers, Interrupt handling, Interfacing with hardware | Include their own driver in kernel code, recompile it and boot from their kernel | Lecture  Self-Study | 1551.4  1551.6 | Class Quiz End Term  Project |
| 31,32,33,34 | Shell scripts with the help of variables, Loops, Conditional statements, Command line arguments, test command, expr command, Interactive scripts with read, Functions & file manipulations, Regular expression & filters | Recall Shell Scripts | Lecture  Self-Study | 1551.5 | Class Quiz  End Term  Programming Assignment |
| 35,36,37 | Advanced scripting techniques: Providing command line options to scripts, Exporting variables, Arrays, Remote shell execution | Write advanced shell scripts | Lecture | 1551.5 | End Term  Project |
| 38,39,40 | Connecting to MySQL using shell, Essential System Administration jobs, Debugging using GDB, make utility, Customizing the environment. | Write scripts for system administration and customizing the environment, know how to use debugger and make utility | Lecture | 1551.5 | End Term  Project |

1. **Course Articulation Matrix: (Mapping of COs with POs)**

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| **CO** | **STATEMENT** | CORRELATION WITH PROGRAM OUTCOMES | | | | | | | | | | | | CORRELATION WITH PROGRAM SPECIFIC OUTCOMES | | |
| PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CS 1551.1 | Demonstrate capabilities for implementing general file system utilities, process trees, input/output redirection & for handling signals | 2 | 1 | 1 | 1 | 1 | 1 |  |  |  |  |  | 1 | 1 |  | 1 |
| CS 1551.2 | Illustrate use of pipe, socket API and Remote procedure calls for inter-process communication. | 3 | 1 | 2 | 1 | 1 | 1 |  |  |  |  |  | 2 | 1 |  | 1 |
| CS 1551.3 | Apply concepts related to concurrency to achieve the same for cooperating pro-cesses. | 2 | 1 | 1 | 1 | 2 | 2 |  |  |  |  |  | 1 | 1 |  | 1 |
| CS 1551.4 | Outline skills to write device driver code. | 3 | 1 | 1 | 1 | 2 | 1 |  |  |  | 1 | 1 | 1 | 1 |  | 1 |
| CS 1551.5 | Show skills to write advanced shell scripts. | 2 | 1 | 2 | 1 | 1 | 1 |  |  |  |  |  | 2 | 1 |  | 1 |

1. **Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

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| Course Coordinator | Student Representative | Head of the Department |