Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2023-2024
COURSE HANDOUT (PART II)

Date: 11/08/2023

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In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. **: CS F372**
Course Title **: Operating Systems**
Instructor-In-Charge**: Prof. Barsha Mitra (barsha.mitra@hyderabad.bits-pilani.ac.in)**
Instructors **: Dr. Paresh Saxena, Dr. Dipanjan Chakraborty**

Scope of the Course:

An operating system (OS) is a set of softwares that manages the computer hardware resources and provides common services for all computer programs that are executed on it. Alternatively stated, an OS acts as a manager of resources. OS provides an established, convenient, and efficient interface between user programs and the bare hardware of the computer on which it runs. It provides relatively uniform interfaces to access the extremely wide variety of devices that a computer interacts with, ranging from input/output devices such as printers and digital cameras, to multiple processors that are available on a single board. OS is responsible for sharing resources (e.g., disks, and processors), providing common services needed by many different programs (e.g., access to the printer), and protecting individual programs from interfering with one another. There is a huge range and variety of computer systems for which operating systems are being designed: from embedded devices like on-board computers for the space shuttle or a luxury sedan and cellphones to PCs, workstations, and mainframes, to supercomputers. The intent of this course is to provide a thorough discussion of the fundamentals of operating system concepts and to relate these to contemporary design issues and current directions in the development of operating systems.

Objectives of the Course:

- To learn about how process management is carried out by the OS. This will include process creation, thread creation, CPU scheduling, process synchronization and deadlocks.
- To learn about memory management carried out by OS. This will include the concepts of paging, segmentation, swapping, and virtual memory.
- To learn how permanent storage like files and disks are managed by OS. This will include topics related to access methods, mounting, disk scheduling, and disk management.
- To gain hands-on experience on the above-mentioned topics through the Linux operating system.

Text Book:

T1. Silberschatz, Galvin, and Gagne, "Operating System Concepts", 9th edition, John Wiley & Sons, 2012.

Reference Books:

R1. W. Stallings, "Operating Systems: Internals and Design Principles", 6th edition, Pearson, 2009.
R2. Tanenbaum, Woodhull, "Operating Systems Design & Implementation", 3rd edition, Pearson, 2006.

R3. Dhamdhere, "Operating Systems: A Concept based Approach", 2nd edition, McGrawHill, 2009.
R4. Robert Love, "Linux Kernel Development", 3rd edition, Pearson, 2010.
R5. Russ Cox, Frans Kaashoek, Robert Morris, "xv6 a simple, Unix-like teaching operating system". Online Draft, 2021. https://pdos.csail.mit.edu/6.828/2021/xv6/book-riscv-rev2.pdf
R6. Daniel P. Bovet, Marco Cesati "Understanding the Linux Kernel", 3rd Edition.
R7. Jonathan Corbet, Alessandro Rubini, Greg Kroah-Hartman "Linux Device Drivers", 3rd Edition.

Course Plan:

Lecture No.	Learning Objectives	Topics to be covered	Chapter in the Text Book
1-3	To understand the various components of a computer and the role OS plays to control them.	**Introduction:** What OS does? Computer System Organization & Architecture, OS Operations, Computing environments.	T1: Ch. 1
4-6	To learn how a system boots and what functions and services an OS provides	**OS Structures:** OS Services, Interfaces, System calls, OS structure, OS Debugging, System boot.	T1: Ch. 2
7-10	To learn how processes are created and handled by the OS and how they communicate with each other.	**Processes:** Process Control Block (PCB), Process states, Operations on processes, Inter Process Communication (IPC), Scheduling queues, Types of schedulers, Context switch.	T1: Ch. 3
11-13	To understand how threads are created and managed by OS and differences between processes & threads	**Threads:** Motivation, Benefits, Multicore programming, Multithreading models, Thread library, Threading issues.	T1: Ch. 4
14-17	To learn how multiple processes are executed by OS	**CPU Scheduling:** Scheduling Criteria, Scheduling Algorithms, Thread scheduling, Algorithm evaluation.	T1: Ch. 6
18-21	To understand how OS manages the concurrent resource access requests	**Process Synchronization:** Critical section problem, Peterson's solution, Hardware solutions, Semaphores, Classical synchronization problems, Monitors.	T1: Ch. 5
22-25	To identify how two or more processes can wait indefinitely for accessing resources and how to resolve the situation	**Deadlocks:** Resource Allocation Graphs, Cycle and Knot, Solutions to deadlock: Prevention, Avoidance, Detection, and Recovery from deadlocks.	T1: Ch. 7
26-29	To learn how main memory is divided into different parts and allocated to the processes so that degree of multiprogramming can be increased.	**Main Memory Management:** Address binding, Logical vs physical address space, Dynamic loading, Swapping, Contiguous memory allocation, Paging: Hardware support, Structure of Page table, Segmentation.	T1: Ch. 8
30-33	To understand how to combine RAM and Hard disk to get a Virtual memory so that larger programs can be run.	**Virtual Memory:** Demand paging, Page replacement algorithms, Allocation of frames, Thrashing, Memory mapped files, Allocating Kernel memory.	T1: Ch. 9

34-35	To learn how secondary storage structures are implemented and managed	**Mass Storage:** Disk structure, disk scheduling, disk management, and RAID.	T1: Ch. 10
36-37	To identify what abstraction OS provides to access contents from a hard disk	**File System Interface:** File system, Access methods, Mounting, sharing, and disk structures.	T1: Ch. 11
38-39	To understand how file system implementation helps to improve the efficiency of storage space	**File System Implementation:** Structure and Implementation, Allocation methods and Free space management.	T1: Ch. 12
40-41	To understand how OS manages various I/O devices	**I/O Systems:** I/O hardware, I/O Interface, Kernel I/O subsystem.	T1: Ch. 13
42	To develop an understanding of how OS provides security through access control schemes	**Protection:** Goals of protection, Access Matrix, Capability-based systems.	T1: Ch. 14

Evaluation:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Mid Semester Examination	90 minutes	35%	12/10 - 11.30 - 1.00PM	Closed Book
Assignments (2 nos.)	-	25% (Assignment 1: 10%, to be graded before the mid-semester grading Assignment 2: 15%, to be released after the mid-semester exams)	TBA	Open Book
Comprehensive Examination	180 minutes	40%	14/12 AN	Closed Book

Chamber Consultation Hour:

To be announced in class.

Notices:

All notices pertaining to this course will be displayed on CMS.

Make-up Policy:

- ***No Make-ups for assignments and class participation will be granted.***
- Prior permission of the Instructor-in-Charge is required to get make-up for Mid-Sem. Only on producing documentary proof of possible absence, which proves that the student will be physically unable to appear for the exam due to medical emergencies, the decision to grant the make-up will be taken. Medical documents provided by campus doctors are only permissible. The documentary proof should be submitted before the examination. Any document submitted after the examination will not be acceptable. The above-mentioned conditions also apply for comprehensive examination.
- Instructor-in-charge's decision in the matter of granting make-up will be final.

10. Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

INSTRUCTOR-IN-CHARGE
CS F372