OPERATING SYSTEMS

Anatomy of the Course

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Course Details

- Subject Code : UE19CS254
- Subject Title : Operating Systems
- Subject Credits: 04
- Sections: B.Tech 4 CS - C, D, H
- Faculty: Nitin V Pujari

Course Assessments

- In Semester Assessment
  - ISA - 1: 60 Marks - Unit 1, 2, 3 => reduced to 21
  - ISA - 2: 40 Marks - Unit 4, 5 => reduced to 14
  - Assignment: 15 Marks => reduced to 15
  - Total =>50
- End Semester Assessment
  - 100 Marks - Unit 1, 2, 3, 4, 5 => Reduced to 50
  - Total =>50
- Total Marks = ISA + ESA = 50+50 => 100 Marks

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Course Syllabus

UNIT 1: Introduction and Process Management

Operating-System Structure & Operations, Kernel Data Structures,Computing Environments, Operating-System Services, OperatingSystem Design and Implementation. Process concept: Process in memory, Process State, Process Control Block, Process Creation and Termination, CPU Scheduling and Scheduling Algorithms, IPC – Shared Memory & Message Passing, Pipes – Named and Ordinary. Case Study: Linux/Windows Scheduling Policies.

UNIT 2: Threads and Concurrency

Introduction to Threads, types of threads, Multicore Programming, Multithreading Models, Thread creation, Thread Scheduling, PThreads and Windows Threads, Mutual Exclusion and Synchronization: software approaches, principles of concurrency, hardware support, Mutex Locks, Semaphores. Classic problems of Synchronization: Bounded-Buffer Problem, Readers -Writers problem, Dining Philosophers Problem concepts. Synchronization Examples - Synchronisation mechanisms provided by Linux/Windows/Pthreads. Deadlocks: principles of deadlock, tools for detection and Prevention.

UNIT 3: Memory Management

Main Memory: Hardware and control structures, OS support, Address translation, Swapping, Memory Allocation (Partitioning, relocation), Fragmentation, Segmentation, Paging, TLBs context switches Virtual Memory – Demand Paging, Copy-on-Write, Page replacement policy – LRU (in comparison with FIFO & Optimal), Thrashing, design alternatives – inverted page tables, bigger pages. Case Study: Linux/Windows Memory.

Unit 4 : Storage Management

Mass-Storage Structure – Mass-Storage overview, Disk Scheduling, Swap-Space Management, RAID structure. File System Interface - file organization/structure and access methods, directories, sharing. File System Implementation/Internals: File control Block (inode), partitions & mounting, Allocation methods. Case Study: Linux/Windows File Systems

Unit 5 : I/O Management and Security

I/O Hardware, polling and interrupts, DMA, Kernel I/O Subsystem and Transforming I/O Requests to Hardware Operations - Device interaction, device driver, buffering. System Protection: Goals, Principles and Domain of Protection, Access Matrix, Access control, Access rights. System Security: The Security Problem,Program Threats, System Threats and Network Threats. Case Study: Windows 7/Windows 10

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Course Outline - Unit 1

Class No.	Chapter Title / Reference Literature	Topics to be covered	% of Portions covered	
			Reference chapter	Cumulative
1	1.1-1.2	What Operating Systems Do, Computer-System Organization?	1	21.4
2	1.3,1.4,1.5	Computer-System Architecture, Operating-System Structure & Operations	1	
3	1.10,1.11	Kernel Data Structures, Computing Environments	1	
4	2.1,2.6	Operating-System Services, Operating System Design and Implementation	2	
5	3.1-3.3	Process concept: Process in memory, Process State, Process Control Block, Process Creation and Termination	3	
6	5.1-5.2	CPU Scheduling: Basic Concepts, Scheduling Criteria	5	
7	5.3	Scheduling Algorithms: First-Come, First-Served Scheduling, Shortest-Job-First Scheduling	5	
8	5.3	Scheduling Algorithms: Shortest-Job-First Scheduling (Pre-emptive), Priority Scheduling	5	
9	5.3	Round-Robin Scheduling, Multi-level Queue, Multi-Level Feedback Queue Scheduling	5	
10	5.5,5.6	Multiple-Processor Scheduling, Real-Time CPU Scheduling	5	
11	5.7	Case Study: Linux/Windows Scheduling Policies	5	
12	3.4,3.6.3	IPC – Shared Memory & Message Passing, Pipes – Named and Ordinary	3,6	

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Course Outline - Unit 2

13	4.1,4.2	Introduction to Threads, types of threads, Multicore Programming.	4	42.8
14	4.3,5.4	Multithreading Models, Thread creation, Thread Scheduling	4	
15	4.4	Pthreads and Windows Threads	4	
16	6.1-6.3	Mutual Exclusion and Synchronization: software approaches	6	
17	6.3-6.4	principles of concurrency, hardware support	6	
18	6.5,6.6	Mutex Locks, Semaphores	6	
19	6.7.1-6.7.3	Classic problems of Synchronization: Bounded-Buffer Problem, Readers -Writers problem, Dining Philosophers Problem concepts	6	
20	6.9	Synchronization Examples - Synchronisation mechanisms provided by Linux/Windows/Pthreads.	6	
21	Handouts	Demonstration of programming examples on process synchronization		
22	7.1-7.3	Deadlocks: principles of deadlock, Deadlock Characterization.	7	
23	7.4	Deadlock Prevention, Deadlock example	7	
24	7.6	Deadlock Detection	7	

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Course Outline - Unit 3

25	8.1	Main Memory: Hardware and control structures, OS support, Address translation,	8	64.2
26	8.2	Swapping, Memory Allocation (Partitioning, relocation), Fragmentation,	8	
27	8.4	Segmentation	8	
28	8.5	Paging	8	
29	8.5	TLBs context switches	8	
30	8.6	Structure of page tables	8	
31	8.6.3-8.7	design alternatives - inverted page tables, bigger pages	8	
32	9.1-9.2	Virtual Memory - Demand Paging,	9	
33	9.39.4.1-9.4.3	Copy-on-Write, Page replacement: Basic page replacement (FIFO page replacement and optimal page replacement)	9	
34	9.4.4, 9.5	Page replacement, Allocation of frames	9	
35	9.6	Thrashing	9	
36	9.10	Case Study: Linux/Windows Memory	9	

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Course Outline - Unit 4

37	12.1	Mass-Storage Structure – Mass-Storage overview	12	82.1
38	12.4	Disk Scheduling	12	
39	12.4	Disk Scheduling	12	
40	12.6-12.7	Swap-Space Management, RAID structure	12	
41	10.1-10.2	File Concept, Access Methods	10	
42	10.3	Directory and Disk Structure	10	
43	10.4-10.6	File-System Mounting, File Sharing, Protection	10	
44	11.1-11.3	File-System Structure, File-System Implementation, Directory Implementation	11	
45	11.4	Allocation methods	11	
46	16.7,11.8	Case Study: Linux/Windows File Systems	11,16	

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Course Outline - Unit 5

47	13.1-13.2	I/O Hardware, polling and interrupts, DMA	13	100
48	13.4	Kernel I/O Subsystem	13	
49	13.5	Transforming I/O Requests to Hardware Operations - Device interaction, device driver, buffering.	13	
50	14.1-14.3	System Protection: Goals, Principles and Domain of Protection.	14	
51	14.3.2	Domain of Protection: Unix, MULTICS examples	14	
52	14.4	Access Matrix	14	
52	14.5	Implementation of Access Matrix, Access control, Revocation of Access rights.	14	
54	15.1	System Security: The Security Problem	15	
55	15.2	Program Threats.	15	
56	15.317.5	System Threats and Network ThreatsCase Study: Windows 7/Windows 10	15,17	

Course Objectives

Course Objectives

- The course focuses on fundamental operating system concepts.
- The course provides an understanding of various components of the operating system.
- The course delves deeper into various algorithms and associated trade-offs for efficient resource management such as process, disk, and memory management.
- The course will introduce design principles and trade-offs in the design of Operating Systems.
- The course will also introduce the concepts such as security, protection and virtualization

Course Outcomes

Course Outcomes

- Gain extensive knowledge on principles and modules of Operating Systems.
- Understand the design of various algorithms for scheduling and their relative performance.
- Design pieces of the operating systems such as process management, concurrent processes and threads, memory

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Course References

Operating System Concepts

Abraham Silberschatz, Greg Gagne, and Peter Baer Galvin, Ninth Edition, 2013

Operating Systems - Internals and Design Principles,

William Stallings,9th edition, pearson, 2018

Operating Systems: Three Easy Pieces

Remzi Arpaci, Self-publishing, 2016

Rerence Book to understand DMA concepts in detail

Advanced Programming in the Unix Environment

Richard Stevens and Stephen A Rago, 3rd edition, Pearson,2017

To understand unix system calls like fork(), exec(), wait(), memory layout of a c program, system calls related to files.

Operating Systems

Harvey Deitel, Paul Deitel, David Choffnes,3rd edition, Prentice Hall,2004

Modern Operating Systems

Andrew S Tanenbaum, 3rd edition, Pearson, 2007

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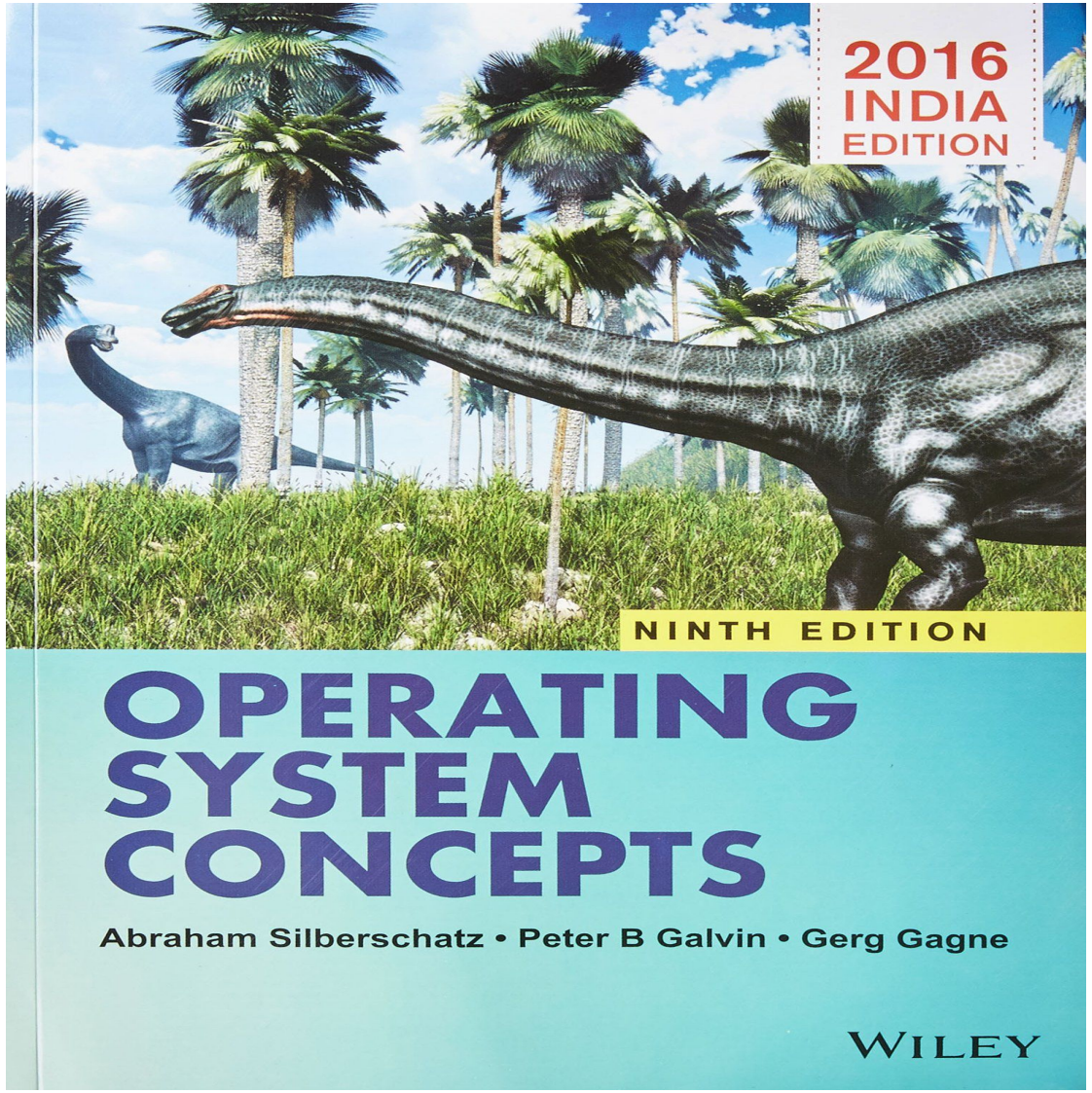
Text Book



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THANK YOU

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