SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES
(AUTONOMOUS)

QUESTION BANK

Year / Semester: III B.Tech VI Semester **Regulation: R23**

Subject and Code: OPERATING SYSTEM & SYSTEM PROGRAMMING - 23CSE353T

SYLLABUS

UNIT –1: FUNDAMENTALS OF OPERATING SYSTEMS AND PROCESS MANAGEMENT (9)

Introduction to Operating Systems: Definition and Basics, Generations and Types of Operating Systems, OS Structure: Layered, Monolithic, Microkernel, OS Services, System Calls, System Boot, System Programs, Virtual Machines, Process Management: Process Concepts, Process States, Process Control Block, Context Switching, Threads and Multithreading, Process Scheduling: Scheduling Criteria and Scheduling Algorithms, Multiprocessor Scheduling: Types and Performance Evaluation, Process Synchronization and Deadlocks: Race Conditions, Critical Section, Mutual Exclusion, Peterson‘s Solution, Semaphores, Monitors Classic IP, C Problems: Reader-Writers, Dining Philosophers, Deadlocks: Definition, Characteristics, Prevention, Avoidance, Detection and Recovery.

UNIT –2: MEMORY, FILE, AND STORAGE MANAGEMENT (9)

Memory Management: Logical vs. Physical Address Mapping, Contiguous Memory Allocation, Internal and External Fragmentation, Compaction, Paging and Page Tables, Segmentation, Virtual Memory: Demand Paging, Page Faults, Page Replacement Algorithms, Thrashing and Working Set Model, File System Management: File Concepts, Access Methods, File Types and Operations, Directory Structure, File System Structure, Allocation Methods, Free-Space Management, Directory Implementation. Storage Management: Mass Storage: Disk Structure, RAID Levels, Disk Scheduling Algorithms, Swap Space Management, Stable Storage, Tertiary Storage Structure.

UNIT –3: I/O SYSTEMS, SECURITY, AND UNIX/LINUX OVERVIEW (9)

I/O System Management: I/O Hardware: Devices, Device Controllers, Direct Memory Access, I/O Software: Interrupt Handlers, Device Drivers, Device-Independent I/O Software, System Protection and Security: Security Environment, Security Design Principles, User authentication, Protection Mechanisms, Protection Domain, Access Control List, Unix/Linux Overview & Case Studies: Development of Unix/Linux, Role of Kernel, System Calls, Elementary Linux Commands, Shell Programming, Directory Structure, System Administration.

UNIT –4: SYSTEM SOFTWARE AND LANGUAGE PROCESSING (9)

Overview of System Software: Software and Software Hierarchy, Systems Programming and Machine Structure, Interfaces, Address Space, and Computer Languages, System Software

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Development and Recent Trends, Language Processors: Programming Languages and Language Processing, Symbol Tables and Data Structures for Language Processing, Search and Allocation Data Structures, Assemblers and Macro Processors: Elements of Assembly Language Programming, Design and Types of Assemblers, Macro Definitions, Expansion, Nested Macros, and Advanced Macro Features, Design of Macro Assemblers and Macro Processors, Linkers and Loaders: Concept of Linking and Relocation, Linking in MS- DOS, Dynamic Linking, Loading Schemes: Sequential, Direct, Absolute, Relocating, and Linking Loaders, Comparison of Linkers and Loaders.

UNIT –5: SYSTEM PROGRAMMING (9)

Scanning and Parsing: Programming Language Grammars and Classification, Ambiguity in Grammatic Specification, Scanning, Parsing, Compilers and Interpreters: Compilation Process, Semantic Gap, Binding, and Scope Rules, Memory Allocation, Compilation of Expressions & Control Structures, Code Optimization, Overview of Interpreters and Debuggers, Operating System Command & Shell Basics: C Development Tools, Machine- Level Representation of Data and Programs, System-Level Programming and Concurrency: File I/O, Process Creation & Control (fork, exec), Pipes, Signals, and Basic Threading.

Total Hours: 45

TEXT BOOKS:

1. Operating System Concepts (9th or 10th Edition) by Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne in publisher: Wiley
2. Operating Systems: A Concept-Based Approach (3rd Edition) by D. M. Dhamdhere publisher: McGraw Hill

REFERENCE BOOKS:

1. Real-Time Systems: Theory and Practice by Rajib Mall, Publisher: Pearson
2. System Software: An Introduction to Systems Programming (3rd Edition) by Leland L. Beck & D. Manjula, Publisher: Pearson.

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<table>
<tr><th>S.No.</th><th>CO</th><th>Questions</th><th>BT</th></tr>
<tr><td colspan="4">Unit I: FUNDAMENTALS OF OPERATING SYSTEMS AND PROCESS MANAGEMENT</td></tr>
<tr><td>1</td><td>1</td><td>Explain Operating System structures (Monolithic, Layered, Microkernel, Modular) with neat diagram and comparison.</td><td>L4</td></tr>
<tr><td>2</td><td>1</td><td>Explain Operating System functions in detail.</td><td>L2</td></tr>
<tr><td>3</td><td>1</td><td>Explain Generations and Types of Operating Systems with suitable examples.</td><td>L2</td></tr>
<tr><td>4</td><td>1</td><td>Explain Process Concept and Process Control Block (PCB) with neat diagram.</td><td>L2</td></tr>
<tr><td>5</td><td>1</td><td>Explain System calls & different types of System calls?</td><td>L2</td></tr>
<tr><td>6</td><td>1</td><td>Define thread. Explain multithreading models with suitable diagram. 5m
Write about Single & Multithreaded Process? 5m</td><td>L2</td></tr>
<tr><td>7</td><td>1</td><td>What is a semaphore? Explain its usage and implementation and solution to the Bounded-Buffer problem using semaphores.</td><td>L3</td></tr>
<tr><td>8</td><td>1</td><td>Define monitor. State dining philosophers’ problem and give a solution using monitors.</td><td>L3</td></tr>
<tr><td>9</td><td>1</td><td>What is critical section problem? Discuss in detail Peterson’s solution to the critical section problem.</td><td>L3/L4</td></tr>
<tr><td>10</td><td>1</td><td>a. Explain about scheduling criteria. 4m
b. Evaluate FCFS CPU scheduling algorithm for given problem find average waiting time turnaround time. 6m
<table>
<tr><td>Process</td><td>P1</td><td>P2</td><td>P3</td><td>P4</td></tr>
<tr><td>Process time</td><td>24</td><td>3</td><td>5</td><td>6</td></tr>
</table></td><td>L2/L3</td></tr>
<tr><td>11</td><td>1</td><td>a. Evaluate SJF CPU Scheduling algorithm for given Problem find average waiting time turnaround time. 5m
<table>
<tr><td>Process</td><td>P1</td><td>P2</td><td>P3</td><td>P4</td></tr>
<tr><td>Process Time</td><td>8</td><td>4</td><td>9</td><td>5</td></tr>
<tr><td>Arrival Time</td><td>0</td><td>1</td><td>2</td><td>3</td></tr>
</table></td><td>L3</td></tr>
</table>

SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES
(AUTONOMOUS)

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<table>
<tr><td></td><td></td><td>b. Evaluate round robin CPU Scheduling algorithm for given Problem find average waiting time turnaround time time slice is 3 ms 5m
<table>
<tr><td>Process</td><td>P1</td><td>P2</td><td>P3</td><td>P4</td></tr>
<tr><td>Process Time</td><td>10</td><td>5</td><td>18</td><td>6</td></tr>
<tr><td>Arrival Time</td><td>5</td><td>3</td><td>0</td><td>4</td></tr>
</table></td><td></td></tr>
<tr><td>12</td><td>1</td><td>Consider the following snapshot of a system in which four resources A, B, C and D area available. The system contains a total of 6 instances of A, 4 of resource B, 4 of resource C, 2 resource D.
<table>
<tr><td></td><td colspan="4">Allocation</td><td colspan="4">Max</td><td colspan="4">Need</td><td colspan="4">Available</td></tr>
<tr><td></td><td>A</td><td>B</td><td>C</td><td>D</td><td>A</td><td>B</td><td>C</td><td>D</td><td>A</td><td>B</td><td>C</td><td>D</td><td>A</td><td>B</td><td>C</td><td>D</td></tr>
<tr><td>P_0</td><td>2</td><td>0</td><td>1</td><td>1</td><td>3</td><td>2</td><td>1</td><td>1</td><td></td><td></td><td></td><td></td><td>6</td><td>4</td><td>4</td><td>2</td></tr>
<tr><td>P_1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>2</td><td>0</td><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>P_2</td><td>1</td><td>0</td><td>1</td><td>0</td><td>3</td><td>2</td><td>1</td><td>0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>P_3</td><td>0</td><td>1</td><td>0</td><td>1</td><td>2</td><td>1</td><td>0</td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
Do the following problems using the banker's algorithm:
• Compute what each process might still request and fill this in under the column Need.
• Is the system in a safe state? Why or why not?
• Is the system deadlocked? Why or why not?
• If a request from P3 arrives for (2,1,0,0), can the request be granted immediately?</td><td>L4/L5</td></tr>
<tr><td>13</td><td>1</td><td>Explain Deadlock Avoidance Mechanism</td><td>L2</td></tr>
<tr><td>14</td><td>1</td><td>a. What are the methods for handling deadlock. 6m
b. Write about deadlock and starvation 4m</td><td>L3/L4</td></tr>
<tr><td>15</td><td>1</td><td>Explain the resource allocation graph algorithm for deadlock avoidance with example.</td><td>L4</td></tr>
<tr><td>16</td><td>1</td><td>Discuss in detail deadlock and its prevention mechanism</td><td>L2</td></tr>
<tr><td>S.No.</td><td>CO</td><td>Questions</td><td>BT</td></tr>
<tr><td colspan="4">Unit II: MEMORY, FILE, AND STORAGE MANAGEMENT</td></tr>
<tr><td>1</td><td>2</td><td>a. Compare Logical & Physical Addressing 5m
b. Explain Contiguous Memory Allocation 5m</td><td>L4
L3</td></tr>
<tr><td>2</td><td>2</td><td>a. What is fragmentation? Explain its types and disadvantages 5m
b. What is address binding? Explain the concept of dynamic relocation of addresses. 5m</td><td>L4
L4</td></tr>
</table>

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(AUTONOMOUS)

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3	**2**	Explain the concept of Segmentation	**L3**
4	**2**	a) Describe Structure of Paging Table with TLB 5m b) Explain the types of page table. 5m	**L4** **L4**
5	**2**	a) Discuss the procedure for page fault in demand paging 5m b) Compare page replacement algorithms 5m	**L4** **L4**
6	**2**	Describe the LRU, FIFO, Optimal page replacement algorithm, assuming there are 3 frames and the page reference string is 7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1 8 Find the number of page faults	**L5**
7	**2**	Given memory partitions of 100 K, 500 K, 200 K, 300 K and 600 K (in order) how Would each of the first fit, best fit and worst fit algorithms work place processes of 212 K, 417K, 112 K and 426 K (in order)? Which algorithm makes the most efficient use of memory?	**L5**
8	**2**	Explain the term locality of reference and elaborate on its usefulness in presenting thrashing.	**L4**
9	**2**	Discuss contiguous, linked, and indexed allocation with advantages and disadvantages.	**L4**
10	**2**	Explain the use of Directory organization of files and discuss the different of directories structures.	**L3**
11	**2**	a. Discuss file system structure with neat diagram. 5m b. Explain free space management techniques. 5m	**L3** **L3**
12	**2**	Discuss FCFS, SSTF, SCAN, and C-SCAN with example and head movement calculation. Consider the following disk request sequence for a disk with 90 tracks 12, 34, 52, 14,25,68,39 R/W head is starting at 53. Find the number of movements using for above scheduling.	**L4** **L3**
13	**2**	a. Explain the mechanism stable storage implementation. 5m b. Discuss about Tertiary storage structure. 5m	**L4** **L3**
15	**2**	a. Discuss disk structure and disk scheduling algorithms. 5m b. Explain Swap space management. 5m	**L3** **L3**
S.No.	**CO**	**Questions**	**BT**
Unit III: I/O SYSTEMS, SECURITY, AND UNIX/LINUX OVERVIEW			
1	**3**	Discuss I/O hardware components, devices, device controllers, and system bus with neat diagram.	**L3**
2	**3**	Explain Direct Memory Access (DMA) in detail.	**L4**

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3	**3**	Discuss interrupt handlers, device drivers, device-independent I/O software.	**L4**
4	**3**	Explain interrupt handling mechanism in detail.	**L4**
5	**3**	Explain Security Design Principles proposed by Saltzer and Schroeder.	**L4**
6	**3**	What is authentication? Explain user authentication mechanisms in operating systems.	**L3**
7	**3**	Explain Protection Domain concept with diagram.	**L3**
8	**3**	Explain Access Control List (ACL) and Capability List with comparison.	**L4**
9	**3**	a. Differentiate between Authentication and Authorization. b. Explain different types of security attacks (Masquerade, Replay, Man-in-the-middle, etc.) with examples.	**L4** **L3**
10	**3**	Explain the role of Kernel in Linux operating system.	**L3**
11	**3**	Explain elementary Linux commands with syntax and examples.	**L3**
12	**3**	a. Explain shell programming with examples. b. Write a shell script to perform basic operations (e.g., factorial, palindrome, file existence check). Explain the logic.	**L3** **L5**
13	**3**	Explain the development and evolution of UNIX and Linux.	**L4**
14	**3**	a. Explain Linux system calls with examples. b. Explain file permissions in Linux with chmod command and examples.	**L3** **L3**

S.No.	**CO**	**Questions**	**BT**
Unit IV: SYSTEM SOFTWARE AND LANGUAGE PROCESSING			
1	**4**	Explain System Software and Software Hierarchy with neat diagram.	**L3**
2	**4**	Explain the Language Processing System with neat block diagram and illustrate how a source program is translated into executable code.	**L3**

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3	**4**	Analyze the phases of a Language Processor (Lexical, Syntax, Semantic, Code Generation) and explain their interrelationship.	**L4**
4	**4**	Design a Symbol Table for a compiler and explain operations such as insertion, search, and deletion using hashing technique.	**L5**
5	**4**	Compare different Search and Allocation Data Structures used in Language Processing and justify their suitability.	**L5**
6	**4**	Explain Systems Programming in relation to Machine Structure and analyze how address space is managed.	**L4**
7	**4**	Design a Two-Pass Assembler and explain its working with algorithm and flowchart.	**L5**
8	**4**	Differentiate between Single-Pass and Two-Pass Assemblers and evaluate their advantages and limitations.	**L4**
9	**4**	Explain Macro Definition and Macro Expansion with suitable example and show how nested macros are processed.	**L4**
10	**4**	Analyze the working of a Macro Processor and explain advanced macro features.	**L4**
11	**4**	Design a Macro Assembler and explain its components with neat diagram.	**L5**
12	**4**	Explain the concept of Linking and Relocation with suitable example and illustrate address modification process.	**L4**
13	**4**	Analyze different Loading Schemes (Absolute, Relocating, Linking Loader) and compare their features.	**L4**
14	**4**	a. Compare Linker and Loader in terms of functionality, design, and execution environment. b. Evaluate Dynamic Linking and discuss its advantages and disadvantages in modern systems.	**L4** **L5**
15	**4**	Analyze the process of external symbol resolution during linking with suitable example.	**L5**

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Unit V: SYSTEM PROGRAMMING			
1	**5**	Explain different types of grammars in Chomsky Hierarchy. Compare Type-0, Type-1, Type-2, and Type-3 grammars with examples.	**L4**
2	**5**	Discuss ambiguity in grammar. How can ambiguity be removed? Explain with suitable examples.	**L4**
3	**5**	Explain the phases of compilation process with neat diagram.	**L3**
4	**5**	Differentiate between compiler and interpreter. Explain semantic gap, binding, and scope rules with examples.	**L4**
5	**5**	Explain scanning and parsing in detail. Compare top-down and bottom-up parsing techniques.	**L4**
6	**5**	Explain memory allocation techniques (Static, Stack, Heap) used in compilation.	**L3**
7	**5**	Explain compilation of expressions and control structures with suitable examples.	**L5**
8	**5**	Discuss code optimization techniques. Explain different types of optimizations with examples.	**L5**
9	**5**	Explain process creation and control in UNIX/Linux using fork() and exec() system calls with example program.	**L3**
10	**5**	Explain Inter-Process Communication (IPC) using Pipes and Signals. Write example programs.	**L3**
11	**5**	Explain machine-level representation of data and programs (Assembly level view of C program).	**L4**
12	**5**	Explain file I/O system calls in UNIX (open, read, write, close) with example.	**L3**
13	**5**	Explain basic threading concepts and compare processes vs threads.	**L4**
14	**5**	Explain symbol tables and data structures used in language processing.	**L3**
15	**5**	Explain shell basics and commonly used UNIX commands in C development environment.	**L3**