Shri Madhwa Vadiraja Institute of Technology & Management
Vishwothama Nagara, Bantakal, Udupi - 574115

SMVITM

COURSE FILE (2022-23)

Department: Computer Science and Engineering **Class: 4th sem**

Course Title: Operating Systems **Course code:21CS44**

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1. Course details

1.1 Primary information

1	**Course Code**	**21CS44**
2	**L-T-P-S**	2-2-0-0
3	**Course Credit**	3
4	**Marks (Min/Max)** **VTU Exam** **Internal Assessment**	40/100 21/50 19/50
5	**Prerequisite**	Computer Organization Basics
6	**Teaching Department**	Computer Science and Engineering
7	**Course Duration**	40
8	**Faculty Handling the course**	Ms. Savitha A Shenoy, Mr.Ranjan Kumar
9	**Course Coordinator**	Ms. Savitha A Shenoy

1.2 Textbooks

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 7th edition, Wiley-India, 2006.

1.3 Reference Books

1. Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition
2. D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGrawHill, 2013.
3. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI(EEE), 2014.
4. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson

1.4 Other Resources (Online, Text, Multimedia, etc.) – NIL

1.5 Link of class web page (Google classroom/CANVAS etc.,)

A Section: https://classroom.google.com/c/NjEzNzE4MDA5NTMx Class code: ld2isyi

B Section: https://classroom.google.com/u/1/c/NjAyMzQ1MzQ3MjMw Class code: osvklbe

2. Course Plan

2.1 Course Outcomes

Sl. No.	At the end of the course, Students will be able to	Bloom's Level	Target Attainment
CO1	**Illustrate** the structure, design, and implementation of an operating system and interprocess communication.	L2	2.1
CO2	**Apply** scheduling algorithms for the processes, threads and **demonstrate** the process synchronization.	L3	2.1
CO3	**Build** the solution for deadlock elimination by Identifying the root causes of deadlock .	L3	2.1
CO4	**Apply** the concepts of paging, page replacement, and file handling in managing free space.	L3	2.1
CO5	**Illustrate** Storage Structures and **Summarize** the Case Study on the Linux Operating system.	L2	2.1

***Cognitive levels as per Bloom's Taxonomy**: L1-Remembering, L2-Understanding, L3-Applying, L4-Analyzing, L5-Evaluating and L6-Creating*

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2.2 Mapping of COs with POs (Course articulation matrix)

POs Mapping Level: 1-Slightly 2-Moderately 3-Highly

	Engineering Knowledge	Problem Analysis	Design & Development of Solutions	Conduct Investigations of Complex Problems	Usage of Modern Tools	Engineer & Society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Management & Finance	Life-long Learning		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1											1	
CO2	2	1		1										
CO3	1	1		1									1	
CO4	1	1												
CO5		1			1									

2.3 Justification for CO-PO mapping

		Justification	Performance Indicator
CO1	PO1	Applying the fundamentals of engineering in design of operating systems and interprocess communication	1.4.1 1.3.1
	PO2	Identifying functionalities in the design of operating systems and comparing various inter process communication methods	2.2.2 2.2.4
	PSO1	Be able to understand the design of various modules of operating System	
CO2	PO1	Apply engineeringfundamentals in design of scheduling algorithms	1.3.1 1.4.1
	PO2	Able to Identify existing solution/methods to solve the critical section problem, including semaphores and monitors	2.2.4 2.2.3
	PO4	Able to choose appropriate scheduling algorithms	4.1.2
CO3	PO1	Apply fundamentals of engineering to identify deadlocks and recover from it	1.3.1
	PO2	Able to compare and contrast alternative solution/methods to select the best methods for memory management	2.2.4
	PO4	Able to choose appropriate memory management algorithms	4.1.2
	PSO1	Able to understand the design of deadlock prevention and recovery algorithms	
CO4	PO1	Apply engineering principles in design of file system structure	1.4.1
	PO2	Compare and contrast various page replacement algorithms	2.2.4
CO5	PO2	Compare and contrast various disk scheduling algorithms	2.2.4
	PO5	Identify modern operating system tools	5.1.1

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2.4 Continuous Improvement (Actions taken based on the comments/suggestions of the AY: 2021-22)

SI	Scope for Improvement/Comments/Curriculum Gap (2020-21)	Action Items
1	Case study on LINUX	Case study will be given for assesment

2.5 Topic Level Outcomes

Module	Topic	Topic Level Outcomes At the end of the topic students will be able to	Bloom's Level	Relevant CO	Assessment Tools
1	Introduction to operating systems, System structures Operating System Services Process Management	1.1Describe the basic organization of operating system and the services provided to users, processes, and other systems. 1.2 Explain the usage of system call, its types and basics of virtual machines 1.3 Outline the basics of the process and illustrate the inter-process communication using different models.	L2 L2 L3	CO1	IA
2	Multi threaded Programming Process Synchronization	2.1 Describe the basics of thread and multi-threaded concept in operating system. 2.2 Discuss thread management concept in operating system. Compare various scheduling algorithms. 2.3 Explain process synchronization and critical section problem with software solution. 2.4 Give an outline on semaphores and monitors as a solution to critical section problems.	L2 L3 L3 L3	CO2	IA, Assignment, Quiz
3	Deadlocks Memory Management	3.1 Discuss the concept of deadlock and its characterization 3.2 Apply the different Deadlock prevention and avoidance algorithms in computer systems. 3.3 Illustrate various memory- management techniques, including paging and segmentation and organizing memory hardware.	L2 L3 L3	CO3	IA, Assignment, Quiz

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L6	System programs; Operating system design and implementation; Operating System structure; Virtual machines; Operating System generation; System boot.	1.2	09/6/23	17/6/23			
L7	**Process Management:** Process concept; Process scheduling; Operations on processes	1.3	13/6/23	17/6/23			Sy
L8	Inter process communication	1.3	16/6/23	22/6/23			
T1	Demo on Virtual machine		16/6/23	23/6/23			
T2	concepts of Inter Process communication		19/6/23	23/6/23			
	Module 2						
L9	**Multi-threaded Programming:** Overview; Multithreading models; Thread Libraries; Threading issues.	2.1	20/6/23	30/6/23			
L10	Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms;	2.2	22/6/23	30/6/23			
L11	Scheduling Algorithms;	2.2	23/6/23	1/7/23			
L12	Multiple-processor scheduling; Thread scheduling.	2.2	30/6/23	3/7/23	Chalk and Talk, PPT		Sy
L13	**Process Synchronization:** Synchronization: The critical section problem;	2.3	03/7/23	11/7/23			
L14	Peterson's solution; Synchronization hardware;	2.3	04/7/23	13/7/23			
L15	Semaphores; Classical problems of synchronization;	2.4	06/7/23	14/7/23			
L16	Monitors.	2.4	13/7/23	20/7/23			
T3	Ubuntu commands		14/7/23	21/7/23			

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4	**Virtual Memory Management** **File System, Implementation of File System**	4.1 Apply page-replacement algorithms, and allocation of page frames and the principle of the working-set model. 4.2 Explain the function of file systems and discuss file- system design tradeoffs, including access methods, file sharing, file locking, and directory structures. 4.3 Outline directory implementation and allocation methods in disk.	L3 L2 L2	CO4	IA, Quiz
5	**Secondary Storage Structures, Protection** **Case Study: The Linux Operating System**	5.1Describe secondary storage structure and application of the good disk scheduling algorithm and swap space management 5.2 Discuss the goals and principles of protection in a modern computer operating system 5.3 Explore the components of LINUX operating system and its design principles	L3 L2 L2	CO5	IA, Assignment

2.6 Course Delivery Schedule

Lect./Prct. No.	Topics to be covered	Relevant TLO	Date on which topics covered		Mode of Delivery	Faculty Sign (Every class)	HoD Sign (Every Module)
			A section	B section			
Module 1							
L1	**Introduction to OS** : What Operating systems do, Computer System organization, Computer System Architecture	1.1	29/5/23	8/6/23	Chalk and Talk, PPT		
L2	Operating System structure; Operating System operations;	1.1	30/5/23	9/6/23			
L3	Process management; Memory management; Storage management; Protection and Security;	1.1	01/6/23	10/6/23			
L4	Distributed system; Special-purpose systems; Computing environments	1.1	05/6/23	13/6/23			
L5	**Operating System Services:** User - Operating System interface; System calls; Types of system calls;	1.2	08/6/23	16/6/23			

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T4	Ubuntu Commands		24/7/23	21/7/23			
Module 3							
L17	**Deadlocks :** Deadlocks; System model; Deadlock characterization;	3.1	25/7/23	26/7/23	Chalk and Talk, PPT		
L18	Methods for handling deadlocks; Deadlock prevention;	3.2	27/7/23	28/7/23			
L19	Deadlock avoidance;	3.2	28/7/23	10/8/23			
L20	Deadlock detection and recovery from deadlock.	3.2	31/7/23	11/8/23			
L21	**Memory Management:** Memory management strategies: Background;	3.3	31/7/23	12/8/23			
L22	Swapping; Contiguous memory allocation;	3.3	02/8/23	17/8/23			
L23	Paging, Structure of Page Table	3.3	03/8/23	17/8/23			
L24	Segmentation	3.3	03/8/23	18/8/23			
T5	Deadlock Problems		04/8/23	18/8/23			
T6	Memory Mgmt Problems		10/8/23	24/8/23			
Module 4							
L25	**Virtual Memory Management:** Background; Demand paging;	4.1	11/8/23	25/8/23	Chalk and Talk, PPT		
L26	Demand paging; Copy-on-write;	4.1	17/8/23	25/8/23			
L27	Page replacement;	4.1	17/8/23	01/9/23			
L28	Page replacement;	4.1	18/8/23	01/9/23			
L29	Allocation of frames; Thrashing.	4.1	18/8/23	2/9/23			

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L30	**File System, Implementation of File System:** File system, File concept; Access methods; Directory Structure; File System Mounting	4.2	21/8/23	2/9/23		
L31	File sharing; Protection: Implementing File system: File system structure; File system implementation;	4.2	22/8/23	2/9/23		
L32	Directory Implementation; Allocation methods; Free space Management	4.3	24/8/23	8/9/23		
T7	Page Replacement Policies		25/8/23	8/9/23		
T8	Concepts of Thrashing		29/8/23	8/9/23		
	Module 5					
L33	**Secondary Storage Structures, Protection:** Mass storage structures; Disk structure; Disk attachment;	5.1	29/8/23	9/9/23	Chalk and Talk, PPT	
L34	Disk scheduling;	5.1	29/8/23	9/9/23		
L35	Disk scheduling; Disk management; Swap space management.	5.1	01/9/23	9/9/23		
L36	Protection: Goals of protection, Principles of protection, Domain of protection, Access Matrix	5.2	01/9/23	11/9/23		
L37	Implementation of access matrix, Access control, Revocation of access rights, Capability- Based systems	5.2	02/9/23	11/9/23		
L38	**Case Study: The Linux Operating System:** Linux history; Design principles; Kernel Modules; Process Management	5.3	04/9/23	11/9/23		
L39	Scheduling; Memory Management; File systems	5.3	04/9/23	Assignment		

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L40	Input and output; Inter-process communication.	5.3	05/9/23	11/9/23			S2
T9	Disk Scheduling problems		09/9/23	9/9/23			
T10	Concepts of Principles of protection		09/9/23	9/9/23			

Signature of Faculty Handling
Date:

Course Coordinator
Date: 29/5/23

HOD
Date: 29/5/23

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2.7 Topics Covered Beyond Syllabus

Date		Topic Covered	Relevant PO	Mode of delivery
A section	B section			
14/7/2023 24/7/2023		Simple command on Ubuntu Operating system (Demo Session)	PO5	Demo was given in the Lab

2.8 Remedial class Details

S. No.	Date	Topic discussed/numerical problem solved	No. of Students attended
1	2/8/2023	IA-1 PAPER REVISION	17
2	10/8/2023	*Numerical Problems on FCFS, non preemptive SJF, Non preemptive Priority process scheduling algorithms*	14
3	21/8/2023	*Numerical Problems on preemptive SJF, preemptive Priority and Round robin process scheduling algorithms*	17
4	02/9/2023	*Numerical Problems on Bankers Algorithm*	16
5	05/9/2023	*Numerical problems on Disk Scheduling algorithms*	17

3. Assessment of COs

3.1 Assessment Schedule

Date	Assessment Tool Used	TLOs Assessed	Average Cognitive Level
11/7/2023	IA1	1.1, 1.2, 1.3, 2.1, 2.2	2.28
08/08/2023	IA2	2.3, 2.4, 3.1, 3.2	2.50
12/09/2023	IA3	3.3, 4.1, 4.2, 4.3	2.25
04/09/2023	Quiz1	1.1, 1.2, 1.3	2.00
17/09/2023	Quiz2	1.1, 1.2, 1.3, 2.2	2.00
04/09/2023	Assignment1	5.1, 5.2, 5.3	2.20

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3.2 Measuring CO Attainment

3.2.1 Direct attainment

CO	TLOs mapped	Assesment Tool Used	Attained Level of Bloom's Taxonomy	Marks allotted	Total Marks	Weightage	Attainment Level	Contribution to CO Attainment	CO - Direct attainment
	1.1	IA1	L2	10		0.26	3.00	0.79	
	1.1	Q1	L2	4		0.11	3.00	0.32	
	1.1	Q2	L2	3		0.08	3.00	0.24	
	1.2	IA1	L2	5		0.13	1.00	0.13	
	1.2	Q1	L2	1		0.03	3.00	0.08	
	1.2	Q2	L2	3		0.08	3.00	0.24	
	1.3	IA1	L2	5		0.13	3.00	0.39	
	1.3	Q1	L2	5		0.13	3.00	0.39	
CO1	1.3	Q2	L2	2	38	0.05	3.00	0.16	2.74
	2.1	IA1	L2	9		0.21	3.00	0.64	
	2.2	IA1	L3	11		0.26	1.00	0.26	
	2.2	Q2	L2	2		0.05	3.00	0.14	
	2.3	IA2	L2	5		0.12	3.00	0.36	
CO2	2.4	IA2	L3	15	42	0.36	3.00	1.07	2.47
	3.1	IA2	L3	10		0.33	3.00	1	
	3.2	IA2	L3	10		0.33	3.00	1	
CO3	3.3	IA3	L2	10	30	0.33	3.00	1	3.00
	4.1	IA3	L3	15		0.50	3.00	1.5	
	4.2	IA3	L2	10		0.33	3.00	1	
CO4	4.3	IA3	L2	5	30	0.17	1.00	0.17	2.67
	5.1	A1	L3	4		0.13	3.00	0.4	
	5.2	A1	L2	4		0.13	3.00	0.4	
CO5	5.3	A1	L2	12	20	0.40	3.00	1.2	2.00

3.2.2 Indirect attainment (Course end survey)

S. No.	CO	No. of students responded				CO attainment
		Strongly Agree	Somewhat Agree	Neutral	Disagree	
1	**Illustrate** the structure, design, and implementation of an operating system and interprocess communication.	75	46	11	1	2.47
2	**Apply** scheduling algorithms for the processes, threads and **demonstrate** the process synchronization.	75	48	9	1	2.48

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3	**Build** the solution for deadlock elimination by Identifying the root causes of deadlock .	73	48	11	1	2.45
4	**Apply** the concepts of paging, page replacement, and file handling in managing free space.	73	50	9	1	2.47
5	**Illustrate** Storage Structures and **Summarize** the Case Study on the Linux Operating system.	75	45	11	2	2.45

3.2.3 Final CO attainment

Sl. No.	Course Outcomes	Direct attainment	Indirect attainment	Final CO = 80% DA + 20% IA
1	**Illustrate** the structure, design, and implementation of an operating system and interprocess communication.	2.74	2.47	2.68
2	**Apply** scheduling algorithms for the processes, threads and **demonstrate** the process synchronization.	2.47	2.48	2.47
3	**Build** the solution for deadlock elimination by Identifying the root causes of deadlock .	3.00	2.45	2.89
4	**Apply** the concepts of paging, page replacement, and file handling in managing free space.	2.67	2.47	2.63
5	**Illustrate** Storage Structures and **Summarize** the Case Study on the Linux Operating system.	2.00	2.45	2.09

3.3 Observations of Course coordinator on CO attainment

Sl. No.	Course Outcomes	Target	Attainment	Gap	Action Proposed to bridge the Gap	Revision of target wherever achieved
1	**Illustrate** the structure, design, and implementation of an operating system and interprocess communication.	2.1	2.68	--		2.2
2	**Apply** scheduling algorithms for the processes, threads and **demonstrate** the process synchronization.	2.1	2.47	-- -		2.2 2.2

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3	**Build** the solution for deadlock elimination by Identifying the root causes of deadlock .	2.1	2.89	--		2.2
4	**Apply** the concepts of paging, page replacement, and file handling in managing free space.	2.1	2.63	--		2.2
5	**Illustrate** Storage Structures and **Summarize** the Case Study on the Linux Operating system.	2.1	2.09	0.01	More problems can be solved on disk scheduling. Also, case studies can be given on different operating systems.	

3.4 Other Information about the course

	Section - A	Section - B
Total number of classes held	50	50
Number of tutorial classes held	10	10
Number of seminars held	-	-
Portion coverage	100%	100%
Student's feedback	82.94	
No. of students having attendance shortage	Nil	Nil
University result		
Use of various teaching methods	PPT, Board work	PPT, Board work
Details of the e-content developed	-	-

3.5 Outcomes on Actions of the Observations/Suggestions of the AY: 2022-23

S. No.	Action Taken	Change Observed
1	Case Study on Linux was given as an assignment	Students were able to learn the concepts of operating system clearly as it was a part in the case study

3.6 Comments/Suggestions by the Course Coordinator for the next academic year (2023-24)

S. No.	Comment/Observations	Suggested Actions

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1.	All CO's are achieved satisfactorily except CO5	Solve more problems on disk scheduling and discuss more case studies on different operating systems.

Signature of Faculty Handling
Date:

Course Coordinator
Date: 17-10-2023

HOD
Date: 17/10/23

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