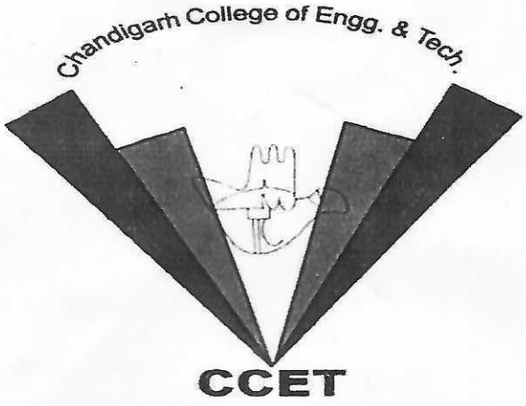
COURSE FILE

Subject: OPERATING SYSTEMS
Course Code: CS-403
B.E II YEAR-IV Semester



CHANDIGARH COLLEGE OF ENGINEERING AND TECHNOLOGY (DEGREEWING)
Government Institute under Chandigarh(UT) Administration,
Affiliated to Panjab University, Chandigarh Sector-26,Chandigarh.PIN-160019

CONTENTS OF COURSE FILE

Institute-Vision and Mission

Vision:

Chandigarh College of Engineering and Technology aims to be a centre of excellence for imparting technical education and serving the society with self-motivated and highly competent technocrats.

Mission:

1. To provide high quality and value based technical education.
2. To establish a centre of excellence in emerging and cutting edge technologies by encouraging research and consultancy in collaboration with industry and organizations of repute.
3. To foster a transformative learning environment for technocrats focused on inter-disciplinary knowledge; problem-solving; leadership, communication, and interpersonal skills.
4. To imbibe spirit of entrepreneurship and innovation for development of enterprising leaders for contributing to Nation progress and Humanity

Department-Vision and Mission

Vision:

To be recognized as a front runner technological leader in Computer Science and Engineering education and research to meet the growing manpower requirements of the Global Software & hardware Industry/Organisation.

Mission:

M1: To move forward as frontiers of human knowledge to enrich the citizen, the nation, and the world.
M2: To excel in research and innovation that discovers new knowledge and enables new technologies and systems.
M3: To develop technocrats, entrepreneurs, and business leaders of future who will strive to improve the quality of human life.
M4: To create world class computing infrastructure for the enhancement of technical knowledge in field of Computer Science and Engineering.

Program Educational Objectives:

PEO1: Graduates will be technocrats who will be able to apply their mathematical, theoretical, Analytical as well as practical skills in the design and implementation of need-based systems.

PEO2: Graduate will go for higher studies and research in technical and management disciplines.

PEO3: Graduates will work as technocrats, Entrepreneurs, and Business Leaders of the future.

Program Specific Outcomes:

Graduate will able to

PSO1: To be able to understand the problem, think of the best suitable approach to solve the problem, develop and evaluate effective solutions.

PSO2: To be able to excel in contemporary technologies being adopted by the industry and academia.

PSO3: To be able to excel in various programming/project competitions and technological challenges laid by professional bodies.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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, review 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 modelling 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 ofthe engineering practice.
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.

Operating Systems

Course Objectives (CO)

1. To introduce design and implementation issues of various Operating Systems: batch, multiprogrammed, time sharing, real time, distributed, parallel Operating System structural Components, layered structure, functions
2. To understand concept of processes, CPU Scheduling Algorithms: FCFS, SJF, RR and Priority, Inter Process communication, Process Synchronization, Critical Sections, Semaphores and Monitors.
3. To introduce Deadlocks Detection , Recovery, Avoidance and Prevention
4. To familiarize with Memory Management using contiguous memory allocation, paging, segmentation, segmentation with paging.
5. To introduce Virtual Memory, demand paging and page replacement algorithms (FIFO, Optimal, LRU), Thrashing.
6. To understand File Systems, directory structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping) and Protection mechanisms.
7. To discuss Disk Structure, Disk Scheduling (FCFS, SSTF, SCAN, CSCAN, and LOOK), Disk Management (Disk Formatting, Boot Blocks, and Bad Blocks), Swap Space Management (Swap Space use, Swap Space Location, Swap Space Management).
8. To explore case Studies: Brief introduction of MS-DOS, Windows, UNIX and LINUX

Course Outcome

1. Design and implement solutions for CPU scheduling, process synchronization and deadlock related problems.
2. Understand the concepts of memory management, Secondary storage management and File system management along with providing solutions for real world problems.
3. Explore features and functionality of MSDOS, Windows, Unix and Linux.

BATCH 2021-25

4TH SEMESTER

2021-25

S.NO.	Roll No.	Name
1	CO21303	Abhishek Sharma
2	CO21304	Aditya Saroj
3	CO21305	AISHITA
4	CO21306	Akshit Chhikara
5	CO21307	Akshit rawat
6	CO21308	Amanpreet Singh
7	CO21309	Ankit Kumar Gupta
8	CO21310	Arnav Arora
9	CO21311	Aryan Malhotra
10	CO21312	Avneet Kaur
11	CO21313	Briti Singla
12	CO21314	Charan Kamal Singh
13	CO21315	Chetan Kumar
14	CO21316	Eshita Badwal
15	CO21317	Garvit Nag
16	CO21318	Gurmehar Singh Virdi
17	CO21320	Harkiran Kaur
18	CO21321	Harmanpreet Singh
19	CO21322	Harshdeep Singh
20	CO21324	Huzaifa Ali
21	CO21325	Ishtveer Singh Billing
22	CO21326	Japan Ajit Singh Gandhi

23	CO21327	Jiya
24	CO21328	Kanishk Nagpal
25	CO21329	Karan Kanwar
26	CO21330	Karan Sharma
27	CO21331	KARAN SINGH BALA
28	CO21332	Karandeep Singh
29	CO21333	Kartik
30	CO21335	Khushal
31	CO21336	Khushbu
32	CO21337	Krish Kathuria
33	CO21338	Krishana Singla
34	CO21339	Kshitij Jethanandani
35	CO21340	Lakshay Arora
36	CO21342	Manraj singh gill
37	CO21343	Mehak Preet
38	CO21344	Mohd Tarique
39	CO21345	Nikunj Arya
40	CO21346	Nirbhay Singh Sandhu
41	CO21347	Palvasha Bansal
42	CO21348	Prince Kumar
43	CO21349	Rishika Rawat
44	CO21350	Ritika Gupta
45	CO21351	Rohan Bhola
46	CO21352	Ruchika Thakur
47	CO21353	Saksham walia

48	CO21354	SAMARTH SHARMA
49	CO21356	Shaurya Harsh
50	CO21357	Siddharth Singh Khati
51	CO21358	Simratpreet kaur
52	CO21359	Sovan chakma
53	CO21361	Tarayan Aggarwal
54	CO21362	Tushar Singh
55	CO21363	Ujjwal
56	CO21364	Utkarsh Chauhan
57	CO21365	Vaghmare Siddharth
58	CO21366	Vanshika Bhardwaj
59	CO21367	Varun goyal
60	CO21368	Vibhuti Bhardwaj
61	CO21370	Yashvi
62	CO21371	Neha Bhagat
63	MCO21373	Hardik Gupta
64	MCO21374	Jaskirat Kaur
65	MCO21375	Karan Sharma
66	MCO21376	Manya
67	LCO21377	Rashmi
68	LCO21378	Ritika Saini
69	LCO21379	Anirudh Mehandru
70	LCO21380	Deepinder Singh
71	LCO21381	Priyanshu
72	LCO21383	Saket Sarin

73	LCO21384	Shivan Goyal
74	LCO21385	Shivan Singh Nayal

Chandigarh College of Engineering and Technology
Sector-26, Chandigarh
Academic Calendar for 4th, 6th & 8th semester
Session: 2022-23

	EVENTS	FROM	TO
1	Academic term: Teaching for the even semester	09-01-2023 (Monday)	12-05-2023 (Friday)
2	Minor-1	27-02-2023(Monday)	03-03-2023 (Friday)
3	Minor-2	01-05-2023 (Monday)	08-05-2023 (Monday)
4	Study Group for odd semester (Preparatory)	09-05-2023 (Tuesday)	14-05-2023 (Sunday)
5	University Examination (Theory) Even semester	15-05-2023 (Monday)	31-05-2023 (Wednesday)
6	Summer Vacation	04-06-2023 (Sunday)	09-07-2023 (Sunday)
7	Showing of answer sheets to students	29-05-2023 (Monday)	02-06-2023 (Friday)
8	Department reopen for Odd semester	10-07-2023 (Monday)	

Prof. Incharge Academic Affairs
Chd. College of Engg. & Tech.
Sector - 26, Chandigarh

Chandigarh College of Engg. & Technology (Degree Wing) and
Tentative Time Table - Computer Sc. & Engg. Deptt. (Jan-June 2023) w.e.f. 27.01.2023

	CSE IV Sem							
	09:30	10:30	11:30	12:30	13:30	14:30	15:30	16:30
Monday	Web Technologies Er. Sudhakar Kumar LH 7	Operating System P- Gp 1 Dr. Dheerendra Singh CL 14			-X-	Analysis & Design of Algo Er. Sunita LH 7	S/w Engg Dr. Ankit Gupta LH 7	
		Analysis & Design of Algo P- Gp 2 Dr. Sunita CL 4						
		S/w Engg P - Gp 3 Dr. Ankit Gupta CL 1						
Tuesday	Analysis & Design of Algo Er. Sunita LH 7	Operating System Dr. Dheerendra Singh LH 7	S/w Engg Dr. Ankit Gupta LH 7	Comp. Arch. & Organization Dr. Sunil K Singh LH 7	-X-	Analysis & Design of Algo P- Gp 1 Dr. Sunita CL 4		
						Web Technologies P - Gp 2 Er. Sudhakar Kumar CL 7		
						Operating System P- Gp 3 Dr. Dheerendra Singh CL 14		
Wednesday	Operating System Dr. Dheerendra Singh LH 7	S/w Engg Dr. Ankit Gupta LH 7	Comp. Arch. & Organization Dr. Sunil K Singh LH 7	Web Technologies Er. Sudhakar Kumar LH 7	-X-	S/w Engg P - Gp 1 Dr. Ankit Gupta CL 1		
						Operating System P- Gp 2 Dr. Dheerendra Singh CL 11		
						Web Technologies P - Gp 3 Er. Sudhakar Kumar CL 7		
Thursday	Web Technologies Er. Sudhakar Kumar LH 7	Operating System Dr. Dheerendra Singh LH 7	Analysis & Design of Algo Er. Sunita LH 7	Comp. Arch. & Organization Dr. Sunil K Singh LH 7	-X-	Web Technologies P - Gp 1 Er. Sudhakar Kumar CL 3		
						S/w Engg P - Gp 2 Dr. Ankit Gupta CL 1		
						Analysis & Design of Algo P- Gp 3 Dr. Sunita CL 9		
Friday	S/w Engg Dr. Ankit Gupta LH 7	Analysis & Design of Algo Er. Sunita LH 7	Comp. Arch. & Organization Dr. Sunil K Singh LH 7	Web Technologies Er. Sudhakar Kumar LH 7	-X-	Operating System Dr. Dheerendra Singh LH 7		

27.01.2

CHANDIGARH COLLEGE OF ENGINEERING AND TECHNOLOGY (CCET- DEGREE WING)

Department of Computer Science and Engineering

Teaching Load (Jan.- June 2023)

S No	Name of Faculty	Subject /Code/Semester	Load			Total	Sign.
			L	T	P		
1	Dr. M. S. Gujral	Industrial Training/ CS 855			6	6	
2	Dr. Sunil K Singh	Computer Architecture and Organization/ CS 405/IV Industrial Training/ CS 855	4		9	13	
3	Dr. R. B. Patel	Computer Networks and Security/CS 601/VI Computer Networks and Security (Pr)/CS 651/VI	4		9	13	
4	Dr. Varun Gupta	Linear Algebra and Probability Theory/ CS 602/VI Data Mining and Analysis (Pr)/CS 655C/VI	4		9	13	
5	Dr. Dheerendra Singh	Operating Systems/CS 403/IV Operating Systems (Pr)/CS 453/IV	4		9	13	
6	Dr. Gulshan Goyal	Compiler Design/CS 604/ VI Compiler Design (Pr)/CS 654/VI Industrial Training/ CS 855	4		9 3	16	
7	Dr. Sunita	Analysis and Design of Algorithms/CS 401/IV Analysis and Design of Algorithms (Pr)/CS 451/IV Industrial Training/ CS 855	4		9 3	16	
8	Dr. Amit Chhabra	Modeling and Simulation/ CS 603/VI Modeling and Simulation (Pr)/ CS 653/VI Industrial Training/ CS 855	4		9 3	16	
9	Dr. Ankit Gupta	Data Mining and Analysis/CS 605C/VI Software Engineering /CS 404/IV Software Engineering (Pr)/CS 454/IV	4 4		9	17	
10	Dr. Sarabjeet Singh	Object Oriented Programming/CSC 201/II Object Oriented Programming (Pr)/CSC 201/II Industrial Training/ CS 855	3		6 7	16	
11	Er. Sudhakar Kumar	Web Technologies/CS 402/IV Web Technologies (Pr)/CS 452/IV Industrial Training/ CS 855	4		9 3	16	
12	Er. Animesh Singh	Introduction to Computer Science/ CSC 202 Industrial Training/ CS 855	3		13	16	

HOD, CSE

Branch: Computer Science and Engineering

Course Code	**CS 403**
Course Title	**OPERATING SYSTEM**
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Introduction to Computer Science and Engineering (CS102), Programming Fundamentals (CS101/201), Data Structures (CS301).
Course Objectives (CO)	1. To introduce design and implementation issues of various Operating Systems: batch, multiprogrammed, time sharing, real time, distributed, parallel Operating System structural Components, layered structure, functions 2. To understand concept of processes, CPU Scheduling Algorithms: FCFS, SJF, RR and Priority, Inter Process Communication, Process Synchronization, Critical Sections, Semaphores and Monitors. 3. To introduce Deadlocks Detection , Recovery, Avoidance and Prevention 4. To familiarize with Memory Management using contiguous memory allocation, paging, segmentation, segmentation with paging. 5. To introduce Virtual Memory, demand paging and page replacement algorithms (FIFO, Optimal, LRU), Thrashing. 6. To understand File Systems, directory structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping) and Protection mechanisms. 7. To discuss Disk Structure, Disk Scheduling (FCFS, SSTF, SCAN, C-SCAN, and LOOK), Disk Management (Disk Formatting, Boot Blocks, and Bad Blocks), Swap Space Management (Swap Space use, Swap Space Location, Swap Space Management). 8. To explore case Studies: Brief introduction of MS-DOS, Windows, UNIX and LINUX.

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SYLLABUS

Note for Examiner- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

SECTION-A

Introduction: What is an O.S., O.S. Functions; Different types of O.S.: batch, multiprogrammed, time sharing, real time, distributed, parallel; General structure of operating system, O/S services, system calls.

(5 hours)

Process Management: Introduction to processes - Concept of processes, process scheduling, operations on processes; Interprocess Communication, Critical Sections, Mutual Exclusion with Busy Waiting, Sleep and Wakeup, Semaphores, Message passing; CPU scheduling- scheduling criteria, pre-emptive & non-pre-emptive scheduling, Scheduling Algorithms: FCFS, SJF, RR and priority, Threads.

(10 hours)

Deadlocks: Introduction to deadlocks, Conditions for deadlock, Resource allocation graphs, Deadlock Detection and Recovery, Deadlock Avoidance, Deadlock Prevention

(6 hours)

SECTION-B

Memory Management: background, logical vs. physical address space, memory management without swapping; swapping; contiguous memory allocation, paging, segmentation, segmentation with paging; Virtual Memory, demand paging, performance, page replacement, page replacement algorithms (FIFO, Optimal ,LRU); Thrashing.

(6 hours)

File Systems: Files - file concept, file structure, file types, access methods, File attributes, file operations; directory structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping), Protection mechanisms.

(6 hours)

Secondary Storage : Disk Structure, Disk Scheduling (FCFS, SSTF, SCAN, C-SCAN, LOOK), Disk Management (Disk Formatting, Boot Blocks, Bad Blocks), Swap Space Management (Swap Space use, Swap Space Location, Swap Space Management)

(6 hours)

Case Studies: Brief introduction of MS-DOS, Windows, UNIX and LINUX.

(6 hours)

TEXT BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1.	Operating System Concepts	Silberschatz and Galvin	Addison Wesley Inc.
2	Operating System Design & Implementation	Tanenbaum A.S	Pearson Education.
3	An introduction to Operating Systems Concepts and Practice,	Bhatt and Chandra	Prentice Hall of India Publication

Branch: Computer Science and Engineering

Course Code	CS 453
Course Title	**OPERATING SYSTEM (Practical)**
Type of Course	Core
L T P	0 0 3
Credits	1
Course Assessment Methods End Semester Assessment Continuous Assessment	 50

SYLLABUS

Practical should be covered based on the following directions:

1. Learning Basic Features and Operating Environment of UNIX and LINUX.
2. Introduction to Shell and Shell Commands.
3. Shell programming: creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions, commands).
4. Process: starting new process, replacing a process image, duplicating a process image, waiting for a process.
5. Programming with semaphores.

OS LESSON PLAN

SECTION A

CHAPTER	TOPICS	NO OF LECTURES
CHAPTER 1	1.1 What is an Operating System?	1
	1.2 OS Functions	1
	1.3 Different Types of OS: Batch, Multiprogrammed, Time Sharing, Real-time, Distributed, Parallel	2
	1.4 General Structure of Operating System	1
	1.5 OS Services and System Calls	1
CHAPTER 2	2.1 Introduction to Processes	1
	2.2 Concept of Processes	1
	2.3 Process Scheduling	1
	2.4 Operations on Processes	1
	2.5 Interprocess Communication	1
	2.6 Critical Sections, Mutual Exclusion, Busy Waiting	1
	2.7 Sleep and Wakeup Mechanisms	1
	2.8 Semaphores, Message Passing	1
	2.9 CPU Scheduling: Criteria, Preemptive & Non-preemptive Scheduling	1
	2.10 Scheduling Algorithms: FCFS, SJF, RR, Priority	2
	2.11 Threads	1
CHAPTER 3	3.1 Introduction to Deadlocks	1
	3.2 Conditions for Deadlock	1
	3.3 Resource Allocation Graphs	1
	3.4 Deadlock Detection and Recovery	1
	3.5 Deadlock Avoidance and Prevention	2

CONTENT BEYOND SYLLABUS

Introduction

Virtual machines (VMs) are software-based emulations of physical computers. They allow multiple operating systems to run on a single physical machine, offering flexibility, isolation, and efficiency. VMs are a cornerstone of modern computing, especially in cloud computing, testing, and server management.

Types of Virtual Machines

1. **System Virtual Machines**: Provide a complete system environment, including a full operating system.
    - Examples: VMware Workstation, VirtualBox.
2. **Process Virtual Machines**: Execute a single program or process.
    - Examples: Java Virtual Machine (JVM), .NET Common Language Runtime (CLR).

Key Components of a Virtual Machine

1. **Hypervisor**: A layer that manages and runs VMs. It can be of two types:
    - **Type 1 (Bare-Metal)**: Runs directly on the host hardware.
        - Examples: VMware ESXi, Microsoft Hyper-V.
    - **Type 2 (Hosted)**: Runs on a host operating system.
        - Examples: Oracle VirtualBox, VMware Workstation.
2. **Guest OS**: The operating system running inside the virtual machine.
3. **Virtual Hardware**: Includes virtual CPU, memory, storage, and network interfaces.

Benefits of Virtual Machines

- **Resource Optimization**: Utilize hardware resources more effectively.
- **Isolation**: Each VM operates independently, ensuring fault containment.
- **Scalability**: Easily add or remove VMs based on workload.
- **Flexibility**: Test and run multiple OSes and configurations without altering the host.
- **Disaster Recovery**: Simplifies backup and recovery processes.

Virtualization Technologies

1. **Hardware Virtualization**:
    - Relies on hardware features like Intel VT-x and AMD-V for efficiency.
2. **Software Virtualization**:
    - Relies on software to emulate hardware.
3. **Para-Virtualization**:

- Guest OS is aware of the virtualization and optimized for the hypervisor.

4. **Containerization**:
   - Lightweight virtualization at the application level, e.g., Docker.

Comparison of VMs and Containers

Feature	Virtual Machines	Containers
Isolation	Strong (full OS)	Moderate (shared OS)
Performance	Overhead from full OS	Lightweight
Startup Time	Minutes	Seconds
Use Case	Multi-OS environments	Microservices

Advanced Use Cases

1. **Cloud Computing**: VMs underpin services like AWS EC2, Google Compute Engine.
2. **Load balancing**
3. **Development and Testing**: Test applications across different environments.
4. **Education and Training**: Simulate environments for learning.
5. **Legacy Systems**: Run outdated software on modern hardware.
6. **High-Performance Computing (HPC)**: Utilize virtual clusters for intensive computations.

Challenges in Using Virtual Machines

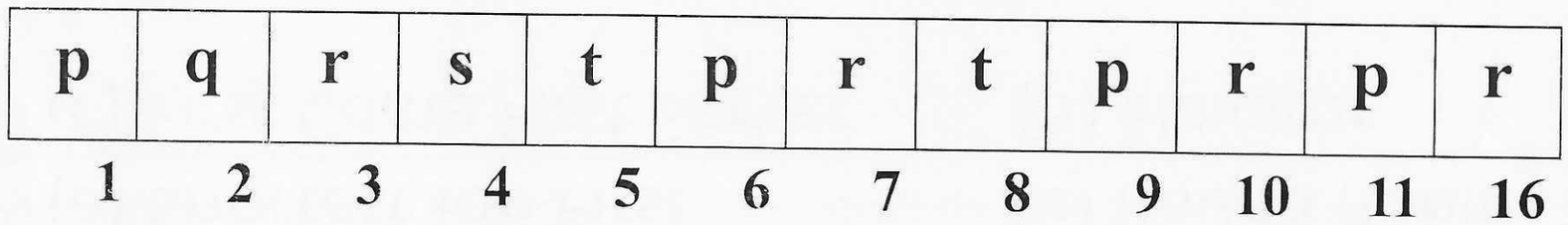
- **Performance Overhead**: VMs can be slower than physical systems.
- **Complex Management**: Large-scale VM deployments require sophisticated tools.
- **Security Risks**: Hypervisor vulnerabilities can compromise multiple VMs.

Future Trends in Virtualization

1. **Serverless Architectures**: Abstraction beyond VMs, focusing on functions.
2. **Edge Computing**: VMs deployed closer to users for low-latency applications.
3. **AI Integration**: Use of VMs for AI model training and deployment.
4. **Quantum Virtualization**: Emerging research on virtualizing quantum systems.

OS_Gate Questions Unit_2.2
(CPU Scheduling)

Ans: option (c)
Explanation:
Execution steps are plotted below



Also Calculate Avg WT and Avg TAT.

Ans: (b)

Explanation:

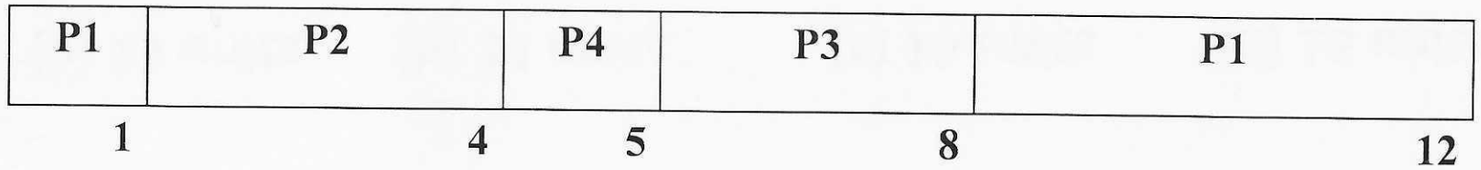
In order to schedule processes fairly, a round-robin scheduler generally employs time-sharing, giving each job a time slot or quantum (its allowance of CPU time), and interrupting the job if it is not completed by then. It is designed especially for time-sharing systems.

Ans: option (d)

Ans: option (a)

Explanation: (Alternate method already discussed in class)

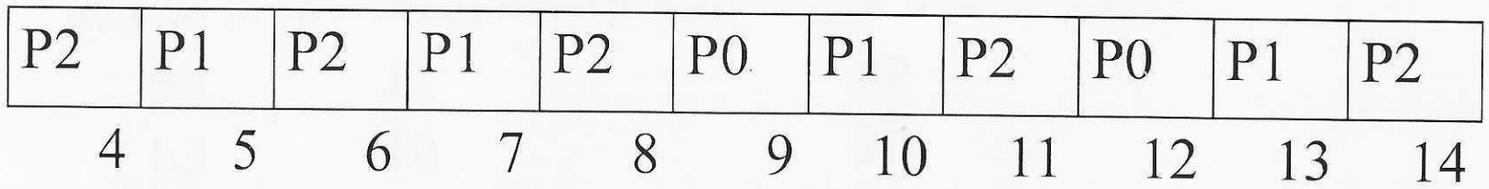
Execution chart is shown below:



Pro	AT	BT	CT	TAT(CT-AT)
P1	0	5	12	12
P2	1	3	4	3
P3	2	3	8	6
P4	4	1	5	1

Avg TAT = (12+3+6+1)/4 = 5.50

Ans: option (a) (Alternate method already discussed in class)
Execution chart is shown below:



Calculate the Turn Around Time (TAT) for each process as shown in the table below.
TAT = Completion Time - Arrival Time

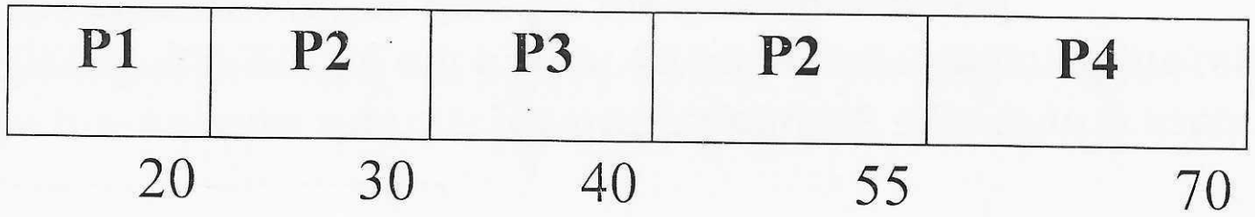
Pro	AT	BT	CT	TAT(CT-AT)
P0	0	2	12	12
P1	0	4	13	13
P2	0	8	14	14

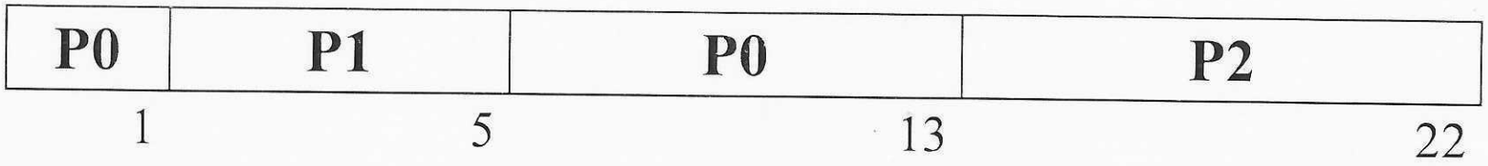
Avg TAT = (12+13+14)/3 = 13

Ans: option (b)

Explanation:

Execution chart is shown below:





(Alternate method already discussed in class)

Waiting Time = Completion Time - Arrival Time - Execution Time

Pro	AT	BT	CT	WT
P0	0	9	13	4
P1	1	4	5	0
P2	2	9	22	11

Average Waiting Time = (4+0+11)/3 = 5ms

Ans: option (c)

SOLUTION is already discussed in class

Answer: (C)

FCFS = First Come First Serve (A, B, C, D)

SJF = Non-preemptive Shortest Job First (A, B, D, C)

SRT = Shortest Remaining Time (A(3), B(1), C(4), D(2), B(5))

RR = Round Robin with Quantum value 2 (A(2), B(2), A(1),C(2),B(2),D(2),C(2),B(2)

Pr	Arr.Time	P.Time	FCFS	SJF	SRT	RR
A	0	3	3-0=3	3-0=3	3-0=3	5-0=5
B	1	6	9-1=8	9-1=8	15-1=14	15-1=14
C	4	4	13-4=9	15-4=11	8-4=4	13-4=9
D	6	2	15-6=9	11-6=5	10-6=4	11-6=5
Average			7.25	6.75	6.25	8.25

Solution:

Table Depicting Performance of RR Algorithm

Process	Arrival Time (T_0) ms	Next Burst (t) ms	Finish Time (T_1) ms	Turnaround Time TAT	Waiting Time WT
P_0	0	10	28	28	18
P_1	1	6	25	24	18
P_2	3	2	12	09	07
P_3	5	4	22	17	13

Average waiting time =14 ms

Average Turnaround time= 19.5 ms

Roll No. ..... Batch 2021-25

Chandigarh College of Engineering & Technology (Degree Wing), Chandigarh
Department of Computer Science & Engineering
Sessional Test -1st March, 2023)

Operating Systems (CS 403)
Dr. Dheerendra Singh
Max Time: 90 Min

Semester (CSE 4th)
Date: 01-03-2023
Maximum Marks: 30

Note: All questions are compulsory. Each question is of 5 marks.

			Mapping of COs
1	(i)	What will happen after using the system calls "fork" three times during the execution of a process P?	1 CO3
	(ii)	What are is the advantages using VM?	1 CO1
	(iii)	Why we use Semaphore in process synchronization?	1 CO1
	(iv)	What is the role of PCB in CPU switching?	1 CO1
	(v)	What is the difference between wait for graph and resource allocation graph?	1 CO1
2.		What down the short note on **Interprocess Communication**.	5 CO1
3.		What is Critical Section Problem? Write down the requirements of Critical Section solution.	5 CO1
4.		Consider the arrival times and execution times for the following processes with the length of the CPU - burst time & arrival time given in milliseconds. Draw Gantt Charts illustrating the execution of these processes using the SRTN algorithm and find the waiting time, turnaround time and completion order of the 4 processes. Also find the average waiting time and average turnaround time in both cases.	5 CO1

Process	Arrival Time	Next Burst
P_1	0	20
P2	15	25
P_3	30	10
P_4	45	15

5. Consider a system with five processes : P_0, P_1, P_2, P_3, P_4 and three resource types : A, B, C. For each process the current allocation and the maximum required allocation are given by the Allocation and MAX matrices. The current available resources are given by the available vector. 5 CO1

Processes	Allocation			MAX			Available		
	A	B	C	A	B	C	A	B	C
P_0	1	1	2	4	3	3	2	1	0
P_1	2	1	2	3	2	2			
P_2	4	0	1	9	0	2			
P_3	0	2	0	7	5	3			
P_4	1	1	2	11	2	3			

(i) Determine the total amount of resources of each type.
(ii) Compute the "need matrix"?
(iii) Determine if this state is "safe" using the Safety Algorithm. (1+1+3) CO1

6. In question number 5, answer the following questions using Banker's Algorithm:
   a. Is system deadlocked?
   b. After that, can a request (0, 1, 1) from P_1 be permitted? Justify the answer. Show the system state after grant of request. (1+4) CO1

Roll No. .....

Batch 2021-25

Chandigarh College of Engineering & Technology (Degree Wing), Chandigarh

Department of Computer Science & Engineering

Sessional Test -2nd (May, 2023)

Operating Systems (CS-403)
Dr. Dheerendra Singh
Max Time: 90 Min.

Semester: CSE 4th
Date: 02-05-2023
Maximum Marks: 30

Note: All questions are compulsory. Each question is of 5 marks.

			Mapping of COs
1.	(i)	What is Overlay?	1 CO2
	(ii)	What is demand segmentation?	1 CO2
	(iii)	What are the advantages and disadvantages of access Matrix?	1 CO2
	(iv)	Write down any five differences between UNIX and LINUX.	1 CO2
	(v)	Write down a shell program to calculate the table of a given number 'n'.	1 CO3
2.		Write down the short note on Disk Management and Swap-Space Management.	5 CO2
3.		A process reference to 5 pages, A, B, C, D and E in the following order A; B; C; D; A; B; E; A; B; C; D; E. Using FIFO and LRU page replacement algorithms what will be the number of page transfer with an empty internal store of 3 frames?	5 CO2
4.		Using OPTIMAL page replacement algorithm, determine the number of page faults when references to pages occur in the following order: 1, 2, 4, 5, 2, 1, 2, 4. Assume the main memory can accommodate 3 pages and the main memory already has the pages 1 and 2, with page 1 having been brought earlier than page 2.	5 CO2
5.		Disk requests come to a disk driver for cylinders 82,170,43,140,24,16,190, in that order at a time when the disk drive is reading from cylinder 50. Suppose the disk has maximum 200 cylinders (numbered from 0 to 199). Draw track charts and find the total seek time, if the disk arm scheduling algorithm is FCFS, SSTF, SCAN and C-LOOK? (Take the initial head movement towards RHS in case of SCAN and C-LOOK)	5 CO2
6.		Write down the short note on Protection Mechanism.	5 CO2

Batch - 2021-25

Exam.Code:0916
Sub. Code: 6398

2053
B.E. (Computer Science and Engineering)
Fourth Semester
CS-403: Operating System

Time allowed: 3 Hours | Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Unit.

x-x-x

I. Attempt the following:-

a) Differentiate counting and binary semaphore. CO1

b) Explain the key aspects of inter process communication. CO1

c) Discuss the access matrix mechanism related to protection. CO2

d) Write a note on Dining-philosophers problem. CO2

e) State the conditions to satisfy critical section problem. CO2 (5x2)

UNIT - I

II. Consider the processes with burst time

Process	burst Time	Priority
P1	7	3
P2	9	2
P3	2	1
P4	1	4
P5	3	5

The processes are assumed to arrive in order P1, P2, P3, P4, P5. Draw Gantt-chart showing execution of these processes using FCFS, SJF, preemptive priority, and RR (time quantum = 1) scheduling algorithms. (10) CO1

III. a) Explain in detail the methods for deadlock detection? Also clearly explain the possible solutions of deadlock recovery. (5) CO1

b) Explain the following:-

i) protection mechanisms

ii) thrashing and virtual memory (2x2.5) CO2

P.T.O.

Date Of Exam: 19/5/2023

Exam.Code:0916
Sub. Code: 6398

B.E. (Computer Science and Engineering) (Batch 2021-25)
Fourth Semester
CS-403: Operating System

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Unit.

X-X-X

I. Attempt the following:-

a) Differentiate counting and binary semaphore.

b) Explain the key aspects of inter process communication.

c) Discuss the access matrix mechanism related to protection.

d) Write a note on Dining-philosophers problem.

e) State the conditions to satisfy critical section problem. (5x2)

UNIT - I

II. Consider the processes with burst time

Process	burst Time	Priority
P1	7	3
P2	9	2
P3	2	1
P4	1	4
P5	3	5

The processes are assumed to arrive in order P1, P2, P3, P4, P5. Draw Gantt-chart showing execution of these processes using FCFS, SJF, preemptive priority, and RR (time quantum = 1) scheduling algorithms. (10)

III. a) Explain in detail the methods for deadlock detection? Also clearly explain the possible solutions of deadlock recovery (5)

b) Explain the following:-

i) protection mechanisms

ii) thrashing and virtual memory

(2x2.5)

P.T.O.

Chandigarh College of Engineering & Technology (Degree)

Department of Computer Science & Engineering

Assignment -1st

Semester & Branch: CSE 4th

Max Marks: 10

Subject & Code: Operating Systems, CS 403

DOA: 13-03-2023

DOS: 17-03-2023

Instructions

1. Date of submission is on or before 17-03-2023 by 11:59 PM.
2. Submit on Google Classroom the pdf file of Assignment done in your own handwriting.
3. Marking will be included the Viva -voice on the assignment.

Q 1. Solve the Gate Questions on Deadlock and CPU Scheduling from year 1998 to 2023.

Dr. Dheerendra Singh

Professor in CSE

Chandigarh College of Engineering & Technology (Degree)

Department of Computer Science & Engineering

Assignment -1st

Semester & Branch: CSE 4th

Max Marks: 10

Subject & Code: Operating Systems, CS 403

DOA: **13-03-2023**
DOS: **17-03-2023**

Instructions

1. Date of submission is on or before 17-03-2023 by 11:59 PM.
2. Submit on Google Classroom the pdf file of Assignment done in your own handwriting.
3. Marking will be included the Viva -voice on the assignment.

Q 1. Solve the Gate Questions on Deadlock and CPU Scheduling from year 1998 to 2023.

Dr. Dheerendra Singh
Professor in CSE

Chandigarh College of Engineering & Technology (Degree)

Department of Computer Science & Engineering

Assignment -2nd

Semester & Branch: CSE 4th

Max Marks: 10

Subject & Code: Operating Systems, CS 403

DOA: **06-04-2023**
DOS: **13-04-2023**

Instructions

1. Date of submission is on or before 13-04-2023 by 02:00 PM.
2. Submit on Google Classroom the pdf file of Assignment done in your own handwriting.
3. Marking will be included the Viva -voice on the assignment.

Q 1. Solve the Gate Questions on Page replacement Algorithms (MM) from year 2010 to 2023.

Dr. Dheerendra Singh
Professor in CSE

Chandigarh College of Engineering & Technology (Degree)

Department of Computer Science & Engineering

Assignment -2nd

Semester & Branch: CSE 4th

Max Marks: 10

Subject & Code: Operating Systems, CS 403

DOA: **06-04-2023**
DOS: **13-04-2023**

Instructions

1. Date of submission is on or before 13-04-2023 by 02:00 PM.
2. Submit on Google Classroom the pdf file of Assignment done in your own handwriting.
3. Marking will be included the Viva -voice on the assignment.

Q 1. Solve the Gate Questions on Page replacement Algorithms (MM) from year 2010 to 2023.

Dr. Dheerendra Singh
Professor in CSE

Operating System Quiz-1, 25-04-2023

OS Quiz-1, 25-04-2023

1. Email *

2. Which of the following features of UNIX may be used for inter process communication? 2 points

Check all that apply.

- [ ] signals
- [ ] Semaphore
- [ ] Deadlock
- [ ] All of the above

3. Pick the correct statement 2 points

Check all that apply.

- [ ] Shell is a command interpreter
- [ ] Shell is the interface between user and kernel
- [ ] System can not work without a shell
- [ ] Shell is a program
- [ ] All of the above

4. Which of the following statements best explains a process? 1 point

Check all that apply.

- [ ] It is a program
- [ ] It is a program in execution
- [ ] It is an instance of a program in execution
- [ ] It is a program that uses system calls

5. Context switch changes the process mode from 1 point

Mark only one oval.

- user to kernel mode
- kernel to kernel mode
- kernel mode to kernel process
- kernel process to the kernel mode of some process

6. Choose the best answer-Suspended processes are written onto 1 point

Mark only one oval.

- swap area
- dedicated area
- ROM
- critical area

7. With a single resource, deadlock occurs 1 point

Mark only one oval.

- if there are more than two processes competing for that resource
- if there are only two processes competing for that resource
- if there is a single process competing for that resource
- None

8. In a system x processes share y resources of same type. The max need of each process does not exceed y and the sum all the their max need is always less than x + y. In this situation: 2 points

Mark only one oval.

- deadlock can never occur
- deadlock may occur
- deadlock has to occur
- none of the above

Quiz 2nd OS, 8-05-2023

Quiz 2nd OS 8-05-2023

1. Email *

2. Which of the following is an example of a SPOOLED device? 1 point

Mark only one oval.

- The terminal used to enter the input data for a program being executed
- The secondary memory device in a virtual memory system
- A line printer used to print the output of a number of jobs
- None of the above

3. Page fault occurs when 1 point

Mark only one oval.

- the page is corrupted by application software
- the page is in main memory
- the page is not in main memory
- one tries to divide a number by zero

4. Fragmentation is 1 point

Mark only one oval.

- dividing the secondary memory into equal sized fragments
- dividing the main memory into equal sized fragments
- fragments of memory words used in a page
- fragments of memory words unused in a page

5. Virtual memory is 1 point

Mark only one oval.

- An extremely large main memory
- An extremely large secondary memory
- An illusion of an extremely large memory
- A type of memory used in super computers

6. The page replacement policy that sometimes leads to more page faults when the size of the memory is increased is 1 point

Mark only one oval.

- FIFO
- LRU
- No such policy exists
- None of the above

7. Disk requests come to a disk driver for cylinders 10, 22, 20, 2, 40, 6 and 38, in that order at a time when the disk drive is reading from cylinder 20. The seek time is 6ms per cylinder. The total seek time, if the disk arm scheduling algorithm is first-come-first-served is 3 points

Mark only one oval.

- 360ms
- 850ms
- 876ms
- None of the above

8. Assume that there are 3 page frames which are initially empty. If the page reference string is 1, 2, 3, 4, 2, 1, 5, 3, 2, 4, 6, the number of page faults using the optimal replacement policy is: 2 points

Mark only one oval.

- 7
- 5
- 6
- 8

9. A process has been allocated 3 page frames. Assume that none of the pages of the process are available in the memory initially. The process makes the following sequence of page references (reference string): 1, 2, 1, 3, 7, 4, 5, 6, 3, 1. If LRU replacement policy is used, how many page faults occur for the given reference string? 2 points

Mark only one oval.

- 9
- 12
- 6
- 11

10. Suppose that a disk drive has 5,000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order, is: 86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130 Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for FCFS disk-scheduling algorithm? 2 points

Mark only one oval.

- 7066
- 7081
- 9081
- 6001

11. A file x is created with the following comments: echo today is : date; If; you type x, then 2 points

Check all that apply.

- [ ] It echoes the message followed by date
- [ ] It gives the desired output only if the executive permission of file x is set
- [ ] The desired output can be got by the command sh x, which works even if x has its executive permission set
- [ ] All of the above

12. Files that store data in the same format as used in program are called 1 point

Mark only one oval.

- ( ) Binary files
- ( ) Source file
- ( ) Text file
- ( ) core

13. The main reasons for the success of pipes are 2 points

Check all that apply.

- [ ] The availability of many filter programs
- [ ] UNX treats devices as files
- [ ] It provides a two way communication channel
- [ ] All of the above

14. Disk scheduling involves deciding 1 point

Check all that apply.

- [ ] which disk should be accessed next
- [ ] the order in which disk access requests must be serviced
- [ ] the physical location where files should be accessed in the disk
- [ ] All of the above

SCHEME OF EVALUATION

EVALUATION CRITERIA	MARKS
Course assignment	5
Quiz Examination	10
Minor-1	30
Minor-2	30
Class Attendance	5
University Examination/External Examination	50
Total	100

Computer Science & Engineering (B.E.), Session 2021-2025, Semester 4

Operating Systems (CS 403) (Theory)

S.No.	Roll Number	Full Name	Minor 1	Minor 2	Assignment	External	Grade
1	CO21303	Abhishek Sharma	21.50	0.00	15.30	36.50	B+ (73.3)
2	CO21304	Aditya Saroj	14.50	19.00	12.00	39.00	B+ (70)
3	CO21305	Aishita	21.50	24.00	18.50	37.50	A (80)
4	CO21306	Akshit Chhikara	0.00	12.00	12.80	29.50	C+ (54.3)
5	CO21307	Akshit Rawat	11.50	18.50	11.30	33.00	B (62.8)
6	CO21308	Amanpreet Singh	18.50	22.50	15.50	32.00	B+ (70)
7	CO21309	Ankit Kumar Gupta	15.00	19.00	13.00	38.00	B+ (70)
8	CO21310	Arnav Arora	15.00	23.50	12.50	38.00	B+ (74)
9	CO21311	Aryan Malhotra	6.00	14.00	13.00	29.00	C+ (56)
10	CO21312	Avneet Kaur	18.00	23.50	12.50	36.00	B+ (72)
11	CO21313	Briti Singla	19.00	0.00	18.00	37.50	B+ (74.5)
12	CO21314	Charan Kamal Singh	18.00	19.50	12.50	39.00	B+ (71)
13	CO21315	Chetan Kumar	17.00	20.00	14.50	35.50	B+ (70)
14	CO21316	Eshita Badwal	17.00	22.00	16.50	31.50	B+ (70)
15	CO21317	Garvit Nag	21.50	25.00	15.00	40.00	A (80)
16	CO21318	Gurmehar Singh Virdi	18.00	18.50	12.00	34.50	B (65)
17	CO21320	Harkiran Kaur	24.50	22.50	15.50	40.00	A (80)
18	CO21321	Harmanpreet Singh	12.00	0.00	12.00	28.50	C+ (52.5)
19	CO21322	Harshdeep Singh	19.00	A	16.00	10.00	C (45)
20	CO21324	Huzaifa Ali	18.00	0.00	10.50	29.00	C+ (57.5)
21	CO21325	Ishtveer Singh Billing	24.50	21.00	15.50	42.00	A (82)
22	CO21326	Japan Ajit Singh Gandhi	19.00	23.00	15.00	42.00	A (80)
23	CO21327	Jiya	12.50	23.00	16.50	42.00	A (81.5)
24	CO21328	Kanishk Nagpal	25.00	22.50	14.50	40.50	A (80)
25	CO21329	Karan Kanwar	19.00	0.00	14.00	34.00	B (67)
26	CO21330	Karan Sharma	11.50	16.00	16.00	28.00	B (60)
27	CO21331	Karan Singh Bala	11.00	17.50	10.50	27.00	C+ (55)
28	CO21332	Karandeep Singh	17.00	10.00	15.50	28.50	B (61)
29	CO21333	Kartik	16.00	22.00	13.00	40.00	B+ (75)
30	CO21335	Khushal	11.00	22.50	10.30	30.00	B (62.8)
31	CO21336	Khushbu	20.50	26.00	15.00	39.00	A (80)
32	CO21337	Krish Kathuria	21.00	22.00	16.00	33.00	B+ (71)
33	CO21338	Krishana Singla	27.50	21.00	16.00	39.50	A (83)
34	CO21339	Kshitij Jethanaadani	15.00	17.50	12.00	31.00	B (60.5)
35	CO21340	Lakshay Arora	22.50	21.50	13.00	40.50	B+ (76)
36	CO21342	Manraj Singh Gill	18.50	17.50	13.00	38.50	B+ (70)
37	CO21343	Mehak Preet	0.00	22.50	17.00	31.50	B+ (71)
38	CO21344	Mohd Tarique	19.00	0.00	13.50	28.50	B (61)
39	CO21345	Nikunj Arya	6.00	14.50	10.00	25.50	C+ (50)

Computer Science & Engineering (B.E.), Session 2021-2025, Semester 4
Operating Systems (Practical) (CS 453) (Practical)

S.No.	Roll Number	Full Name	Practical Marks	Grade
1	CO21303	Abhishek Sharma	43.38	A (43.38)
2	CO21304	Aditya Saroj	35.25	B+ (35.25)
3	CO21305	Aishita	41.75	A (41.75)
4	CO21306	Akshit Chhikara	33.00	B (33)
5	CO21307	Akshit Rawat	37.25	B+ (37.25)
6	CO21308	Amanpreet Singh	40.75	A (40.75)
7	CO21309	Ankit Kumar Gupta	32.25	B (32.25)
8	CO21310	Arnav Arora	37.25	B+ (37.25)
9	CO21311	Aryan Malhotra	33.00	B (33)
10	CO21312	Avneet Kaur	40.00	A (40)
11	CO21313	Briti Singla	41.00	A (41)
12	CO21314	Charan Kamal Singh	38.75	B+ (38.75)
13	CO21315	Chetan Kumar	37.75	B+ (37.75)
14	CO21316	Eshita Badwal	45.25	A+ (45.25)
15	CO21317	Garvit Nag	36.75	B+ (36.75)
16	CO21318	Gurmehar Singh Virdi	41.88	A (41.88)
17	CO21320	Harkiran Kaur	42.50	A (42.5)
18	CO21321	Harmanpreet Singh	33.38	B (33.38)
19	CO21322	Harshdeep Singh	32.63	B (32.63)
20	CO21324	Huzaifa Ali	33.88	B (33.88)
21	CO21325	Ishtveer Singh Billing	40.75	A (40.75)
22	CO21326	Japan Ajit Singh Gandhi	46.00	A+ (46)
23	CO21327	Jiya	41.13	A (41.13)
24	CO21328	Kanishk Nagpal	45.25	A+ (45.25)
25	CO21329	Karan Kanwar	38.88	B+ (38.88)
26	CO21330	Karan Sharma	38.38	B+ (38.38)
27	CO21331	Karan Singh Bala	35.00	B+ (35)
28	CO21332	Karandeep Singh	36.25	B+ (36.25)
29	CO21333	Kartik	43.63	A (43.63)
30	CO21335	Khushal	36.38	B+ (36.38)
31	CO21336	Khushbu	38.00	B+ (38)
32	CO21337	Krish Kathuria	42.25	A (42.25)
33	CO21338	Krishana Singla	45.88	A+ (45.88)
34	CO21339	Kshitij Jethanandani	31.50	B (31.5)
35	CO21340	Lakshay Arora	45.50	A+ (45.5)
36	CO21342	Manraj Singh Gill	37.00	B+ (37)
37	CO21343	Mehak Preet	41.75	A (41.75)
38	CO21344	Mohd Tarique	35.75	B+ (35.75)
39	CO21345	Nikunj Arya	34.00	B (34)
40	CO21346	Nirbhay Singh Sandhu	40.00	A (40)
41	CO21347	Palvasha Bansal	42.88	A (42.88)
42	CO21348	Prince Kumar	40.25	A (40.25)
43	CO21349	Rishika Rawat	30.00	B (30)
44	CO21350	Ritika Gupta	42.50	A (42.5)

S.No.	Roll Number	Full Name	Practical Marks	Grade
45	CO21351	Rohan Bhola	42.88	A (42.88)
46	CO21352	Ruchika Thakur	44.00	A (44)
47	CO21353	Saksham Walia	41.75	A (41.75)
48	CO21354	Samarth Sharma	30.50	B (30.5)
49	CO21356	Shaurya Harsh	27.38	C+ (27.38)
50	CO21357	Siddharth Singh Khati	45.13	A+ (45.13)
51	CO21358	Simratpreet Kaur	35.00	B+ (35)
52	CO21359	Sovan Chakma	33.13	B (33.13)
53	CO21361	Tarayan Aggarwal	42.50	A (42.5)
54	CO21362	Tushar Singh	36.50	B+ (36.5)
55	CO21363	Ujjwal Chopra	42.50	A (42.5)
56	CO21364	Utkarsh Chauhan	31.13	B (31.13)
57	CO21365	Vaghmare Siddharth	40.00	A (40)
58	CO21366	Vanshika Bhardwaj	45.13	A+ (45.13)
59	CO21367	Varun Goyal	28.13	C+ (28.13)
60	CO21368	Vibhuti Bhardwaj	23.25	C (23.25)
61	CO21370	Yashvi	41.75	A (41.75)
62	CO21371	Neha Bhagat	35.13	B+ (35.13)
63	LCO21379	Anirudh Mehandru	26.25	C+ (26.25)
64	LCO21380	Deepinder Singh	25.13	C+ (25.13)
65	LCO21381	Priyanshu	40.63	A (40.63)
66	LCO21383	Saket Sarin	45.13	A+ (45.13)
67	LCO21384	Shivam Goyal	43.63	A (43.63)
68	LCO21385	Shivam Singh Nayal	34.13	B (34.13)
69	MCO21373	Hardik Gupta	47.75	A+ (47.75)
70	MCO21374	Jaskirat Kaur	43.25	A (43.25)
71	MCO21375	Karan Sharma	38.75	B+ (38.75)
72	MCO21376	Manya	42.50	A (42.5)
73	MCO21377	Rashmi	42.25	A (42.25)
74	MCO21378	Ritika Saini	40.38	A (40.38)

Panjab University

Counterfoil for examiners's record. Which should be preserved for at least 6 months.

Semester: 4
Course: B.E.(Computer Science & Engineering)
Subject: Operating Systems (CS 403)
Paper: Theory
Group(s): 2021-25/BE/CSE/S4/GT1
Max Marks: 100

Roll No.	Name	Marks	Grade
CO21303	Abhishek Sharma	36.50	B+(73.30)
CO21304	Aditya Saroj	39.00	B+(70.00)
CO21305	Aishita	37.50	A(80.00)
CO21306	Akshit Chhikara	29.50	C+(54.30)
CO21307	Akshit Rawat	33.00	B(62.80)
CO21308	Amanpreet Singh	32.00	B+(70.00)
CO21309	Ankit Kumar Gupta	38.00	B+(70.00)
CO21310	Arnav Arora	38.00	B+(74.00)
CO21311	Aryan Malhotra	29.00	C+(56.00)
CO21312	Avneet Kaur	36.00	B+(72.00)
CO21313	Briti Singla	37.50	B+(74.50)
CO21314	Charan Kamal Singh	39.00	B+(71.00)
CO21315	Chetan Kumar	35.50	B+(70.00)
CO21316	Eshita Badwal	31.50	B+(70.00)
CO21317	Garvit Nag	40.00	A(80.00)
CO21318	Gurmehar Singh Virdi	34.50	B(65.00)
CO21320	Harkiran Kaur	40.00	A(80.00)
CO21321	Harmanpreet Singh	28.50	C+(52.50)

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Dheerendra Singh
dsingh@ccet.ac.in
19-11-2024

Panjab University

Semester: 4
Course: B.E.(Computer Science & Engineering)
Subject: Operating Systems (CS 403)
Paper: Theory
Group(s): 2021-25/BE/CSE/S4/GT1
Max Marks: 100

Roll No.	Grade	Marks	Description
CO21303	B+(73.30)	36.50	Very Good
CO21304	B+(70.00)	39.00	Very Good
CO21305	A(80.00)	37.50	Excellent
CO21306	C+(54.30)	29.50	Average
CO21307	B(62.80)	33.00	Good
CO21308	B+(70.00)	32.00	Very Good
CO21309	B+(70.00)	38.00	Very Good
CO21310	B+(74.00)	38.00	Very Good
CO21311	C+(56.00)	29.00	Average
CO21312	B+(72.00)	36.00	Very Good
CO21313	B+(74.50)	37.50	Very Good
CO21314	B+(71.00)	39.00	Very Good
CO21315	B+(70.00)	35.50	Very Good
CO21316	B+(70.00)	31.50	Very Good
CO21317	A(80.00)	40.00	Excellent
CO21318	B(65.00)	34.50	Good
CO21320	A(80.00)	40.00	Excellent
CO21321	C+(52.50)	28.50	Average

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Semester: 4
Course: B.E.(Computer Science & Engineering)
Subject: Operating Systems (CS 403)
Paper: Theory
Group(s): 2021-25/BE/CSE/S4/GT1
Max Marks: 100

Roll No.	Name	Marks	Grade
CO21322	Harshdeep Singh	10.00	C(45.00)
CO21324	Huzaifa Ali	29.00	C+(57.50)
CO21325	Ishtveer Singh Billing	42.00	A(82.00)
CO21326	Japan Ajit Singh Gandhi	42.00	A(80.00)
CO21327	Jiya	42.00	A(81.50)
CO21328	Kanishk Nagpal	40.50	A(80.00)
CO21329	Karan Kanwar	34.00	B(67.00)
CO21330	Karan Sharma	28.00	B(60.00)
CO21331	Karan Singh Bala	27.00	C+(55.00)
CO21332	Karandeep Singh	28.50	B(61.00)
CO21333	Kartik	40.00	B+(75.00)
CO21335	Khushal	30.00	B(62.80)
CO21336	Khushbu	39.00	A(80.00)
CO21337	Krish Kathuria	33.00	B+(71.00)
CO21338	Krishana Singla	39.50	A(83.00)
CO21339	Kshitij Jethanandani	31.00	B(60.50)
CO21340	Lakshay Arora	40.50	B+(76.00)
CO21342	Manraj Singh Gill	38.50	B+(70.00)

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Semester: 4
Course: B.E.(Computer Science & Engineering)
Subject: Operating Systems (CS 403)
Paper: Theory
Group(s): 2021-25/BE/CSE/S4/GT1
Max Marks: 100

Roll No.	Grade	Marks	Description
CO21322	C(45.00)	10.00	Below Average
CO21324	C+(57.50)	29.00	Average
CO21325	A(82.00)	42.00	Excellent
CO21326	A(80.00)	42.00	Excellent
CO21327	A(81.50)	42.00	Excellent
CO21328	A(80.00)	40.50	Excellent
CO21329	B(67.00)	34.00	Good
CO21330	B(60.00)	28.00	Good
CO21331	C+(55.00)	27.00	Average
CO21332	B(61.00)	28.50	Good
CO21333	B+(75.00)	40.00	Very Good
CO21335	B(62.80)	30.00	Good
CO21336	A(80.00)	39.00	Excellent
CO21337	B+(71.00)	33.00	Very Good
CO21338	A(83.00)	39.50	Excellent
CO21339	B(60.50)	31.00	Good
CO21340	B+(76.00)	40.50	Very Good
CO21342	B+(70.00)	38.50	Very Good

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Semester: 4
Course: B.E.(Computer Science & Engineering)
Subject: Operating Systems (CS 403)
Paper: Theory
Group(s): 2021-25/BE/CSE/S4/GT1
Max Marks: 100

Roll No.	Name	Marks	Grade
CO21343	Mehak Preet	31.50	B+(71.00)
CO21344	Mohd Tarique	28.50	B(61.00)
CO21345	Nikunj Arya	25.50	C+(50.00)
CO21346	Nirbhay Singh Sandhu	40.00	B+(72.50)
CO21347	Palvasha Bansal	43.00	A(81.00)
CO21348	Prince Kumar	39.00	B+(76.00)
CO21349	Rishika Rawat	21.50	C+(50.30)
CO21350	Ritika Gupta	40.50	B+(75.30)
CO21351	Rohan Bhola	32.00	B(60.30)
CO21352	Ruchika Thakur	41.50	A(84.80)
CO21353	Saksham Walia	37.50	B(69.80)
CO21354	Samarth Sharma	17.50	D(40.00)
CO21356	Shaurya Harsh	35.00	B(60.25)
CO21357	Siddharth Singh Khati	33.00	B(65.00)
CO21358	Simratpreet Kaur	22.00	D(44.00)
CO21359	Sovan Chakma	31.50	C+(50.00)
CO21361	Tarayan Aggarwal	38.50	B+(70.50)
CO21362	Tushar Singh	35.50	B+(71.30)

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Semester: 4
Course: B.E.(Computer Science & Engineering)
Subject: Operating Systems (CS 403)
Paper: Theory
Group(s): 2021-25/BE/CSE/S4/GT1
Max Marks: 100

Roll No.	Grade	Marks	Description
CO21343	B+(71.00)	31.50	Very Good
CO21344	B(61.00)	28.50	Good
CO21345	C+(50.00)	25.50	Average
CO21346	B+(72.50)	40.00	Very Good
CO21347	A(81.00)	43.00	Excellent
CO21348	B+(76.00)	39.00	Very Good
CO21349	C+(50.30)	21.50	Average
CO21350	B+(75.30)	40.50	Very Good
CO21351	B(60.30)	32.00	Good
CO21352	A(84.80)	41.50	Excellent
CO21353	B(69.80)	37.50	Good
CO21354	D(40.00)	17.50	Marginal
CO21356	B(60.25)	35.00	Good
CO21357	B(65.00)	33.00	Good
CO21358	D(44.00)	22.00	Marginal
CO21359	C+(50.00)	31.50	Average
CO21361	B+(70.50)	38.50	Very Good
CO21362	B+(71.30)	35.50	Very Good

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Subject: Operating Systems (CS 403)
Paper: Theory
Group(s): 2021-25/BE/CSE/S4/GT1
Max Marks: 100

Roll No.	Name	Marks	Grade
CO21363	Ujjwal Chopra	31.50	B+(70.00)
CO21364	Utkarsh Chauhan	42.50	B+(78.00)
CO21365	Vaghmare Siddharth	33.50	B(60.00)
CO21366	Vanshika Bhardwaj	38.00	B+(73.00)
CO21367	Varun Goyal	29.50	B(61.00)
CO21368	Vibhuti Bhardwaj	15.00	C+(55.00)
CO21370	Yashvi	39.00	A(80.00)
CO21371	Neha Bhagat	30.50	C+(56.75)
LCO21379	Anirudh Mehandru	37.00	B+(77.00)
LCO21380	Deepinder Singh	26.00	B(60.00)
LCO21381	Priyanshu	35.50	B(64.00)
LCO21383	Saket Sarin	42.00	B+(78.50)
LCO21384	Shivam Goyal	38.00	B+(74.30)
LCO21385	Shivam Singh Nayal	0.00	F(23.00)
MCO21373	Hardik Gupta	37.50	B+(75.30)
MCO21374	Jaskirat Kaur	42.00	A(80.00)
MCO21375	Karan Sharma	30.50	B(63.80)
MCO21376	Manya	38.00	B+(74.30)

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Subject: Operating Systems (CS 403)
Paper: Theory
Group(s): 2021-25/BE/CSE/S4/GT1
Max Marks: 100

Roll No.	Grade	Marks	Description
CO21363	B+(70.00)	31.50	Very Good
CO21364	B+(78.00)	42.50	Very Good
CO21365	B(60.00)	33.50	Good
CO21366	B+(73.00)	38.00	Very Good
CO21367	B(61.00)	29.50	Good
CO21368	C+(55.00)	15.00	Average
CO21370	A(80.00)	39.00	Excellent
CO21371	C+(56.75)	30.50	Average
LCO21379	B+(77.00)	37.00	Very Good
LCO21380	B(60.00)	26.00	Good
LCO21381	B(64.00)	35.50	Good
LCO21383	B+(78.50)	42.00	Very Good
LCO21384	B+(74.30)	38.00	Very Good
LCO21385	F(23.00)	0.00	Very Poor
MCO21373	B+(75.30)	37.50	Very Good
MCO21374	A(80.00)	42.00	Excellent
MCO21375	B(63.80)	30.50	Good
MCO21376	B+(74.30)	38.00	Very Good

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Semester: 4
Course: B.E.(Computer Science & Engineering)
Subject: Operating Systems (CS 403)
Paper: Theory
Group(s): 2021-25/BE/CSE/S4/GT1
Max Marks: 100

Roll No.	Name	Marks	Grade
MCO21377	Rashmi	39.50	B+(70.00)
MCO21378	Ritika Saini	43.00	B+(76.50)

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Semester: 4
Course: B.E.(Computer Science & Engineering)
Subject: Operating Systems (CS 403)
Paper: Theory
Group(s): 2021-25/BE/CSE/S4/GT1
Max Marks: 100

Roll No.	Grade	Marks	Description
MCO21377	B+(70.00)	39.50	Very Good
MCO21378	B+(76.50)	43.00	Very Good

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Semester: 4
Course: B.E.(Computer Science & Engineering)
Subject: Operating Systems (Practical) (CS 453)
Paper: Practical
Group(s): 2021-25/BE/CSE/S4/GP1, 2021-25/BE/CSE/S4/GP2, 2021-25/BE/CSE/S4/GP3
Max Marks: 50

Roll No.	Name	Marks	Grade
CO21303	Abhishek Sharma	43.38	A(43.38)
CO21304	Aditya Saroj	35.25	B+(35.25)
CO21305	Aishita	41.75	A(41.75)
CO21306	Akshit Chhikara	33.00	B(33.00)
CO21307	Akshit Rawat	37.25	B+(37.25)
CO21308	Amanpreet Singh	40.75	A(40.75)
CO21309	Ankit Kumar Gupta	32.25	B(32.25)
CO21310	Arnav Arora	37.25	B+(37.25)
CO21311	Aryan Malhotra	33.00	B(33.00)
CO21312	Avneet Kaur	40.00	A(40.00)
CO21313	Briti Singla	41.00	A(41.00)
CO21314	Charan Kamal Singh	38.75	B+(38.75)
CO21315	Chetan Kumar	37.75	B+(37.75)
CO21316	Eshita Badwal	45.25	A+(45.25)
CO21317	Garvit Nag	36.75	B+(36.75)
CO21318	Gurmeher Singh Virdi	41.88	A(41.88)
CO21320	Harkiran Kaur	42.50	A(42.50)
CO21321	Harmanpreet Singh	33.38	B(33.38)

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Panjab University

Semester: 4
Course: B.E.(Computer Science & Engineering)
Subject: Operating Systems (Practical) (CS 453)
Paper: Practical
Group(s): 2021-25/BE/CSE/S4/GP1, 2021-25/BE/CSE/S4/GP2, 2021-25/BE/CSE/S4/GP3
Max Marks: 50

Roll No.	Grade	Marks	Description
CO21303	A(43.38)	43.38	Excellent
CO21304	B+(35.25)	35.25	Very Good
CO21305	A(41.75)	41.75	Excellent
CO21306	B(33.00)	33.00	Good
CO21307	B+(37.25)	37.25	Very Good
CO21308	A(40.75)	40.75	Excellent
CO21309	B(32.25)	32.25	Good
CO21310	B+(37.25)	37.25	Very Good
CO21311	B(33.00)	33.00	Good
CO21312	A(40.00)	40.00	Excellent
CO21313	A(41.00)	41.00	Excellent
CO21314	B+(38.75)	38.75	Very Good
CO21315	B+(37.75)	37.75	Very Good
CO21316	A+(45.25)	45.25	Outstanding
CO21317	B+(36.75)	36.75	Very Good
CO21318	A(41.88)	41.88	Excellent
CO21320	A(42.50)	42.50	Excellent
CO21321	B(33.38)	33.38	Good

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Semester: 4
Course: B.E.(Computer Science & Engineering)
Subject: Operating Systems (Practical) (CS 453)
Paper: Practical
Group(s): 2021-25/BE/CSE/S4/GP1, 2021-25/BE/CSE/S4/GP2, 2021-25/BE/CSE/S4/GP3
Max Marks: 50

Roll No.	Name	Marks	Grade
CO21322	Harshdeep Singh	32.63	B(32.63)
CO21324	Huzaifa Ali	33.88	B(33.88)
CO21325	Ishtveer Singh Billing	40.75	A(40.75)
CO21326	Japan Ajit Singh Gandhi	46.00	A+(46.00)
CO21327	Jiya	41.13	A(41.13)
CO21328	Kanishk Nagpal	45.25	A+(45.25)
CO21329	Karan Kanwar	38.88	B+(38.88)
CO21330	Karan Sharma	38.38	B+(38.38)
CO21331	Karan Singh Bala	35.00	B+(35.00)
CO21332	Karandeep Singh	36.25	B+(36.25)
CO21333	Kartik	43.63	A(43.63)
CO21335	Khushal	36.38	B+(36.38)
CO21336	Khushbu	38.00	B+(38.00)
CO21337	Krish Kathuria	42.25	A(42.25)
CO21338	Krishana Singla	45.88	A+(45.88)
CO21339	Kshitij Jethanandani	31.50	B(31.50)
CO21340	Lakshay Arora	45.50	A+(45.50)
CO21342	Manraj Singh Gill	37.00	B+(37.00)

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Semester: 4
Course: B.E.(Computer Science & Engineering)
Subject: Operating Systems (Practical) (CS 453)
Paper: Practical
Group(s): 2021-25/BE/CSE/S4/GP1, 2021-25/BE/CSE/S4/GP2, 2021-25/BE/CSE/S4/GP3
Max Marks: 50

Roll No.	Grade	Marks	Description
CO21322	B(32.63)	32.63	Good
CO21324	B(33.88)	33.88	Good
CO21325	A(40.75)	40.75	Excellent
CO21326	A+(46.00)	46.00	Outstanding
CO21327	A(41.13)	41.13	Excellent
CO21328	A+(45.25)	45.25	Outstanding
CO21329	B+(38.88)	38.88	Very Good
CO21330	B+(38.38)	38.38	Very Good
CO21331	B+(35.00)	35.00	Very Good
CO21332	B+(36.25)	36.25	Very Good
CO21333	A(43.63)	43.63	Excellent
CO21335	B+(36.38)	36.38	Very Good
CO21336	B+(38.00)	38.00	Very Good
CO21337	A(42.25)	42.25	Excellent
CO21338	A+(45.88)	45.88	Outstanding
CO21339	B(31.50)	31.50	Good
CO21340	A+(45.50)	45.50	Outstanding
CO21342	B+(37.00)	37.00	Very Good

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Semester: 4
Course: B.E.(Computer Science & Engineering)
Subject: Operating Systems (Practical) (CS 453)
Paper: Practical
Group(s): 2021-25/BE/CSE/S4/GP1, 2021-25/BE/CSE/S4/GP2, 2021-25/BE/CSE/S4/GP3
Max Marks: 50

Roll No.	Name	Marks	Grade
CO21343	Mehak Preet	41.75	A(41.75)
CO21344	Mohd Tarique	35.75	B+(35.75)
CO21345	Nikunj Arya	34.00	B(34.00)
CO21346	Nirbhay Singh Sandhu	40.00	A(40.00)
CO21347	Palvasha Bansal	42.88	A(42.88)
CO21348	Prince Kumar	40.25	A(40.25)
CO21349	Rishika Rawat	30.00	B(30.00)
CO21350	Ritika Gupta	42.50	A(42.50)
CO21351	Rohan Bhola	42.88	A(42.88)
CO21352	Ruchika Thakur	44.00	A(44.00)
CO21353	Saksham Walia	41.75	A(41.75)
CO21354	Samarth Sharma	30.50	B(30.50)
CO21356	Shaurya Harsh	27.38	C+(27.38)
CO21357	Siddharth Singh Khati	45.13	A+(45.13)
CO21358	Simratpreet Kaur	35.00	B+(35.00)
CO21359	Sovan Chakma	33.13	B(33.13)
CO21361	Tarayan Aggarwal	42.50	A(42.50)
CO21362	Tushar Singh	36.50	B+(36.50)

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Subject: Operating Systems (Practical) (CS 453)
Paper: Practical
Group(s): 2021-25/BE/CSE/S4/GP1, 2021-25/BE/CSE/S4/GP2, 2021-25/BE/CSE/S4/GP3
Max Marks: 50

Roll No.	Grade	Marks	Description
CO21343	A(41.75)	41.75	Excellent
CO21344	B+(35.75)	35.75	Very Good
CO21345	B(34.00)	34.00	Good
CO21346	A(40.00)	40.00	Excellent
CO21347	A(42.88)	42.88	Excellent
CO21348	A(40.25)	40.25	Excellent
CO21349	B(30.00)	30.00	Good
CO21350	A(42.50)	42.50	Excellent
CO21351	A(42.88)	42.88	Excellent
CO21352	A(44.00)	44.00	Excellent
CO21353	A(41.75)	41.75	Excellent
CO21354	B(30.50)	30.50	Good
CO21356	C+(27.38)	27.38	Average
CO21357	A+(45.13)	45.13	Outstanding
CO21358	B+(35.00)	35.00	Very Good
CO21359	B(33.13)	33.13	Good
CO21361	A(42.50)	42.50	Excellent
CO21362	B+(36.50)	36.50	Very Good

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Subject: Operating Systems (Practical) (CS 453)
Paper: Practical
Group(s): 2021-25/BE/CSE/S4/GP1, 2021-25/BE/CSE/S4/GP2, 2021-25/BE/CSE/S4/GP3
Max Marks: 50

Roll No.	Name	Marks	Grade
CO21363	Ujjwal Chopra	42.50	A(42.50)
CO21364	Utkarsh Chauhan	31.13	B(31.13)
CO21365	Vaghmare Siddharth	40.00	A(40.00)
CO21366	Vanshika Bhardwaj	45.13	A+(45.13)
CO21367	Varun Goyal	28.13	C+(28.13)
CO21368	Vibhuti Bhardwaj	23.25	C(23.25)
CO21370	Yashvi	41.75	A(41.75)
CO21371	Neha Bhagat	35.13	B+(35.13)
LCO21379	Anirudh Mehandru	26.25	C+(26.25)
LCO21380	Deepinder Singh	25.13	C+(25.13)
LCO21381	Priyanshu	40.63	A(40.63)
LCO21383	Saket Sarin	45.13	A+(45.13)
LCO21384	Shivam Goyal	43.63	A(43.63)
LCO21385	Shivam Singh Nayal	34.13	B(34.13)
MCO21373	Hardik Gupta	47.75	A+(47.75)
MCO21374	Jaskirat Kaur	43.25	A(43.25)
MCO21375	Karan Sharma	38.75	B+(38.75)
MCO21376	Manya	42.50	A(42.50)

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Subject: Operating Systems (Practical) (CS 453)
Paper: Practical
Group(s): 2021-25/BE/CSE/S4/GP1, 2021-25/BE/CSE/S4/GP2, 2021-25/BE/CSE/S4/GP3
Max Marks: 50

Roll No.	Grade	Marks	Description
CO21363	A(42.50)	42.50	Excellent
CO21364	B(31.13)	31.13	Good
CO21365	A(40.00)	40.00	Excellent
CO21366	A+(45.13)	45.13	Outstanding
CO21367	C+(28.13)	28.13	Average
CO21368	C(23.25)	23.25	Below Average
CO21370	A(41.75)	41.75	Excellent
CO21371	B+(35.13)	35.13	Very Good
LCO21379	C+(26.25)	26.25	Average
LCO21380	C+(25.13)	25.13	Average
LCO21381	A(40.63)	40.63	Excellent
LCO21383	A+(45.13)	45.13	Outstanding
LCO21384	A(43.63)	43.63	Excellent
LCO21385	B(34.13)	34.13	Good
MCO21373	A+(47.75)	47.75	Outstanding
MCO21374	A(43.25)	43.25	Excellent
MCO21375	B+(38.75)	38.75	Very Good
MCO21376	A(42.50)	42.50	Excellent

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Course: B.E.(Computer Science & Engineering)
Subject: Operating Systems (Practical) (CS 453)
Paper: Practical
Group(s): 2021-25/BE/CSE/S4/GP1, 2021-25/BE/CSE/S4/GP2, 2021-25/BE/CSE/S4/GP3
Max Marks: 50

Roll No.	Name	Marks	Grade
MCO21377	Rashmi	42.25	A(42.25)
MCO21378	Ritika Saini	40.38	A(40.38)

Name of Examiner Signature Countersigned by

Principal

Dheerendra Singh
dsingh@ccet.ac.in
19-11-2024

Panjab University

Semester: 4
Course: B.E.(Computer Science & Engineering)
Subject: Operating Systems (Practical) (CS 453)
Paper: Practical
Group(s): 2021-25/BE/CSE/S4/GP1, 2021-25/BE/CSE/S4/GP2, 2021-25/BE/CSE/S4/GP3
Max Marks: 50

Roll No.	Grade	Marks	Description
MCO21377	A(42.25)	42.25	Excellent
MCO21378	A(40.38)	40.38	Excellent

Name of Examiner Signature Countersigned by

Principal

Dheerendra Singh
dsingh@ccet.ac.in
19-11-2024

List of Advanced learners CS-403

- CO21305 Aishita
- CO21317 Gravit Nag
- CO21320 Harkiran Kaur
- CO21325 Ishtveer Singh Billing
- CO21326 Japan Ajit Singh Gandhi
- CO21327 Jiya
- CO21328 Kanishka Nagpal
- CO21336 Khusboo
- CO21338 Krishan Singla
- CO21347 Palvasha Bansal
- CO21352 Ruchika Thakur
- CO21370 Yashvi
- MCO21374 Jaskirt Kaur

List of slow learner CS-403

- CO21354 Samarth Sharma
- CO21358 Simaratpreet Kaur
- I CO21385 Shivam Singh Nayal

CS 403 OS 2021-2025

[Direct CO - Attainment]

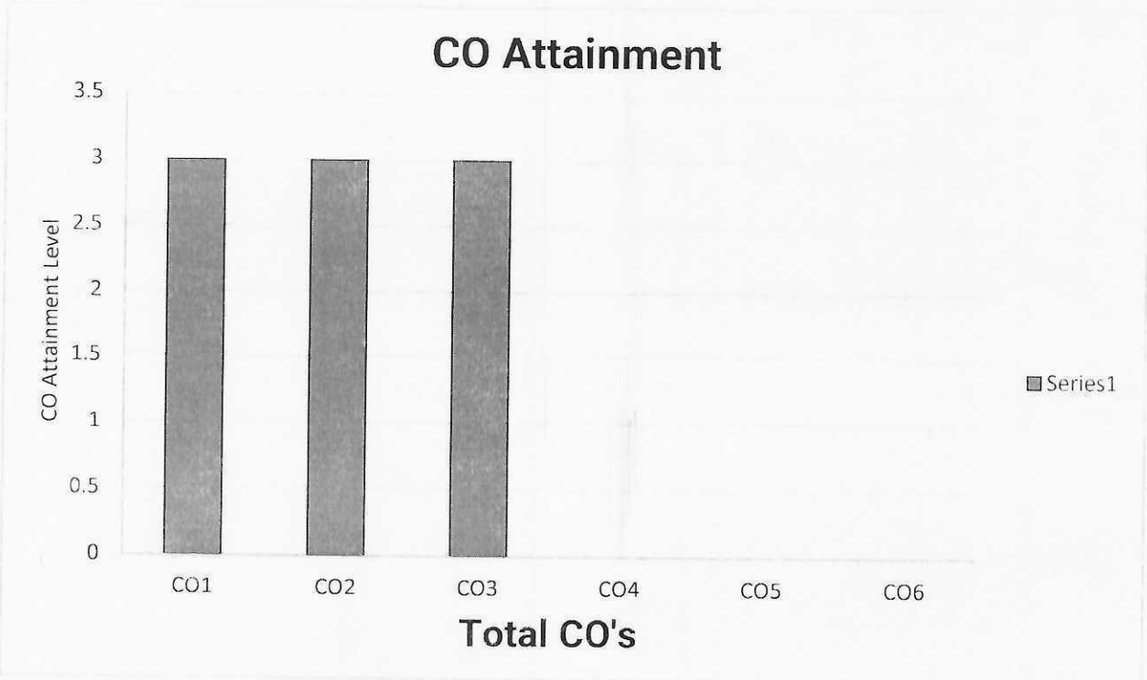
COs	CO1	CO2	CO3	CO4	CO5	CO6
Minor	3.00	3.00	3.00	0.00	0.00	0.00
Assignment	3.00	3.00	3.00	0.00	0.00	0.00
ESE	3	3	3	0	0	0
Minor*0.3+Assignment*0.2 + ESE*0.5	**3.00**	**3.00**	**3.00**	**0.00**	**0.00**	**0.00**

[Indirect CO - Attainment]

COs	CO1	CO2	CO3	CO4	CO5	CO6
Course Survey Feedback	3	3	3	0	0	0

[OVERALL - Attainment]

COs	CO1	CO2	CO3	CO4	CO5	CO6
Overall Attainment	3	3	3	0	0	0



CS 403 OS 2021-2025

PO Attainment MATRIX [Direct]															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	0	2	2	1	0	2	2	2	2	2	2	2
CO2	2	2	2	0	2	2	1	0	2	0	2	2	3	1	2
CO3	3	2	2	3	3	2	3	0	3	3	3	3	2	2	3
CO4															
CO5															
CO6															
CO7															
CO8															
CO9															
CO10															
	2	2	2	3	2.33	2	1.67	0	2.33	2.5	2.33	2.33	2.33	1.67	2.33

PO attainment = (PO mapping level/3) *CO attainment from previous sheet

A=PO MATRIX * DIRECT CO ATTAINMENT

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	0	2	2	1	0	2	2	2	2	2	2	2
CO2	2	2	2	0	2	2	1	0	2	0	2	2	3	1	2
CO3	3	2	2	3	3	2	3	0	3	3	3	3	2	2	3
CO4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AVERAGE	2	2	2	3	2.33	2	1.67	0	2.33	2.5	2.33	2.33	2.33	1.67	2.33

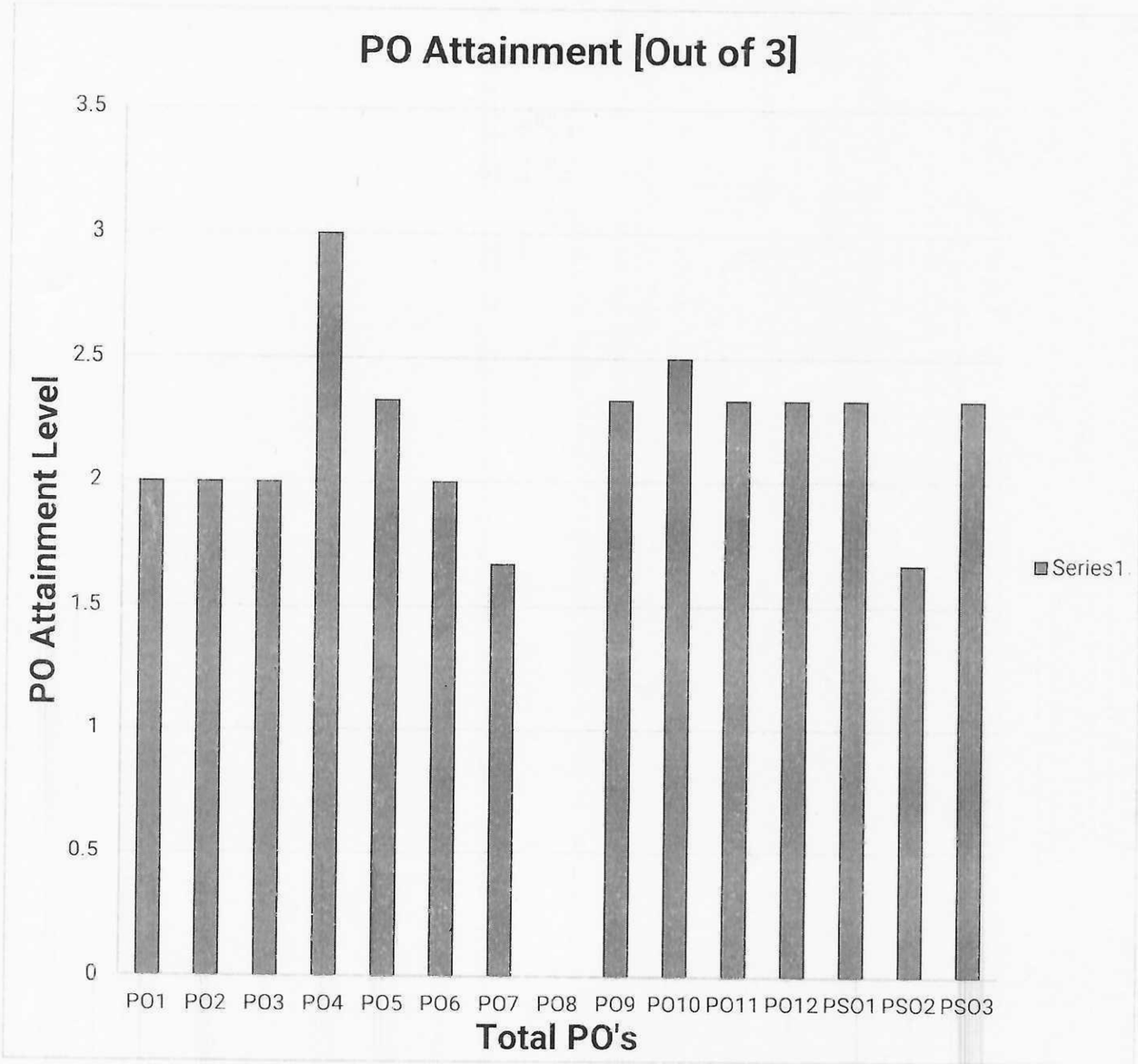
PO Attainment MATRIX [Indirect]

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	0	2	2	1	0	2	2	2	2	2	2	2
CO2	2	2	2	0	2	2	1	0	2	0	2	2	3	1	2
CO3	3	2	2	3	3	2	3	0	3	3	3	3	2	2	3
CO4															
CO5															
CO6															
CO7															
CO8															
CO9															
CO10															

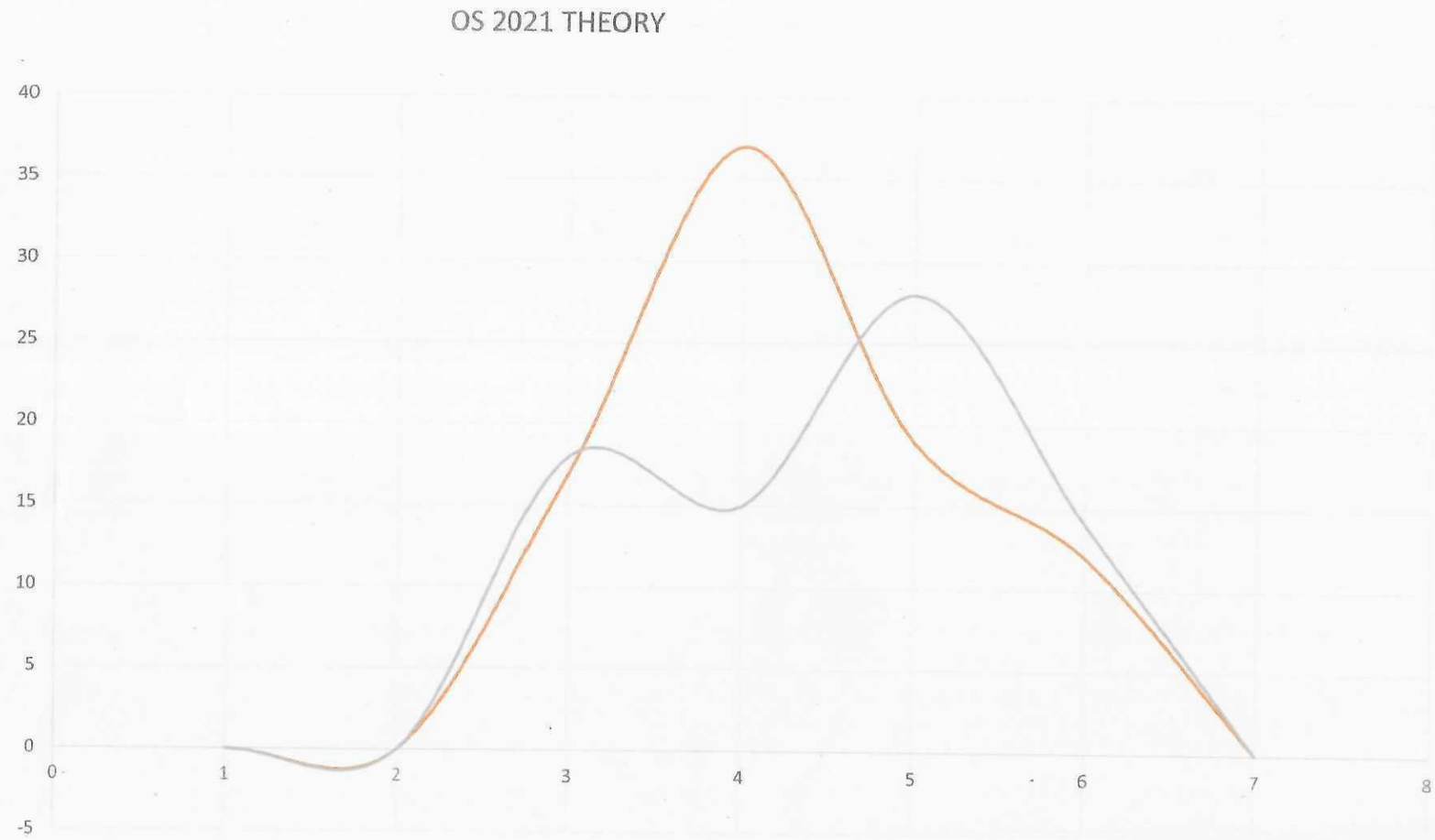
PO MATRIX * INDIRECT CO ATTAINMENT [Indirect]

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	0	2	2	1	0	2	2	2	2	2	2	2
CO2	2	2	2	0	2	2	1	0	2	0	2	2	3	1	2
CO3	3	2	2	3	3	2	3	0	3	3	3	3	2	2	3
CO4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	2	2	2	3	2.33	2	1.67	0	2.33	2.5	2.33	2.33	2.33	1.67	2.33

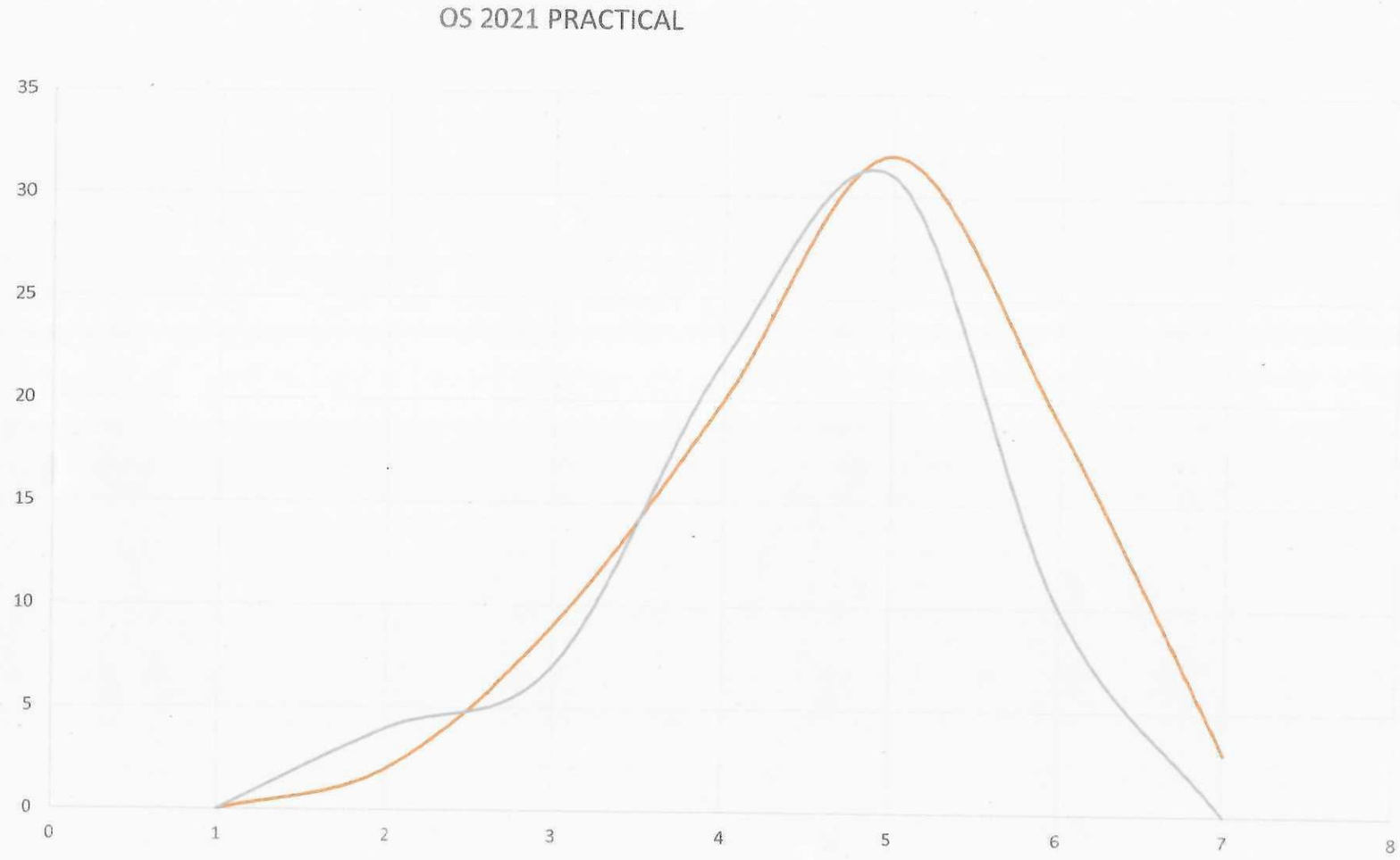
FINAL PO ATTAINMENT [Out of 3]														
PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
2	2	2	3	2.33	2	1.67	0	2.33	2.5	2.33	2.33	2.33	1.67	2.33



BELL SHAPED CURVE



BELL SHAPED CURVE

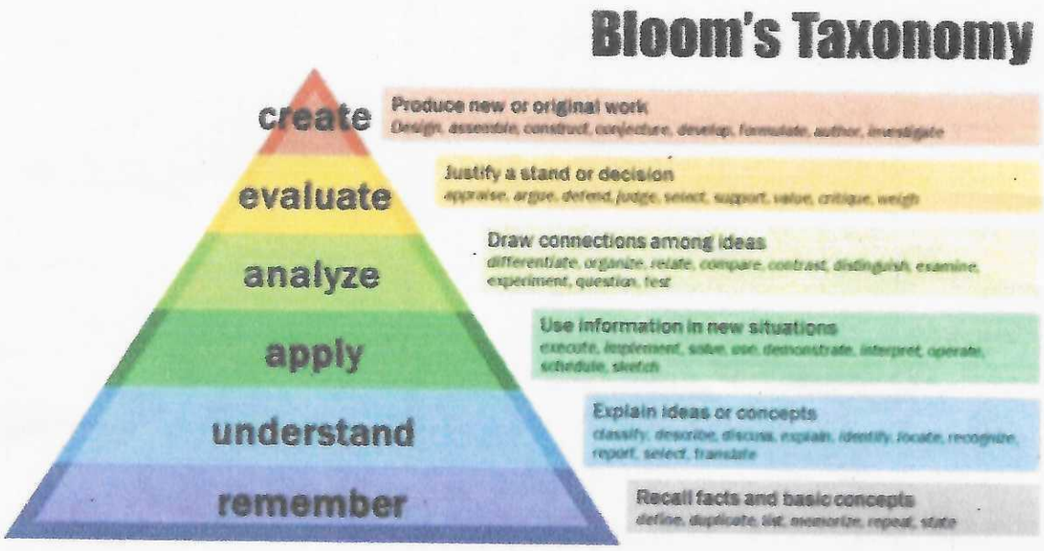


Bloom's Taxonomy Mapping for Operating System (2021-25)

Course Outcome aligned to the questions	Performance Criteria/Indicators	Level of Bloom's Taxonomy to be met	Target for Achievement	Question Mapping		
CO2	Differentiates counting and binary semaphore	Understand (L2)	100% students to the extent of 85%	Q1(a)		
CO3	Explains interprocess communication	Understand (L2)	100% students to the extent of 85%	Q1(b)		
CO3	Discusses access matrix mechanism	Apply (L3)	100% students to the extent of 85%	Q1(c)		
CO1	Writes a note on Dining Philosophers problem	Create (L6)	100% students to the extent of 85%	Q1(d)		
CO3	States conditions for critical section problem	Remember (L1)	100% students to the extent of 85%	Q1(e)		
CO3	Draws Gantt charts for scheduling algorithms	Create (L6)	100% students to the extent of 85%	Q2		
CO3	Explains methods for deadlock detection and recovery	Understand (L2)	100% students to the extent of 85%	Q3(a)		
CO1	Explains protection mechanisms and thrashing	Understand (L2)	100% students to the extent of 85%	Q3(b)		
CO3	Explains OS services and file architecture	Understand (L2)	100% students to the extent of 85%	Q4(a)		
CO1	Finds page faults using optimal page replacement	Apply (L3)	100% students to the extent of 85%	Q5(a)		

CO1	Explains demand paging performance impact	Understand (L2)	100% students to the extent of 85%	Q5(b)		
CO3	Explains SCAN and C-SCAN scheduling	Understand (L2)	100% students to the extent of 85%	Q6(a)		
CO3	Explains layered OS structure	Understand (L2)	100% students to the extent of 85%	Q6(b)		
CO3	Writes notes on Linux kernel and caching	Apply (L3)	100% students to the extent of 85%	Q7		

Bloom's Taxonomy



Operating System (CS-403)					
Course Feedback Form					
Batch 2021-25					
Parameter	Strongly Agree (Out of 50)	Agree (Out of 50)	Somewhat Agree (Out of 50)	Disagree (Out of 50)	Strongly Disagree (Out of 50)
1	48	2	0	0	0
2	36	8	6	0	0
3	22	20	8	0	0
4	27	15	8	0	0
5	39	4	7	0	0
6	23	12	15	0	0
7	34	13	3	0	0
8	18	21	11	0	0
9	29	21	0	0	0
10	31	9	10	0	0
11	17	20	13	0	0
Total	324	145	75	0	0
Rating	0.58	0.26	0.136	0	0

Chandigarh College of Engineering & Technology (Degree Wing), Chandigarh 160019
Course Feedback Form

Subject Title: Operating systems Sub code: CS 403 Session: 23-24
Semester: 4
Faculty Name: Dr Dheerendra Singh Department: CSE

S. No.	Parameter	Strongly Agree	Agree	Somewhat Agree	Disagree	Strongly Disagree
1	The lectures were well organized	✓				
2	The syllabus was fully covered	✓				
3	There was emphasis on fundamentals	✓				
4	The contents were illustrated with adequate examples	✓				
5	The Text books/ Study materials of the course was available	✓				
6	Tests and assignments are used for deep understanding of the course	✓				
7	Information was provided regarding latest advancements or developments	✓				
8	The discussions and responses to questions are encouraged during the course	✓				
9	Various instructional methods such as group discussions, presentations were used to reach the course objectives	✓				
10	Course encourages me to think critically	✓				
11	The objectives of the course are met	✓				

Overall rating of the course:

☐ Excellent ☐ Very good ☐ Good ☐ Average ☐ Poor

1. **New Topics likely to be added to make the course more attractive:**
   (Write suggestions)

2. **Suggestions regarding coverage of the topics for improvement (Specify the topics):**
   (Write suggestions)

3. **Any Other Suggestions:**
   (Write suggestions)

Note: If interested, the student can provide his/her contact details.

(7640/CCET/Chd-Govt. Press, U.T., Chd.)

Chandigarh College of Engineering & Technology (Degree Wing), Chandigarh 160019

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Semester: 4

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4	The contents were illustrated with adequate examples					
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Course Feedback Form

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Semester: 4
Faculty Name: Dr Dheerendra singh Department: CSE

S. No.	Parameter	Strongly Agree	Agree	Somewhat Agree	Disagree	Strongly Disagree
1	The lectures were well organized		✓			
2	The syllabus was fully covered		✓			
3	There was emphasis on fundamentals		✓			
4	The contents were illustrated with adequate examples		✓			
5	The Text books/ Study materials of the course was available		✓			
6	Tests and assignments are used for deep understanding of the course		✓			
7	Information was provided regarding latest advancements or developments		✓			
8	The discussions and responses to questions are encouraged during the course		✓			
9	Various instructional methods such as group discussions, presentations were used to reach the course objectives		✓			
10	Course encourages me to think critically		✓			
11	The objectives of the course are met		✓			

Overall rating of the course:

☐ Excellent ☐ Very good ☐ Good ☐ Average ☐ Poor

1. **New Topics likely to be added to make the course more attractive:**
   (Write suggestions)

2. **Suggestions regarding coverage of the topics for improvement (Specify the topics):**
   (Write suggestions)

3. **Any Other Suggestions:**
   (Write suggestions)

Note: If interested, the student can provide his/her contact details.

(7640/CCET/Chd-Govt. Press, U.T., Chd.)