

PRN No.	
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PAPER CODE	U315-294A (ESE)
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(AY:2025-26) December 2025 (ENDSEM) EXAM

TY (SEMESTER - I)

COURSE NAME: Operating System

Branch: E&TC

COURSE CODE:

ETUA31234A

T.Y (Pattern 2023)

Time: [1Hr 30 Min]

[Max. Marks: 40]

(*) Instructions to candidates:

- 1) Figures to the right indicate full marks. Use of scientific calculator is allowed
- 2) Use suitable data wherever required
- 3) All questions are compulsory. Solve any two sub question each from Questions 1 and 2
- 4) Solve any one sub question (2 marks) from Questions 3 ,4 ,5 and 6 and sub question of 4 marks is compulsory from questions 3,4,5,and 6

Q. No.	Question Description	Max. Marks	CO mapped	BT Level															
Q.1	Analyze how the kernel functions as a bridge between hardware and user-level applications. Illustrate and interpret the layered structure of an operating system to explain these interactions.	[4]	1	Analyze															
a)	Compare distributed and parallel operating systems. Use diagrams to explain how tasks are managed across systems.	[4]	1	Analyze															
b)	Analyze the sequence of events that occur when a user process invokes a system call. Identify which components of the operating system are involved and how control is transferred between them.	[4]	1	Analyze															
Q2	Apply your understanding of the multithreaded model to draw and explain, with a suitable example, how multiple threads within a process share resources and execute concurrently.	[4]	2	Apply															
a)	Apply your understanding of the Process Control Block to explain how the operating system uses PCB information to perform a context switch between two processes, using a suitable example	[4]	2	Apply															
b)	<table border="1"> <thead> <tr> <th>Process</th> <th>Arrival Time (ms)</th> <th>CPU Burst (ms)</th> </tr> </thead> <tbody> <tr> <td>P1</td> <td>0</td> <td>8</td> </tr> <tr> <td>P2</td> <td>1</td> <td>4</td> </tr> <tr> <td>P3</td> <td>2</td> <td>1</td> </tr> <tr> <td>P4</td> <td>3</td> <td>2</td> </tr> </tbody> </table> <p>Using SJF (preemptive): Draw the Gantt chart showing execution order. Compute Completion Time, Turnaround Time, Waiting Time for each process. Compute average turnaround time and average waiting time.</p>	Process	Arrival Time (ms)	CPU Burst (ms)	P1	0	8	P2	1	4	P3	2	1	P4	3	2	[4]	2	Apply
Process	Arrival Time (ms)	CPU Burst (ms)																	
P1	0	8																	
P2	1	4																	
P3	2	1																	
P4	3	2																	
c)																			

Q3 a)	Define a hypervisor and explain its role in virtualization.	[2]	3	Understand												
OR																
b)	Define a spinlock and explain its purpose in process synchronization.	[2]	3	Understand												
c)	Explain the concepts of Symmetric Multiprocessing (SMP) and Simultaneous Multithreading (SMT). Describe how the operating system supports these architectures for efficient execution.	[4]	3	Understand												
Q4 a)	Does a race condition occur when two processes update a shared counter simultaneously? Explain your evaluation.	[2]	4	Evaluate												
OR																
b)	For the Producer-Consumer problem, which is more efficient: using semaphores or monitors? Explain.	[2]	4	Evaluate												
c)	A system has 3 processes (P1, P2, P3) and 3 resource types (A, B, C). The total resources are: A = 10, B = 5, C = 7. The Maximum Claim and Allocation table is: <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Process</th> <th>Max (A,B,C)</th> <th>Allocation (A,B,C)</th> </tr> </thead> <tbody> <tr> <td>P1</td> <td>7, 5, 3</td> <td>0, 1, 0</td> </tr> <tr> <td>P2</td> <td>3, 2, 2</td> <td>2, 0, 0</td> </tr> <tr> <td>P3</td> <td>9, 0, 2</td> <td>3, 0, 2</td> </tr> </tbody> </table> Using Banker's Algorithm, determine whether the system is in a safe state or not.	Process	Max (A,B,C)	Allocation (A,B,C)	P1	7, 5, 3	0, 1, 0	P2	3, 2, 2	2, 0, 0	P3	9, 0, 2	3, 0, 2	[4]	4	Evaluate
Process	Max (A,B,C)	Allocation (A,B,C)														
P1	7, 5, 3	0, 1, 0														
P2	3, 2, 2	2, 0, 0														
P3	9, 0, 2	3, 0, 2														
Q.5 a)	Analyze internal and external fragmentation with an example of memory allocation and explain which type is more critical.	[2]	5	Analyze												
OR																
b)	Analyze how segmentation improves memory management compared to simple partitioning with an example of a process with multiple segments.	[2]	5	Analyze												
c)	Given a page reference string: 1, 2, 3, 4, 2, 1, 5, 2, 4, 5 and 3-page frames, apply the LRU page replacement algorithm. 1. Draw the frame table showing pages in memory at each step. 2. Calculate the total number of page faults. 3. Explain how LRU reduces page faults compared to FIFO in this example.	[4]	5	Analyze												
Q.6 a)	Examine the advantages and drawbacks of various directory structures (single-level, two-level, tree, acyclic graph) in terms of search efficiency and management complexity.	[2]	6	Understand												
OR																
b)	Explain how different file system structures affect system reliability, performance, and ease of maintenance."	[2]	6	Understand												
c)	Given requests at tracks 98, 183, 37, 122, 14, with the head starting at 50 moving towards higher track numbers, determine the order of servicing using SCAN. Calculate the total seek time.	[4]	6	Understand												