D: 444,446,977, C = 125

Student ID:

Air University
Department of Cyber Security
(Mid-Term Examination: Spring 2025)

Subject: *Operating System*
Class: *BS-Cyber Security*
Code: *CS-325*
Section: *A & B*
FM Name: *Ms. Maryam Malik*
FM Signature: .....

Total Marks: 50
Time Allowed: 2hr
Date:

HoD Signature: .....

Instructions:

- You are required to attempt **ALL Questions**.
- This is a closed book/notes exam.
- Calculators not allowed
- **Return question paper with the answer sheet**

Q. No	Questions	CLO	Marks
1	a) Explain how system calls provide an interface between user programs and the operating system. Why do most applications use APIs instead of direct system calls? **(3 Marks)** b) Explain the role of long-term, short-term, and medium-term schedulers in process scheduling. How do they contribute to system performance? **(3 Marks)** c) Explain the Critical Section Problem in process synchronization. What are the three conditions that a correct solution must satisfy? **(3 Marks)** d) What is the role of the upcall mechanism in Scheduler Activations? How does it help dynamically managing kernel threads? **(3 Marks)** e) Assume that an operating system maps user-level threads to the kernel using the many-to-many model and that the mapping is done through LWPs. Furthermore, the system allows developers to create real-time threads for use in real-time systems. Is it necessary to bind a real-time thread to an LWP? Explain. **(3 Marks)**	1	15
2	Consider a CPU scheduling scenario where the Shortest Job Remaining First (SJRF) (Preemptive SJF) algorithm is used. You are given a set of processes with their respective arrival times and burst times as follows:	2	15

Process	Queue	Burst time	Arrival time
P1		6	2
P2		2	5
P3		8	1
P4		3	0
P5		4	4

	Construct the Gantt Chart, and determine the Completion Time (CT) for each process. Using the completion times, calculate the Average Turnaround Time (ATAT), Average Waiting Time (AWT), and Average Response Time (ART) for the given set of processes.		
3	A software development team is designing a real-time banking application that allows multiple clients to perform transactions concurrently. The application needs to handle operations such as deposits, withdrawals, and balance inquiries while ensuring data integrity. As an operating system specialist, you are consulted to implement process synchronization mechanisms to prevent race conditions, deadlocks, and data inconsistency. I. Analyze the occurrence of a race condition when two clients attempt to withdraw money from the same account at the same time. Identify the key factors contributing to the race condition and explain its potential consequences. **(5 Marks)** II. Compare and contrast Peterson's Solution and Test-and-Set as synchronization techniques. Which method is more efficient in a multi-core system, and why? **(10 Marks)** III. Evaluate the potential drawbacks of using low-level synchronization mechanisms (such as Peterson's Solution and Test-and-Set) in a large-scale banking system. **(5 Marks)**	3	20

**********End of Paper **********