

資格考試科目：高等作業系統

Instructions: There are **seven** questions which count 100 points in total. Each question may have several sub-questions. Please read the questions carefully before answering.

1. (16 pts) Memory management:
 - A. (4 pts) Please explain the different between internal fragmentation and external fragmentation.
 - B. (4 pts) Which one of the above two fragmentations occurs in paging systems? Please explain your answer.
 - C. (4 pts) Which one of the above two fragmentations occurs in pure segmentation? Please explain your answer.
 - D. (4 pts) If LRU page replacement is used with four page frames and eight pages, how many page faults will occur with the reference string 017327103 if the four frames are initially empty?
2. (6 pts) (I/O Management) RAID is proposed to enhance IO performance and improve its reliability.
 - A. (3 pts) Please define the following two RAID levels: RAID level 0 and RAID level 4.
 - B. (3 pts) Which one of the two levels is more reliable than the other one? Please explain your answer.
3. (12 pts) Please answer the following questions for process synchronization in distributed systems:
 - A. (6 pts) Please define **serializable schedule** and **serial schedule**.
 - B. (6 pts) Please define **two-phase locking** and **strict two-phase locking** for concurrency control.
4. (16 pts) When multi-core processors are used in a system and computation workload are shared among all the cores, the operating system usually tries to evenly dispatch the tasks among the cores. Please answer the following questions.
 - A. (4 pts) Please define **load balance** and **load sharing**.
 - B. (6 pts) One approach for load balance is to maintain a global task queue for all the ready tasks and use one of the cores to dispatch the tasks. Please describe the advantage and disadvantage of this approach.
 - C. (6 pts) To conduct load sharing/load balance, the operating system should be aware of the load on each core. One may use the average task response time or length of the task queue to estimate the load. Please compare the accuracy and runtime overhead of these two approaches.
5. (10 pts) There are conflicting goals in the design of operating systems: Convenience and Efficiency. Please give us an example in operating systems features or designs or even some observation that shows any conflict on the two goals.
6. (20 pts) Please answer the following questions for process synchronization.
 - A. (10 pts) Please use counting semaphores to implement a solution to the dining philosopher problem in which each philosopher has a unique number (from 1 to 5), and each professor with an odd number should pick up their right chopstick first, and each professor with an even number should pick up their left chopstick first.
 - B. (10 pts) Please tell us whether your solution is deadlock-free or starvation-free. You must provide your proof to receive any credits.

7. (20 pts) Please answer the following questions for process management and process scheduling:
- A. (8 pts) Signals could be classified as either synchronous or asynchronous signals. Please give me 1 example signal for synchronous signals and 1 example signal for asynchronous signals.
 - B. (12 pts) It is common to integrate priority scheduling and round-robin scheduling, in which processes of the same priority are scheduled by round-robin scheduling, and processors of higher priorities are scheduled before those of lower priorities. Please give us two ways to favor interactive processes in such an integrated scheduling. (Hint: Process priorities and time quantum could be changed.)