

**Ph.D. Qualifying Exam: Operating Systems**  
**Department of Computer Science and Engineering,**  
**National Sun Yat-sen University**

**1. [Process: 20%]**

- (1) What are the seven major components of a process control block? (7%)
- (2) What is the priority inversion problem? How to solve it? (3%)
- (3) What is a critical section? Explain three necessary requirements for any solution to the critical-section problem. (5%)
- (4) Except CPU's utilization and throughput, please explain the three criteria to measure the performance of a process scheduling algorithm. (3%)
- (5) Is it safe to terminate a thread by invoking the `exit()` procedure in a multi-threading program? Why or why not? (2%)

**2. [Memory: 20%]**

- (1) Please explain three common solutions to the dynamic storage allocation problem in memory. (6%)
- (2) What are the purposes of base and limit registers? (4%)
- (3) Please explain how a page-buffering algorithm works. (3%)
- (4) What is swap space? What are the two major features of swap space? (3%)
- (5) Let memory access time be 200ns and average page fault time be 80 $\mu$ s. If you want EAT below 220ns, what is the expected page fault rate? List your calculation. (4%)

**3. [Storage and I/O: 20%]**

- (1) Please explain the two interrupt request lines for a CPU. (4%)
- (2) Consider a disk queue with requests for I/O to blocks on cylinders 110, 175, 48, 120, 31, 138, 75 and 88. Let the disk head currently stay at cylinder 65, and the maximum cylinder be 250. Give the results of SSTF and C-LOOK scheduling methods. (6%)
- (3) Please explain the following terms: (10%)
  - (a) mount point, (b) seek time, (c) rotational latency, (d) vectored I/O, (e) spool.

**4. [Distributed and Special Systems: 20%]**

- (1) Please explain how the deadlock prevention scheme works. (4%)
- (2) Suppose that processes P1, P2, and P3 have timestamps 29, 40, and 75, respectively. P2 is holding a resource that P1 and P3 want to access. Please show the behavior of these processes in the wait-die and wound-wait schemes. (5%)
- (3) What is the difference between stateful and stateless services? (2%)
- (4) Please give three requirements of designing a real-time OS. (3%)
- (5) Please explain three QoS levels. (6%)

## **5. [Protection & Security: 20%]**

- (1) Please give four benefits of using language-based protection. (4%)
- (2) How do UNIX and Windows NT systems defend against fake login programs? (4%)
- (3) How does message-authentication code work? (4%)
- (4) Please explain the two capabilities defined in the Cambridge CAP system. (4%)
- (5) How do tunneling and armored viruses avoid detection by an antivirus scanner?  
(4%)