

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

1. Process Management (35 points)
  - A. (10 points) Please describe the steps of context switching a process from running state to ready state and vice versa, including the steps on process, memory and storage subsystems, on single-core processor systems.
  - B. (5 points) Please describe the difference while switching out from a core and switching in to another core on multi-core systems.
  - C. (5 points) Please describe the difference while switching out from a processor and switching in to another processor on multi-processor systems.
  - D. (5 points) Please describe the difference while switching out from a computer and switching in to another computer on multi-computer distributed systems.
  - E. (10 points) Consider round-robin scheduling and scheduling criteria being "higher throughput". Will the throughput of the system becomes higher with a smaller time quantum? You must explain why.
  
2. (15 points) Memory management:
  - A. (10 points) Please explain the cause of internal and external fragmentation.
  - B. (5 points) If LRU page replacement is used with three page frames and eight pages, how many page faults will occur with the reference string 271321037 if the four frames are initially empty?
  
3. (50 points) When developing networked file systems, the server may be either centralized or distributed.
  - A. (20 points) Please describe the major difference between centralized and distributed file systems, in terms of system architecture, scalability, reliability, and robustness.
  - B. (10 points) Please describe the difference between replicated files and cached files on networked file systems.
  - C. (20 points) Please describe quorum-based consistency algorithm for distributed file systems, including the concept and advantage/disadvantages of the algorithm.