

Master of Software Engineering  
1<sup>st</sup> year, 1<sup>st</sup> Semester examination, 2024

**Subject: Operating System & Kernel Programming**

Time - three hours

Full marks - 100

*Instructions: Different parts of the same question should be answered together. Answer precisely and to-the-point. Irrelevant/duplicate answers are highly discouraged.*

**Answer question number 1(one) and any 5(five) form the rest.**

1. 10x2 = 20
  - i) Distinguish between library and system calls.
  - ii) Write briefly the functions of an 'inode' in Linux file system.
  - iii) Write the function of Set User ID(SUID) bit?
  - iv) What is a 'zombie' process?
  - v) Write a shell command to list all zombie processes.
  - vi) Write the function of the signal 'SIGKILL' in Linux.
  - vii) Write a C function 'setPriority(int pid, int prty)' that sets the priority of the process with process-id 'pid' to new priority 'prty'.
  - viii) Name different tools provided by Linux system for inter-process communication.
  - ix) What is the range of real time priorities in Linux?
  - x) How many process scheduling policies does the Linux OS support?
  
2. [4+4+(4+4)]
  - i) How file system is implemented in Linux?.
  - ii) Suppose the block size in a Linux system is 4096 bytes. What is the maximum possible file size?
  - iii) What are boot and super blocks? What information is stored here?
  
3. [4+4+8]
  - i) Distinguish between a hard and soft links.
  - ii) Write commands to create a hard link and a soft link? Write their applications.
  - iii) Write a C function that takes two file names as arguments and copies the content of the first file to the second one using system calls. Mention assumptions (if any) made.
  
4. [4+4+(4+4)]
  - i) Describe briefly the structure of process descriptor.
  - ii) Briefly describe how the process descriptor is obtained from a given PID.
  - iii) Explain briefly the process state transition diagram in Linux. Write a sample piece of code in C to find all zombie processes in a Linux system.

[ Turn over

5. [4+4+(2+6)]
- i) What does 'nice' represent?
  - ii) How can you get and change the static priority of a process?
  - iii) Write the names scheduling policies used for real time tasks. Explain any one.
6. [4+4+8]
- i) Explain with examples the usage and significance of 'Sticky bit'.
  - ii) Write, with example, the ways a process can be started from another process.
  - iii) Write a program with 2 threads; one thread should print even and other should print odd numbers in sequence.
7. [4+4+8]
- i) The 'fork' system call creates a new child process from a parent. How can you obtain the PID, PPID and child id (from parent)?
  - ii) Show with example. Outline a C program to create 5(five) child processes from a (parent) process.
  - iii) Suppose a bank provides multiple 'teller' counters and multiple 'update' counters. A teller can perform read, withdraw and deposit operation while an update counter can only read current balance on accounts. Write the structure of teller and update processes.
8. [4+4 +(2+2+4)]
- i) Write why Red-Black Tree is used instead of other height balanced trees to implement CFS.
  - ii) Write that basic idea of Completely Fair Scheduling (CFS) used for traditional processes.
  - iii) In a system, n threads  $T_1, T_2, T_3 \dots T_n$  want to execute within a critical section in that order. How many semaphores will be required to achieve this ordering, and what should be their initial values? Sketch the code for the n threads.