System Software PYQ’

1. Explain the following kernel types with suitable Architecture diagrams
    a. Monolithic
    b. Micro
    c. Hybrid
2. Assume the XFS file system has 15 direct and (one) single indirect and (one) double indirect data locks. Each data block size is 4 KiB. The single and double indirect blocks store only addresses of data blocks. Each data block's address size is 4 bytes.
    a. What is the maximum size of a file that you can store in the above file system?
    b. If each data block has stored a single file then how many files can be stored in the file system? What would be the maximum number of inode entries in the inode block?
3. Explain the following process states with process state diagram:
    a. TASK RUNNING
    b. TASK_INTERRUPTIBLE
    c. TASK_UNINTERRUPTIBLE
    d. TASK_STOPPED
    e. TASK ZOMBIE
4. Answer the following with suitable diagrams:
    a. Explain the difference between preemptive and non-preemptive kernels.
    b. In preemptive scheduling, when will a higher priority process can be blocked by a lower priority process and how do you overcome this problem?
5. Servers can be designed to limit the number of open connections. For example, a server may wish to have only N socket connections at any point in time. As soon as N connections are made, the server will not accept another incoming connection until an existing connection is released. Explain how semaphores can be used by a server to limit the number of concurrent connections in Socket Programming.

1 Multiple Choice - Single Answer ⚠ 0.0

Which of the signals cannot be caught or ignored:

- SIGILL
- SIGSEGV
- SIGSTOP
- SIGFPE

2 Multiple Choice - Single Answer ✔ 1.0

Which of the following is false regarding shared memory?

- shmget ( ) is used to create a shared memory segment.
- Shared Memory does not require an intermediate buffer.
- Shared Memory is a much faster method of communication than either semaphores or message queues.
- On success, shmget ( ) returns 1 else return -1.

3 Multiple Choice - Single Answer ✔

On the expiration of ITIMER_REAL will generate the ---------- signal.

- SIGVTALRM
- SIGHUP
- SIGALRM
- SIGTSTP

4 Multiple Choice - Single Answer ✔

How many times getpid ( ) will be executed?

```
#include<stdio.h>
main()
 {
     int i;
     for (i = 1; i <= 5; i++)
       fork();
     printf("my pid = %d\n", getpid());
}
```

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5 Multiple Choice - Single Answer ✔ 1.0 Hide Answer

If a process exits without unlocking a semaphore, which one of the following should be assigned in the sem_flg (in the sembuf structure) to release the semaphore?

- SEM_EXIT
- SEM_RELEASE
- IPC_NOWAIT
- SEM_UNDO

6 Multiple Choice - Single Answer ⚠ 0.0 Hide Answer

A successful execl() call changes (choose more appropriate one)

- Address space, process image, resetting pending signals, pid.
- Address space, process image, reset pending signals and dropping existing memory locks.
- only the address space and process image and files.
- Address space, process image, resetting pending signals.

7 Multiple Choice - Single Answer ✔ 1.0

Which functionality is handled by the architecture-dependent code of the kernel?

- Network communication support
- IPC
- Terminal-interface driver
- Input-Output Runtime Support

8 Multiple Choice - Single Answer ⚠ 0.0

When a process is executing in kernel mode, if it receives any signal the signal will be executed:

- when it returns to user mode
- when it is in protected mode
- immediately
- not predictable

9 Multiple Choice - Single Answer ✔ 1.0

Orphan process's pid is ----------.

- init pid.
- its own pid
- systemd pid
- 1

10 Multiple Choice - Single Answer ⚠ 0.0

In the msgrcv function, if the msgtype argument is some negative integer value means, the message will be retrieved in:

- the exact value of the message type
- first message or <= to the absolute value
- FIFO order

11 Multiple Choice - Single Answer ✔ 1.0

What is buffer/cache?

- It is an on-disk memory that stores the recently accessed data from a file system.
- It is another caching device like the primary cache to improve paging performance.
- It is an in-memory store that stores the recently accessed data from a filesystem.
- None of the above.

12 Multiple Choice - Single Answer ✔ 1.0

Which one of the following is the disadvantage of a message queue?

- All of the options
- during message sending, the message is copied from the user buffer into the kernel buffer
- very expensive for large data transfer
- a message in a queue cannot be reused

13 | Multiple Choice - Single Answer | ✔ | 1.0

Which of the following command /system call is used to change the real-time attributes of a process?

- nice
- chrt
- chmod
- sched_get_priority_max

14 | Multiple Choice - Single Answer | ✔ | 1.0

Which one of the following is false regarding a FIFO?

- zero buffering capacity.
- half-duplex.
- communicate between only related processes.
- uses circular buffer.

15 Multiple Choice - Single Answer ⚠ 0.0

Which one of the following is never set as value of backlog argument in the listen ( ) system call?

- 5
- 1
- 0
- 3

1. On expiration of ITIMER_REAL will generate ---------- signal.
a) SIGALRM
b) SIGHUP
c) SIGTSTP
d) SIGVTALRM

2. Which one of the following is never set as value of backlog argument in the listen ( ) system call?
a) 0
b) 1
c) 4
d) 5

3. In the msgrcv function if the msgtype argument is some negative integer value means, the message will be retrieved in
a) FIFO order
b) first message or <= to the absolute value
c) depends on the priority of the messages
d) the exact value of the message type

4. If a process exits without unlocking a semaphore, which one of the following should be assigned in the sem_flg (in the sembuf structure) to release the semaphore?
a) IPC_NOWAIT
b) SEM_RELEASE
c) SEM_DO
d) SEM_UNDO

5. Which functionality is handled by architecture dependent code of kernel-
a) Terminal-interface driver
b) IPC

c) Input-Output Runtime Support
d) Input-Output Buffer Management

6. What is buffer/cache?
a) It is an in-memory store which stores the recently accessed data from a filesystem.
b) It is an on-disk store which stores the recently accessed data from a file system.
c) It is another caching device like a primary cache to improve paging performance.
d) None of the above.

7. A successful execl() call changes (choose more appropriate one)
a) only the address space and process image and files.
b) Address space, process image, resetting pending signals.
c) Address space, process image, resetting pending signals, pid.
d) Address space, process image, resetting pending signals, dropping existing memory locks.

8. Zombie state of the process's PPID is?
a) 0
b) 1
c) Its own parent process id
d) systemd's pid

9. In a filesystem typical the following is replicated
a) Superblock
b) File Datablocks
c) Directory information
d) File paths

10. File descriptors created by *dup( )*
a) creates a new copy of the file table entry
b) reset the file position at the beginning of a file
c) reset the file position at the end of a file
d) shares the current file position

11. Which of the following is true about a jiffy:
a) It is the frequency at which the hardware clock is running
b) It is the frequency at which the hardware clock interrupts the CPU
c) It is a time period corresponding to the hardware clock frequency
d) It is determined by the kernel configuration variable HZ

12. When a fork ( ) system call is called, what are the possible return values?
a) 0, 1, >0
b) 1, -1, >0
c) -1, >0, 2

d) 0, >0, -1

13. A program opens an existing file for reading resulting in the file descriptor fd1 using open(). It then uses dup() to create fd2 from fd1. Then it reads 10 bytes using fd1 and then reads 10 bytes using fd2 using read(). When the program runs, which of the following is true:

a) The first and second read both give the first 10 bytes
b) The first read gives first 10 bytes and the second read give the second 10 bytes
c) The first read changes things in an unpredictable way for the second read.
d) The two fds point to different entries in the global open files table

14. A program assigns the variable int v =1; it then forks. After the fork, the child assigns the same variable v=2 and the parent assigns v=3. Immediately after these new assignments, both parent and child print v. which of the following hold:

a) Since one of them assigns v to be 2 and the other assigns v to be 3, either both print 2 or both print 3 depending on if the child or the parent executes first.
b) The parent will always print its output before the child.
c) The parent and child are different processes, so they cannot access the same variable so this is an error.
d) Parent prints 3 and child prints 2

15. If a jiffy value is 1ms, then what is the clock frequency?

a) 1000 Hz
b) 100 Hz
c) 10 Hz
d) 1 Hz

16. Using signal with SIG_DFL in place of the handler will cause the following:

a) Setup for no action to be taken when the signal arrives
b) Set the signal specific pre-defined default handler to run when the signal arrives
c) Deletes the signal
d) Cause the a signal to terminate the process

17. A simple contiguous memory allocation strategy (without paging or segmentation) often

a) Causes internal fragmentation
b) Causes external fragmentation
c) Can cause both internal as well as external fragmentation
d) Eliminates need to maintain base and bound registers

18. When the page frames in RAM are all full, then the best policy to find a victim to replace is:

a) LRU
b) FIFO

c) FILO
d) MRU

19. Micro kernel is
a) Highly extensible
b) less run time overhead
c) bigger than monolithic kernel
d) suitable for server

20. A creat( ) system call creates a file in
a) read only mode
b) write only mode
c) read – write mode
d) append mode

Assume paging based memory management
a) What is a TLB, where is it located, and what is its role from that of the Page Table? (1 mark)
b) When does a page fault occur? (1 mark)
c) Assume a 64-bit virtual address and 64-bit physical address space. Further, assume the least significant 12 bits are used for the offset and the next 36 bits are for virtual page number (assume the most significant 16 bits are unused). Illustrate and describe how address translation occurs. Give a flowchart indicating the process including TLB miss and page fault scenarios. (4 marks)

a) read only mode
b) write only mode
c) read – write mode
d) append mode

1	File Upload	✔	6.0	Hide Answer

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2	File Upload	✔	5.5	Hide Answer

Answer the following questions:
a) Explain the different process states with a process state diagram. (3 marks)
b) Draw a process tree structure for the following program execution (2 marks) and find out how many ***printf*** statements will be displayed on the console (1 mark).

```
int main (void) {
 int i;
 printf ( "Hello fork " );
 for(i=0; i<=2; i++)
 fork();
}
```

3	File Upload	✔	5.0	Hide Answer

Operating Systems support multiple locking mechanisms.
a) Describe the circumstances under which one may use spinlocks, semaphores, and File locking. (4 marks)
b) Explain why a spinlock is unsuitable for single processor systems. (1 mark)
c) In what use case would you prefer spinlock over semaphore? (1 mark)

4	File Upload	✔	3.0	Hide Answer

Write out an algorithm for a concurrent TCP server (pseudo code is ok, but it ***must*** include all the basic calls from socket creation to accepting connections (3 marks). Further, your code must handle only N concurrent active socket connections at any point in time. Implement this feature by using semaphores to limit the number of active connections. If a new request comes at the time N connections are active, the new connection will be accepted only when one of the existing connections is released (3 marks).

Evaluator Comments

What psedu code was expected
Create and Initialize the counting semaphore

5	File Upload	✔	6.0	Hide Answer

Explain the difference between preemptive and non-preemptive scheduling kernels (2 marks). In pre-emptive scheduling in a soft real time system, when will a higher priority process can be effectively blocked by a lower priority process? Explain in detail with a scenario. Describe one strategy to overcome this problem. Show in your given scenario how that resolves the problem (4 marks).