**PART-A (20 points)**

* 1. UNIX is an example of \_\_\_\_
     1. a single user, single tasking operating system
     2. a single-user, multitasking operating system
     3. a multi user, single tasking operating system
     4. a multi user, multitasking operating system
  2. An important goal of an operating system is to

1. translate programs written in higher programming language to machine language
2. bind the user code with library routines and make an executable code
3. allocate and manage resources in the computer system
4. slow down execution of programs so users are forced to buy systems with more RAM
   1. To access the services of operating system, the interface is provided by the
5. System calls
6. API
7. Library
8. Assembly instructions

4. The main function of the command interpreter is

1. to get and execute the next user-specified command
2. to provide the interface between the API and application program
3. to handle the files in operating system
4. none of the mentioned

5. A virtual machine system

a. offers no protection to the various system resources

b. is ideal for operating system research and development

c. needs no physical resources

d. does not support multitasking

1. Consider a personal computer in which keyboard interrupts arrive at the rate 10 interrupts/sec. If interrupt processing takes 20 \* 10-6 seconds, what percentage of the CPU time is spent on interrupt processing?
   * 1. 10%
     2. 2.0%
     3. 0.10%
     4. 0.02%
2. How does the software trigger an interrupt?
3. Sending signals to CPU through bus
4. Executing a special operation called system call
5. Executing a special program called system program
6. Executing a special program called interrupt trigger program
7. What is a trap/exception?
8. hardware generated interrupt caused by an error
9. software generated interrupt caused by an error
10. user generated interrupt caused by an error
11. none of the mentioned
12. With \_\_\_\_\_\_\_\_\_\_\_\_\_ only one process can execute at a time; meanwhile all other process are waiting for the processor. With \_\_\_\_\_\_\_\_\_\_\_\_\_ more than one process can be running simultaneously each on a different processor.
13. Multiprocessing, Multiprogramming
14. Multiprogramming, Uniprocessing
15. Multiprogramming, Multiprocessing
16. Uniprogramming, Multiprocessing
17. The \_\_\_\_\_\_\_\_ provides a portion of the system call interface for UNIX and Linux.
18. POSIX
19. Java
20. Standard C library
21. Standard API
22. What is a long-term scheduler?
23. It selects which process has to be brought into the ready queue
24. It selects which process has to be executed next and allocates CPU
25. It selects which process to remove from memory by swapping
26. None of the mentioned
27. If all processes I/O bound, the ready queue will almost always be \_\_\_\_\_\_ and the Short term Scheduler will have a \_\_\_\_\_\_ to do.
28. full,little
29. full,lot
30. empty,little
31. empty,lot
32. What is a medium-term scheduler?
33. It selects which process has to be brought into the ready queue
34. It selects which process has to be executed next and allocates CPU
35. It selects which process to remove from memory by swapping
36. None of the mentioned
37. The most optimal scheduling algorithm of minimum waiting time is:
38. FCFS – First come First served
39. SJF – Shortest Job First
40. RR – Round Robin
41. FCLS – First come last served
42. The purpose of a dispatcher is to

a. maintain a proper mix of I/O-bound and CPU-bound jobs

b. handle timer interrupts

c. service page faults in a virtual memory system

d. carry out the decision of the short-term scheduler

1. The interval from the time of submission of a process to the time of completion is termed as
2. waiting time
3. turnaround time
4. response time
5. throughput
6. In priority scheduling algorithm
7. CPU is allocated to the process with highest priority
8. CPU is allocated to the process with lowest priority
9. Equal priority processes cannot be scheduled
10. None of the mentioned
11. Process are classified into different groups in
12. shortest job scheduling algorithm
13. round robin scheduling algorithm
14. priority scheduling algorithm
15. multilevel queue scheduling algorithm
16. Which one of the following *cannot* be scheduled by the kernel?
17. kernel level thread
18. user level thread
19. process
20. none of the mentioned
21. One of the disadvantages of the priority scheduling algorithm is that:
22. it schedules in a very complex manner
23. its scheduling takes up a lot of time
24. it can lead to some low priority process waiting indefinitely for the CPU
25. none of the mentioned
26. Which one in a process’s life time is preemptive:
27. terminated
28. switch from running to waiting state
29. switch from running to ready state
30. switch from waiting to ready state
31. switch from ready to running state

**PART-B (15 Points)**

Circle **T** if the statement is True or **F** if the statement is False.

|  |  |  |  |
| --- | --- | --- | --- |
| 1. | T | F | Windows 10 does not support multitasking since it is meant to be used on a personal computer. |
| 2. | T | F | A short-term scheduler selects which process has to be executed next and allocates CPU. |
| 3. | T | F | The client-server architecture is not the preferred model for implementing operating systems these days. |
| 4. | T | F | Change to user mode from system mode is an example of a non-privileged instruction. |
| 5. | T | F | In modern computer systems, before fetching a new instruction, the CPU will check if there are any interrupts to be handled. |
| 6. | T | F | Kernel is made of various modules which cannot be loaded in running operating system. |
| 7. | T | F | The OS X has a monolithic kernel. |
| 8. | T | F | An interrupt vector is an address that is indexed to an interrupt handler. |
| 9. | T | F | I/O polling refers to that CPU watches the I/O control bit randomly to avoid a loop and save CPU resources. |
| 10. | T | F | Medium-term scheduler is another name for the OS component called CPU scheduler. |

**PART-C (20 Points)**

Fill-in the most appropriate word or phrase in the blank and complete the sentence.

1. Mac OS X kernel, partly based on Mach that is an example of \_\_\_\_\_\_\_\_\_\_\_\_\_, structures the operating system by removing nonessential components from the kernel and implementing them as user-level programs, leading to a smaller and reliable kernel.
2. Switching the CPU to another process by performing a state save of the current process and a state restore of a different process is known as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ switch.
3. If the time quantum used for round-robin scheme is extremely large, the CPU scheduling reduces to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ algorithm.
4. There are several metrics/criteria to measure the CPU scheduling algorithm. They are CPU utilization, throughput, \_\_\_\_\_\_\_\_\_\_\_ time, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ time, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ time.
5. In a simple 16-bit computer system, the interrupted program address usually is saved to the memory address of 0x\_\_\_\_\_\_\_\_\_.
6. From the perspective of access speed, \_\_\_\_\_\_\_\_\_\_\_\_ is a storage device whose speed is between register and main memory.
7. A balanced binary search tree in OS data structure can achieve the time complexity of O(\_\_\_\_\_ ) for searching, assuming ***n*** nodes.
8. For the foreground programs, in order to receive the best response time, \_\_\_\_\_\_\_\_\_\_\_\_\_ algorithm is often used.

**PART-D (20 Points)**

Match the terms below with the phrases provided later. In the table below, for each term (a - g) in the list, write the letter (A – L) of the most appropriate phrase (one and only one). Note that there are more phrases in the list than there are terms below.

# List of terms

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| a. | Booting |  | b. | Deadlock |
| c. | Interrupt vector |  | d. | HALT |
| e. | Module |  | f. | System calls |
| g. | Job scheduler |  | h. | Memory Stack |
| i. | Message Passing |  | j. | Register |

# List of phrases

1. Periodically increase the priority based on the wait time
2. Also known as hardware interrupts
3. An alternative name of Long-term scheduler
4. Each process needs a resource held by another process and hence all of them wait indefinitely, unable to make any progress
5. A privileged instruction, if dual mode operation is supported
6. A particular CPU register that holds condition codes resulting from arithmetic and logical operations
7. Monitors page fault rate to swap out a process if necessary
8. a small amount of fast storage, usually quickly accessible to CPU
9. Long delays in processing
10. One of communication methods between in-process threads
11. Requests for operating system service
12. The process of loading the operating system kernel
13. A table of starting addresses of interrupt service routines
14. A primitive form of interprocess communication
15. That can be mounted to OS kernel.
16. Starts from the lower address towards higher address
17. Starts from the higher address towards lower address

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Term | **a** | **b** | **c** | **d** | **e** | **f** | **g** | **h** | **i** | **j** |
| **Phrase** |  |  |  |  |  |  |  |  |  |  |

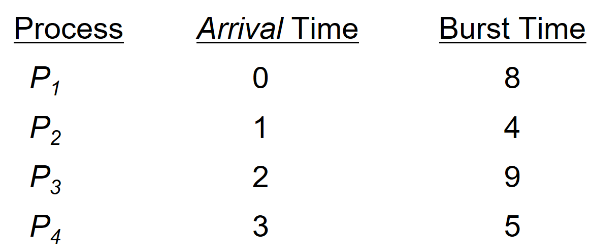
**PART-E (25 Points)**

1. There are two different ways that commands can be processed by a command interpreter. One way is to allow the command interpreter to contain the code needed to execute the command. The other way is to implement the commands through system programs. Compare and contrast the two approaches?
2. List at least three kinds of specific hardware support/techniques that can assist the implementation of operating system functions and give the explanation.
3. Explain the concept of an interrupt driven I/O. First identify one input device in a desktop computer that is handled by interrupt driven I/O (i.e., without a DMA), and then use it as an example to explain the concept. Hint: CPU & Interrupt.

Device: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Explanation:

1. Using the shortest-remaining-time-first algorithm, please (1) calculate the average ***response*** time; (2) calculate the average ***turnaround*** time.



1. Adopting the Round-Robin algorithm with quantum time = 2, please calculate the average ***response*** time.

