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RV COLLEGE OF NGINEERING®

(An Autonomous Institution Affiliated to VTU)

III Semester B. E. Examinations April/May-2023

Common to CSE/ISE/AI&ML

OPERATING SYSTEMS

Time: 03 Hours ***Maximum Marks: 100***

Instructions to candidates:

1. Answer all questions from Part A. Part A questions should be answered in first three pages of the answer book only.
2. Answer FIVE full questions from Part B. In Part B question number 2 is compulsory. Answer any one full question from 3 and 4, 5 and 6, 7 and 8, 9 and 10.

PART-A

1	1.1	Identify any two events that takes a process form running state to ready state.	02
	1.2	Analyze the code below and create parent-child relationship tree to determine number of process. $int\ main()$ $\{$ $if\ (fork()\ \|\|\ fork\ ())$ $fork();$ $return\ 0;$ $\}$	02
	1.3	How the operating system protects processes from being modified by other processes?	02
	1.4	Identify the multithreading model where a) The entire process blocks when makes blocking system call b) The entire process does NOT blocks when a thread makes blocking system call	02
	1.5	Even if number of frames are increased, ___________ page replacement algorithm may result in increased number of page faults. This scenario is known as ___________.	02
	1.6	"Shortest Job First does not necessarily gives minimum waiting time if they arrive at different times". Justify this statement with an example.	02
	1.7	Provide example of an application that typically access files in the following ways: a) Sequential access b) Random access	02
	1.8	Name the various layers of a File System?	02
	1.9	At a particular time of computation the value of a counting semaphore is 9 then $20\,P$ operations and $15V$ operations were completed on this semaphore. Determine the resulting value of the semaphore.	02
	1.10	Assuming $1\,KB$ page size and 32,768 logical address space size, what are the page numbers and offsets for the following address references i) 20780 ii) 9366	02

PART-B

2 a Illustrate with help of an example and a neat diagram how the Linux system call interface handles invoking a system call. List the broad category of Linux system calls with an example for each. 06

b With the help of a neat diagram explain the memory map of a process. Identify the memory region allocated for the variables for the variables $var1, var2, var3, var4$ and $var5$ in the following program:

```
int var1  = 10, var2;
int main ()
{
  int var3  =  5;
  static int var4  = 20
  int ∗ var5  =  malloc (sizeof  (int)  ∗ 5);
  return 0;
}
```

05

c Elucidate with the help of neat diagram the dual mode of operation and it’s purpose in operating system. Which of the following instructions need to execute in privileged mode or user mode, give reason?

i) Printing file on printer
ii) Create a child process
iii) Sorting list of numbers
iv) Read the clock.

05

3 a Indicate, with specific justification, whether or not the following claims are true. Marks will be awarded only if the justification is correct.

i) Timesharing systems are identical to multiprogramming systems when the time slice exceeds CPU burst of every program.
ii) Kernel mode is essential for isolated and protected execution of processes.
iii) Process creation is heavy-weight while thread creation is light–weight.

06

b Consider the following set of processes with a length of the CPU burst time given in milliseconds

Process	*Arrival Time*	*Burst Time*	*Priority*
$P1$	0	11	2
$P2$	5	28	0
$P3$	12	2	3
$P4$	2	10	1
$P5$	9	16	4

Draw Gantt charts illustrating the execution of these processes using Preemptive SJF, Preemptive Priority (lower number higher priority) and Round Robin (Time slice $= 3ms$). Compute the average waiting time, average turnaround time and number of context switches in each approach. 10

OR

4 a Consider the following set of processes with a length of the CPU burst time given in milliseconds:

$Process$	$Arrival\ Time$	$Burst\ Time$
$P1$	0	11
$P2$	0	28
$P3$	4	2
$P4$	3	10
$P5$	9	16

i) Draw Gantt charts illustrating the execution of these processes using $FCFS$ and Pre-emptive SJF scheduling algorithm considering the arrival time. Compute the average waiting time, average turnaround time and number of context switches in each approach. 08

b What are the benefits and challenges associated with multicore programming? Write a program to create threads to demonstrate the advantage of parallel execution. 08

5 a Describe the different scenarios under which it is appropriate to use spinlocks, mutex locks, semaphores and condition variables with an example for each. 06

b Illustrate how deadlock and starvation situation can arise in the classical Dining Philosopher problem. Develop a deadlock free solution to classical dining philosopher synchronization. 10

OR

6 a Describe hardware solution to critical section problem. Write pseudo code that uses TestAndSet instruction to provide mutual exclusion that satisfies bounded waiting for N processes. 08

b Illustrate with an example the possibility of race condition among Reader-Writer processes and using semaphores. Write a pseudo code to solve the Reader-Write synchronization problem. 08

7 a With the help of a neat diagram explain the basic paging scheme of memory management, what is the significance of Valid/Invalid bit, Read-only bit, dirty bit, Copy-on-write bit, and reference bit. 10

b Consider six memory partitions of size 200 KB, 400 KB, 600 KB, 500 KB, 300 KB and 250 KB. These partitions need to be allocated to four processes of sizes 357 KB, 210 KB, 468 KB and 491 KB in that order. Identify the block allocation by best fit, first fit and worst fit strategy. Determine the internal and external fragmentation. 06

OR

8 a With a neat diagram discuss how does Translation Lookaside Buffer (TLB) support paging operation. Assume a program has just referenced an address in virtual memory. Describe a scenario how each of the following can occur: (If a scenario cannot occur, explain why?)

i) TLB miss with no page fault
ii) TLB miss and page fault
iii) TLB hit and no page fault
iv) TLB hit and page fault. 08

	b	Consider the following page reference string: 1,2,3,4,2,1,5,6,2,1,2,3,7,6,3,2,1,2,3,6 Calculate the page faults for the LRU replacement, $FIFO$ replacement and Optimal replacement algorithms, assuming initially empty three frames.	08
9	a	With the help of a neat diagram, discuss the implementation of file system.	10
	b	Develop a program to implement copy command (cp) in Linux operating systems using file system $APIs$.	06
		OR	
10	a	Briefly describe the on-disk and in-memory structures that are used to implement a file system. What is the content of a typical file control block?	10
	b	List and briefly explain the various file access methods.	06