VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

Fall Semester 2024-25

CAT I

SLOT: B1 Slot

Programme Name & Branch: B. Tech CSE

Course Name & Code: Operating Systems & BCSE303L

Class Number (s): Common to all

Exam Duration: 90 Min. **Maximum Marks: 50**

Q. No.	Question	Max Marks
	(i) A Computer system can have single processor, multiprocessor, and multicore processor architecture. A job or program can be executed either sequentially or in parallel based on its design. Enumerate the advantages of having different system architecture and analyse the effect of executing a set of jobs run in sequential or parallel over these architectures. (ii) Operating system provides tremendous services to the user. From the security perspective, which are the services to be considered. Justify your answer.	5+5
2.	(i) What is a system call? Why are system calls necessary? Illustrate the methods to pass the parameters of system calls to the operating systems. (ii)Categorize the following instructions into privileged instructions and non-privileged instructions. Also mention whether the instruction to be executed under user mode or kernel mode. i) Reading system time ii) Clear Memory iii) Opening and reading a file iv) Set the timer v) Performing arithmetic operation	5+5
3.	What are the differences between user-level threads and kernel level threads? Discuss the threading issues in implementing it in multi-programming.	10

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Assume the following workload in a system:

Process	Arrival Time(ms)	Burst Time(ms)	Priority
P1	5	5	0
P2	4	2	7
P3	3	7	5
P4	0	4	10
P5	3	5	5

Draw the Gantt chart illustrating the execution of these processes using round robin scheduling algorithm (Time Quantum= 3 ms) and priority scheduling algorithm, also calculate the average waiting time and average turnaround time.

10

Consider a system with five processes (P1, P2, P3, P4, P5), all arriving at time zero, with total execution time (includes CPU Burst time and I/O Burst time) of 25, 15, 20, 10 and 5 milliseconds respectively. Each process spends 20% of execution time doing I/O and 80% of time doing computation. The operating system uses SJF and FCFS scheduling algorithms to schedule the processes by considering only CPU burst time of each process. Draw the Gantt chart and calculate average turnaround time and average waiting time for both the algorithms.

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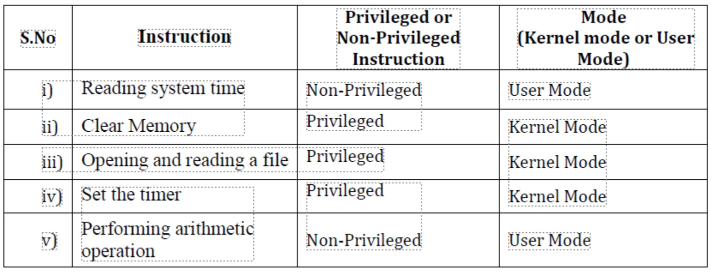
Q. No.	**Question**	**Max Marks**	**CO**	**BL**
1.	(i)A *multiprocessor* system contains *more than one* CPU (also known as **processor**) and they work in parallel. This is called **Simultaneous Multiprocessing (SMP)**. Multiprocessor systems have a special type of motherboard which has several CPU sockets. A *multicore* system contains more than one execution core on *one* CPU. The exact meaning of multicore depends on the architecture, but essentially a certain subset of the CPU's components is replicated, so that several *cores* can work in parallel on isolated CPU operations. This is called **Chip-level Multiprocessing (CMP)**. A multicore chip can have a dedicated execution unit and L1 cache for a core and a shared L2 cache for the entire CPU. Multiprocessor means having several CPUs whereas multicore means having several cores. (ii) **Privacy and Authentication at all levels (Protection and Security)** The operating system controls all a computer system's hardware resources, including processor, memory, storage space, network controller, peripherals, and user input/output. As such, it controls many resources that need protection. Some of the tools an OS often utilizes include user identity management, anti-malware software, network firewalls, and encryption.	5+5	CO 1	BL 2

<table>
<tr><td></td><td>The operating system operates at many levels of security. It controls access to hard drives, network controllers, and user interfaces. Therefore, it participates in security at the data, user, and network levels. It also plays a role in mitigating damage at the physical security level through the use of backup and restore operations.</td><td></td><td></td><td></td></tr>
<tr><td>2.</td><td>Definition - Programming interface to the services provided by the OS. A system call is a request from computer software to an operating system's kernel. (1 mark)

Need - System calls allow user-level processes to request services of the operating system
Simplicity – No need to write complex code (1 mark)

Parameter passing methods (3 marks)
Three general methods used to pass parameters to the OS
◦ Simplest: pass the parameters in registers
• In some cases, may be more parameters than registers
◦ Parameters stored in a block, or table, in memory, and address of block passed as a parameter in a register
• This approach taken by Linux and Solaris
◦ Parameters placed, or pushed, onto the stack by the program and popped off the stack by the operating system
◦ Block and stack methods do not limit the number or length of parameters being passed

(ii) Instruction Mode (5 marks)

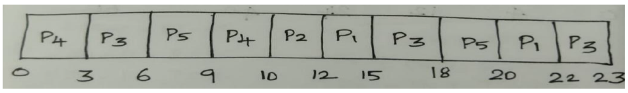

<table>
<tr><th>S.No</th><th>Instruction</th><th>Privileged or Non-Privileged Instruction</th><th>Mode (Kernel mode or User Mode)</th></tr>
<tr><td>i)</td><td>Reading system time</td><td>Non-Privileged</td><td>User Mode</td></tr>
<tr><td>ii)</td><td>Clear Memory</td><td>Privileged</td><td>Kernel Mode</td></tr>
<tr><td>iii)</td><td>Opening and reading a file</td><td>Privileged</td><td>Kernel Mode</td></tr>
<tr><td>iv)</td><td>Set the timer</td><td>Privileged</td><td>Kernel Mode</td></tr>
<tr><td>v)</td><td>Performing arithmetic operation</td><td>Non-Privileged</td><td>User Mode</td></tr>
</table>
</td><td>5+5</td><td>CO 1</td><td>BL 4</td></tr>
<tr><td>3.</td><td></td><td>10</td><td>CO 1</td><td>BL 5</td></tr>
</table>

User Level Thread	Kernel Level Thread
User-level threads are faster to create and manage.	Kernel level threads are slower to create and manage.
Implemented by a thread library user level.	Operating system support directly to Kernel threads.
User level thread can run on any operating system.	Kernel level threads are specific to .the operating system.
Support provided at the user level called user-level thread	Support may be provided by Kernel is called Kernel level threads.
Multithread applications cannot take advantage of multiprocessing.	Kernel routines themselves can be multithreaded.
Implementation of User threads is easy.	Implementation of Kernel thread is complicated.
Context switch time is less.	Context switch time is more.
Context switch requires no hardware support.	Hardware support is needed.
Example: User-thread libraries include POSIX Pthreads, Mach C-threads, and Solaris 2 UI-threads.	Example: Windows NT, Windows 2000, Solaris 2, BeOS, and Tru64 UNIX (formerly Digital UNIX)-support kernel threads.

4.

Round Robin (Time Slice=3 ms): (4 Marks)

Gantt Chart:



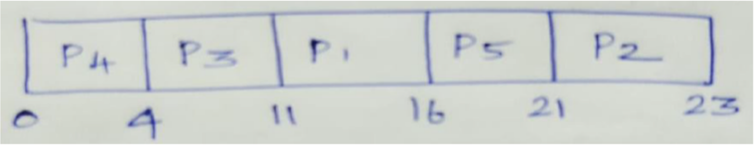
Process	Waiting Time	Turnaround Time
P1	12	17
P2	6	8
P3	13	20
P4	6	10
P5	12	17

Average waiting time: 9.8 ms

Average Turnaround time: 14.4 ms

Priority (Non preemptive) : (3 Marks)

Gantt Chart:



Process	Waiting Time	Turnaround Time
P1	6	11
P2	17	19
P3	1	8
P4	0	4
P5	13	18

Average waiting time: 7.4 ms

Average Turnaround time: 12 ms

10

CO 2

BL 3

5.

10

CO 2

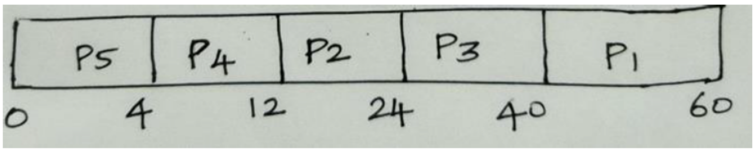
BL 3

Calculation of CPU Burst Time: (2 Marks)

Process	Total Execution Time (ms)	CPU Burst Time [80% of total execution time] (ms)
P1	25	20
P2	15	12
P3	20	16
P4	10	8
P5	5	4

SJF: (4 Marks)

Gantt Chart:



Process	Waiting Time	Turnaround Time
P1	40	60
P2	12	24
P3	24	40
P4	4	12
P5	0	4

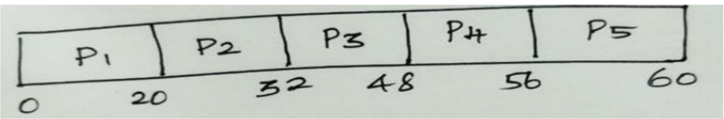
Average waiting time: 16 ms

Average Turnaround time: 28 ms

FCFS: (4 Marks)

FCFS: (4 Marks)

Gantt Chart:



Process	Waiting Time	Turnaround Time
P1	0	20
P2	20	32
P3	32	48
P4	48	56
P5	56	60

Average waiting time: 31.2 ms

Average Turnaround time: 43.2 ms