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Operating System Assignment 01

Q1.
Ans → Even with advanced hardware, OS is essential for resource management (CPU, memory, I/O). It provides abstraction, multitasking, security and insure programs can run safely and efficiency.

Q2.
Ans → A real-time embedded OS is best because the device needs quick and predictable response, low power usage, and small footprint.

Q3.
Ans → Avoid microkernel, as frequent inter-process communication adds overhead. Monolithic or layered gives better raw performance.

Q4 →
Ans → Yes, Structure impacts performance, maintainability, and fault isolation. For example, micro-kernal is secure but slower, monolithic is faster but less reliable.

Q5.
Ans → If PCB stores registers, PC and state → errors show uninitialized values.

Date..................

(ii) Content switch = saving current process state, updating PCB, loading new state.

(iii) Mid-execution I/O allocation usually needs non-blocking call so process continues running.

Part - B

Que 6.

Ans a) Total content switching time,

save state = 2ms
Load State = 3 ms
Schedular overhead = 1ms

Total time = 2+3+1 = 6ms.

b)

* Content switching is pure overhead (no useful work is done during this time).

* Higher switching time reduces CPU efficiency, as more time is spent switching than executing process.

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Ans. Execution time estimate:

In ideal conditions (perfect parallelism, no overhead):

$$T_{multi} = \frac{T_{single}}{n} = \frac{40}{n} \text{ second.}$$

Single thread = 40 sec.
With 2 threads under ideal condⁿ = $\frac{40}{2}$ = 20 sec.

★ Multithreading allows overlapping of I/O and computation, utilizing multiple cores and reducing waiting time, though in practice overhead reduces perfect gains.

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Process :	P_1	P_2	P_3	P_4
Burst time :	5	3	8	6

a) FCFS

Process	Arrival time (AT)	Burst Time (BT)	Completion Time (CT)	Waiting Time (WT)	TAT
P_1	0	5	5	5-5 = 0	5-0 = 5
P_2	0	3	8	8-3 = 5	8-0 = 8
P_3	0	8	16	16-8 = 8	16-0 = 16
P_4	0	6	22	22-6 = 16	22-0 = 22

WT = Turnaround - Burst (TAT - BT)
TAT = Completion - Arrival (CT - AT)

Gantt Chart

P_1	P_2	P_3	P_4

0 5 8 16 22

CT(P_1) CT(P_2) CT(P_3) CT(P_4)

Avg waiting time = (0+5+8+16) / 4 = 7.25 ms
Avg turnaround time = (5+8+16+22) / 4 = 12.75 ms

(b) Non-premptive SJF

Process	AT	BT	CT	WT	TAT
P_1	0	5	8	8 - 5 = 3	8 = 8 - 0
P_2	0	3	3	3 - 3 = 0	3 = 3 - 0
P_3	0	8	22	22 - 8 = 14	22 = 22 - 0
P_4	0	6	14	14 - 6 = 8	14 = 14 - 0

Grantt Chart,

P_2	P_1	P_4	P_3

0 3 8 14 22

CT(P_2) CT(P_1) CT(P_4) CT(P_3).

Avg waiting time = (3+0+14+8) / 4 = 6.25 ms
Avg turnaround time = (8+3+22+14) / 4 = 11.75 ms

(c) Round Robin (quantum = 4ms)

Process	AT	BT	CT	WT	TAT
P_1	0	5	16	16 - 5 = 11	16 - 0 = 16
P_2	0	3	7	7 - 3 = 4	7 - 0 = 7
P_3	0	8	20	20 - 8 = 12	20 - 0 = 20
P_4	0	6	22	22 - 6 = 16	22 - 0 = 22

Date..................

Grant Chart,

P_1	P_2	P_3	P_4	P_1	P_3	P_4

0 4 7 11 15 16 20 22

CT(P_2) CT(P_1) CT(P_3) CT(P_4)

Avg waiting time = (11 + 4 + 12 + 16) / 4 = 10.75 ms
Avg turn around = (16 + 7 + 20 + 22) / 4 = 16.25 ms

⇒ SJF gives lowest waiting and turnaround times, while RR improves fairness for interactive takes.

Que 9.
Ans. → (i) Cloud migration:

For a virtualized cloud, a microkernel is suitable since it separates core services and provides better security and scalability. Virtual machies (VMs) add isolation by running multiple OS instance on the same hardware. They also support resource sharing, load balance and living migration.

(ii) Smart home system:
Her, many IOT devices run together. The OS uses priority scheduling and IPC so urgent tasks like intrusing detection get

Date..................

CPU immediately, while low-priority scheduling and IPC so urgent takes like intrusion detection get CPU immediately, which low-priority tasks like lighting wait. Algorithms such as EDF (Earliest Deadline first) or RMS (Rate Monotonic Scheduling) can ensure critical tasks meets their deadlines without starving background process.