**Q1) (20 points)** A System Call is used for handling kernel-mode operations in a program. List the main steps of the execution of a system call for the following statement;

status = copy_file (fd-1, fd-2)

√

⑩ increment SP
③ call copy_file
② push fd-2
① push fd-1

⑤ trap to kernel
④ put code

⑥ ⑦ dispatch ⑧ sys call handle
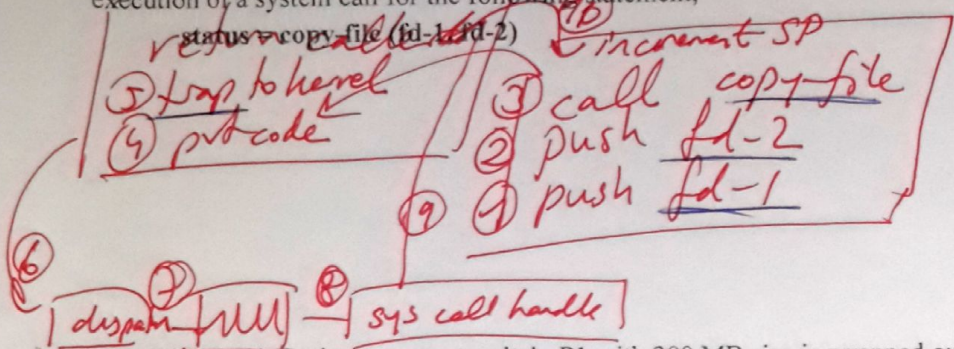
**Q2) (20 points)** During a context switch, P1 with 200 MB size is swapped out. Then, P2 with 120 MB size is swapped in, and run on CPU for 3 seconds.
Then, another context switch occurred, P2 is swapped out, and P1 is swapped in back to continue.
What is the total time spent, assuming disk latency as 20 miliseconds, and disk transfer rate as 40 MB/second.

P1 swap out : $200\,MB / 40\,MB/sec = 5\,sec$
P2 swap in : $120\,MB / 40\,MB/sec = 3\,sec$
    P2 execute $= 3\,sec$

$2 \times$ latency $= 40\,msec$

$\Rightarrow 5 + 3 + 0.04 + 3 + 3 + 5 + 0.04$
        $19.08\,'sec$ total

**Q3)**

| Process | CPU Burst Time | Arrival Time | Threads |
|---|---|---|---|
| P1 | 7 | 0 | T1,T2 |
| P2 | 4 | 2 | T3,T4,T5 |
| P3 | 3 | 5 | T6 |
| P4 | 1 | 8 | T7,T8 |
| P5 | 6 | 10 | T9,T10 |

(a) FCFS; draw Gantt chart, compute the **waiting time** of each process, list threads might be running between times 10-11.
(b) SRTF, draw Gantt chart. compute the **waiting time** of each process, list threads might be running between times 10-11.
(c) RR (q = 3), draw Gantt chart. compute the **waiting time** of each process, list threads might be running between times 10-11.

**(a) FCFS:**

| P1 | P2 | P3 | P4 | P5 |

0      7    11    14   15    21

T3,T4,T5 might be running
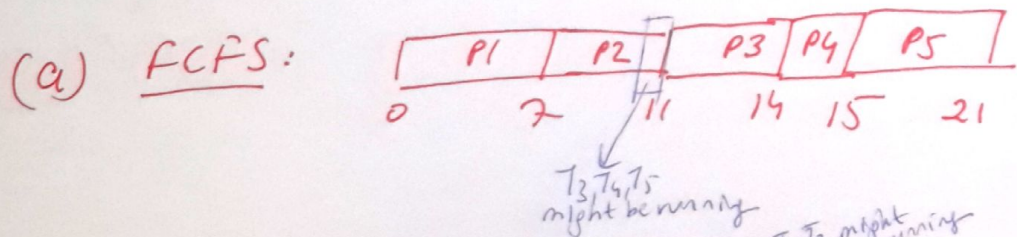
Turnaround
P1: 7-0=7
P2: 11-2=9
P3: 14-5=9
P4: 15-8=7
P5: 21-10=11

Wait
P1: 7-7=0
P2: 9-4=5
P3: 9-3=6
P4: 7-1=6
P5: 11-6=5

**(b) SRTF:**

| P1 | P2 | P3 | P4 | P1 | P5 |

0   2    5   6    8   9   10     15    21

T1,T2 might be running

P1(5)   P1(5)   P1(5)   P1(5)
P2(4)   P2(1)   P3(1)   P5(6)
      P3(3)   P4(1)
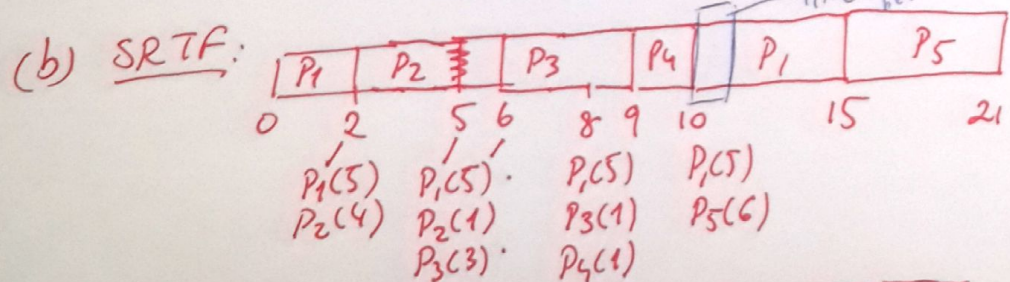
T.A.
P1: 15-0=15
P2: 6-2=4
P3: 9-5=4
P4: 10-8=2
P5: 21-10=11

W.T.
P1: 15-7=8
P2: 4-4=0
P3: 4-3=1
P4: 2-1=1
P5: 11-6=5

**(c) RR (q=3):**

| P1 | P2 | P1 | P3 | P2 | P4 | P1 | P5 | P5 |

0   3    6     9    12 13 14 15   18   21

T2    P3,P1    P4   P5

P4,P2,P3

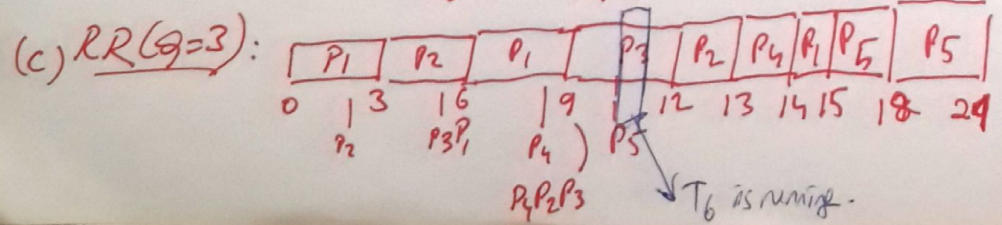T6 is running.

TA
P1: 15-0=15
P2: 13-2=11
P3: 12-5=7
P4: 14-8=6
P5: 21-10=11

WT
P1: 15-7=8
P2: 11-4=7
P3: 7-3=4
P4: 6-1=5
P5: 11-6=5