AUTUMN MID SEMESTER EXAMINATION-2023

School of Computer Engineering
Kalinga Institute of Industrial Technology, Deemed to be University
Operating System
[CS2002]

Time: 1 1/2 Hours **Full Mark: 20**

Answer any four Questions including Q.No.1 which is Compulsory.
The figures in the margin indicate full marks. Candidates are required to give theiranswers in their own words as far as practicable and all parts of a question should beanswered at one place only.

1. Answer all the questions. [1 x 5]

a) What is the difference between a thread and a process?

Ans: Process means any program is in execution. Thread means a segment of a process.
The process has its own Process Control Block, Stack, and Address Space. Thread has Parents' PCB, its own Thread Control Block, and Stack and common Address space.
Process also takes more time for context switching. Thread takes less time for context switching. And many more....

b) "Medium term scheduler maintains the degree of multi programming"- true or false? Justify your answer.

Ans: False. Degree of multi programming is maintained by the long term scheduler from new state to ready state.

c) What are the difference between multiprocessing and multi-programming?

Ans: The main difference between multiprocessing and multi-programming is that multiprocessing runs multiple processes simultaneously on multiple processors, while multi-programming keeps multiple programs in the main memory and runs them simultaneously through a single CPU.

d) The monitor construct ensures that ____________

I. only one process can be active at a time within the monitor
II. n (< 1) number of processes can be active at a time within the monitor
III. the queue has only one process in it at a time
IV. all of the above

Ans: I. only one process can be active at a time within the monitor

e) Is it possible that the response time of all the process is equal to their waiting time in preemptive scheduling algorithm? Give a reason.

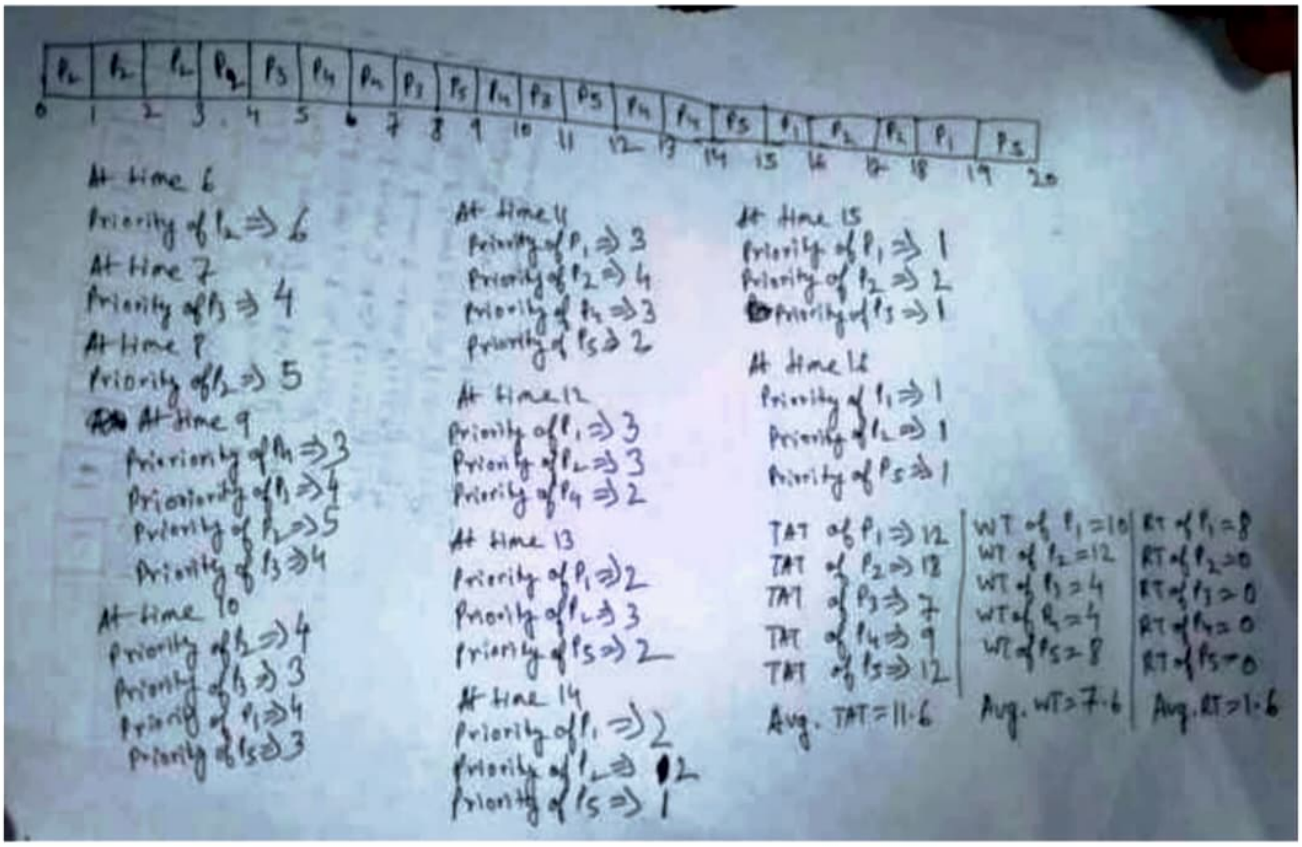
Ans: yes. If context switch only occurs when a process terminates.
If answer is no, then marks will be 0.

2. Use Preemtive Priority Scheduling with aging technique to calculate average waiting time, average response time, and average turnaround time of the processes as given bellow. The range of the priority starts from 1 to 10, where 1 is the high priority and 10 is the low priority. Here, the criteria for aging technique is that the priority of a process will be increased by one, if a process continuously waits in the ready queue for every 2 units of time. (For example, let a process enters into ready queue at time 11 with priority 6 and waits in the ready queue till 13. As it has stayed continuously in the ready queue for 2 units, so, at time 13, its priority changes from 6 to 5. If it waits in the ready queue continuously till 15, then its priority changes from 6 to 4 and so on.) [5 Marks]

Process	CPU Burst Time	Arrival Time	Priority
P1	2	7	5
P2	6	0	7
P3	3	4	5
P4	5	5	4
P5	4	8	3

Ans: There is two correct solutions

1) Calculation is based on: If priority of two processes are same then follow FCFS.



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

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

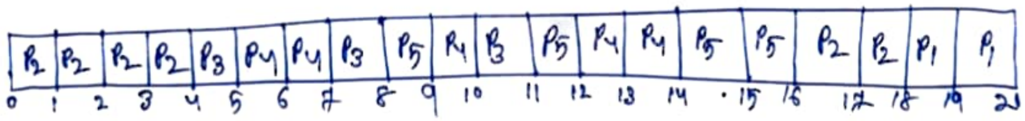
At time 6
Priority of P2 ⇒ 6
At time 7
Priority of P3 ⇒ 4
At time 8
Priority of P2 ⇒ 5
At time 9
Priority of P4 ⇒ 3
Priority of P3 ⇒ 4
Priority of P2 ⇒ 5
Priority of P3 ⇒ 4
At time 10
Priority of P2 ⇒ 4
Priority of P3 ⇒ 3
Priority of P1 ⇒ 4
Priority of P5 ⇒ 3

At time 11
Priority of P1 ⇒ 3
Priority of P2 ⇒ 4
Priority of P4 ⇒ 3
Priority of P5 ⇒ 2
At time 12
Priority of P1 ⇒ 3
Priority of P2 ⇒ 3
Priority of P4 ⇒ 2
At time 13
Priority of P1 ⇒ 2
Priority of P2 ⇒ 3
Priority of P5 ⇒ 2
At time 14
Priority of P1 ⇒ 2
Priority of P2 ⇒ 2
Priority of P5 ⇒ 1

At time 15
Priority of P1 ⇒ 1
Priority of P2 ⇒ 2
Priority of P5 ⇒ 1
At time 16
Priority of P1 ⇒ 1
Priority of P2 ⇒ 1
Priority of P5 ⇒ 1

TAT of P1 ⇒ 12	WT of P1 = 10	RT of P1 = 8
TAT of P2 ⇒ 18	WT of P2 = 12	RT of P2 = 0
TAT of P3 ⇒ 7	WT of P3 = 4	RT of P3 = 0
TAT of P4 ⇒ 9	WT of P4 = 4	RT of P4 = 0
TAT of P5 ⇒ 12	WT of P5 = 8	RT of P5 = 0
Avg. TAT = 11.6	Avg. WT = 7.6	Avg. RT = 1.6

2) Calculation is based on: If priority of two processes are same then follow Shortest remaining time.



Process	Burst Time	Arrival Time	Priority	Response Time	Turn-around Time	Waiting Time
P1	2	7	5	11	13	11
P2	6	0	7	0	18	12
P3	3	4	5	0	7	4
P4	5	5	4	0	9	4
P5	4	8	3	0	8	4

Chart: 2.5 marks, calculation 2.5

Only calculation and no chart: 0 marks

Partly correct (chart+calculation): part marks as you wish

3. There is a small dental clinic with one dentist and one chair for the patient inside the clinic. Five chairs are kept outside the clinic for the waiting patients. Assuming the dentist comes ahead of any patient, write a synchronization solution using semaphore for handling the following situation.

   a) If there is no patient, the dentist has to wait for the patient.

   b) In case there is no patient, if a new patient arrives then he is allowed to go inside the clinic.

   c) If there are patients waiting outside of the clinic, then the patient has to wait provided there are empty chairs or else he has to leave the clinic.

[5 Marks]

Ans:

```
Semaphore patient=0;  //initially no patient

Semaphore dentist_mutex=0;

Semaphore mutex=1;


int free_chairs=6;

dentist_work()

{

        while(1)

        {
                P(patient);//wait for patient
                P(mutex);
                free_chairs=free_chairs+1;//grab a free chair
                V(dentist_mutex);//Inform the patient about his own turn
                V(mutex);
        }
}

patient_work()
{
        P(mutex);
        if(free_chairs>0)
        {
                free_chairs=free_chairs-1;//grab a free chair
                V(patient);//Signal the doctor about a new patient
                V(mutex);
                P(dentist_mutex);//wait for the dentist for his own turn
        }
        else
                V(mutex);
}
```

Partly correct: part marks

4. There are five threads (T1, T2, … T5) which are calling INCR( ) and there are three threads (P1, P2, P3) which are calling DECR( ) for the code given below:

Statement Number	INCR( )	Statement Number	DECR( )
1	wait(s);	1	wait($mutex$);
2	$x = x+1$;	2	$y = y-1$;
3	signal(s);	3	signal($mutex$);

Shared integer variable x initialized with 10 and shared variable y initialized to 5. Find the following with justification:

i. Minimum and Maximum possible value of x for binary semaphore $s = 1$
ii. Minimum and maximum possible value of y for counting semaphore $mutex = 2$.

[5 Marks]

Ans: i. For binary semaphore mutual exclusion will be followed hence x = 10 + 5 = 15 (both minimum and maximum)

ii. For counting semaphore 2 threads can access y = 5. One thread (P1) should call DECR( ) and other (P2) should call DECR( ) but will not update y. Now finish DECR( ) 2-times (P1, P3) then finish P2. Hence, maximum value of y = 5 - 1 = 4

If all three threads are executed sequentially, the minimum value of y = 5 - 3 = 2

Wrong explation or wrong answer: no marks

5. (a) While executing a *printf* function call execution on a typical processor, explain the steps of how the processor switches between:

i) user mode to privileged mode (kernel mode)

ii) privileged mode to user mode [3 Marks]

Ans: **User to privileged**: While executing printf, the printf call is translated into the write function which contains a "syscall" instruction. Upon receiving the instruction the kernel set the mode bit in processor to 0, switching from user mode to privileged mode, and the processor start executing the instructions for write.

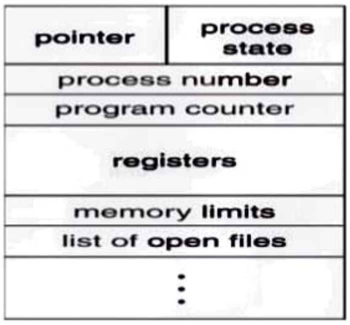
Privileged to user: At the end of code for write, processor encounter a special "return" instruction, upon receiving the instruction the mode bit is set to 1, switching from privileged mode to user mode.

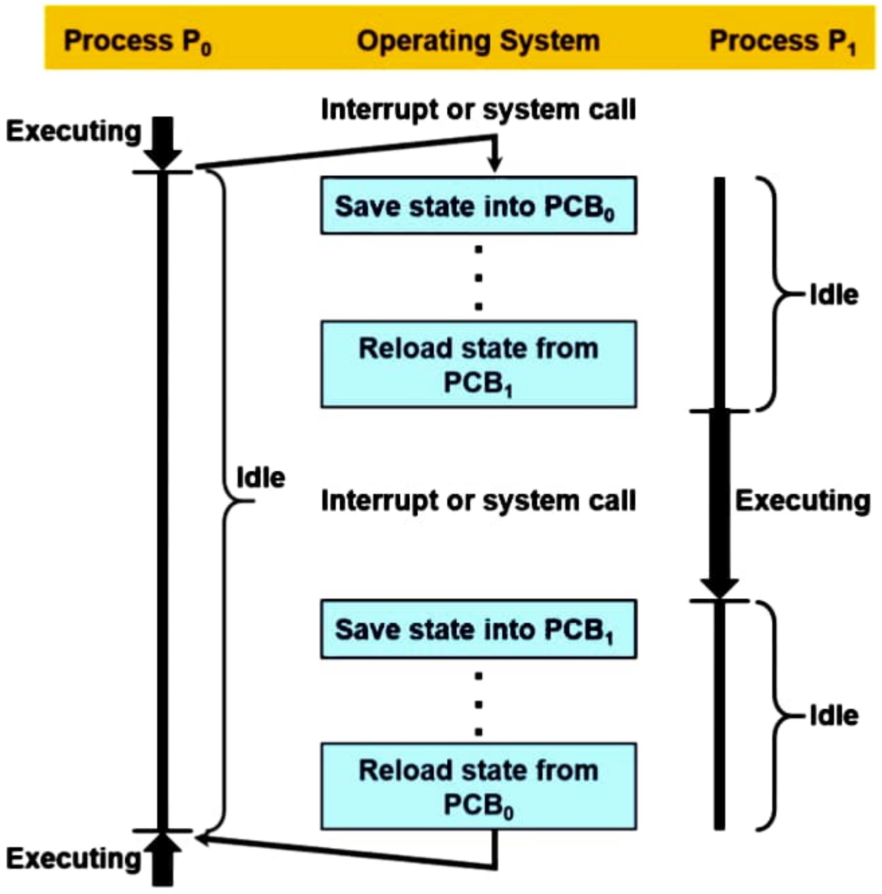
Diagram with explation is preferable.

Diagram: 0.5 marks, explanation: 2.5 marks

(b) Explain the working of the process control block (PCB) [2 Marks]

Ans:





Only Explation: full marks

*** Best of Luck ***