Mid-Term Test for Operating Systems

(9:00-10:30AM, Dec. 6, 2011, open book, Process and Memory Management)

Class: ________ **Name:** ________________________ **Student ID No.:** ______________

Problem 1 (30 points). Consider the following set of processes with the length of the CPU-burst time given in milliseconds:

Processes	Burst Time	Priority
P_1	3	1
P_2	4	2
P_3	3	3
P_4	2	2

The processes are assumed to have arrived in the order P_1, P_2, P_3, P_4, all at the time 0. The lowest number means *a higher priority*.

(a) (15 points). Draw four Gantt charts illustrating the execution of these processes using FCFS, SJF, a non-preemptive priority (a smaller priority number implies a higher priority), and RR (quantum = 1) scheduling joined with FCFS.

First-Come First-Served (FCFS)

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

Shortest-Job-First (SJF)

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

Non-preemptive priority

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

Round-Robin with FCFS

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

(b) (10 points). What is the waiting time of each process for each of the scheduling algorithms in part (a)?

	First-Come First-Served	Shortest-Job-First	Non-preemptive	Round-Robin
P_1	0	2	0	6
P_2	3	8	3	8
P_3	7	5	7	8
P_4	10	0	9	6

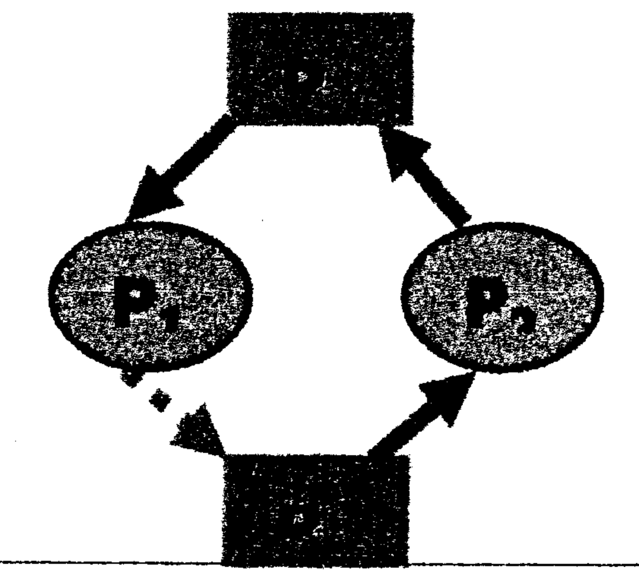
(c) (5 points). Which of the schedules in part (a) results in the minimum average waiting time over all processes? What value is the minimum average waiting time?

Algorithm: *Shortest-Job-First* *Average Waiting Time:* *3.75*

Problem 2 (10 points). The following is a program for the dining philosopher problem: 2 philosophers spend their lives thinking and eating. They share a table and 2 chopsticks (1 pair). A philosopher gets 2 chopsticks to eat. After eating, the philosopher puts down the 2 chopsticks.

Philosopher1	*Philosopher2*
wait(chopstick1);	**wait**(chopstick2);
wait(chopstick2);	**wait**(chopstick1);
philosopher 1 eats;	philosopher 2 eats;
signal(chopstick1);	**signal**(chopstick2);
signal (chopstick2);	**signal** (chopstick1);

(5 points). Does the above program guarantee that both philosophers can eat? If not, what problem could happen and why? Show, please, the resource-allocation graph.

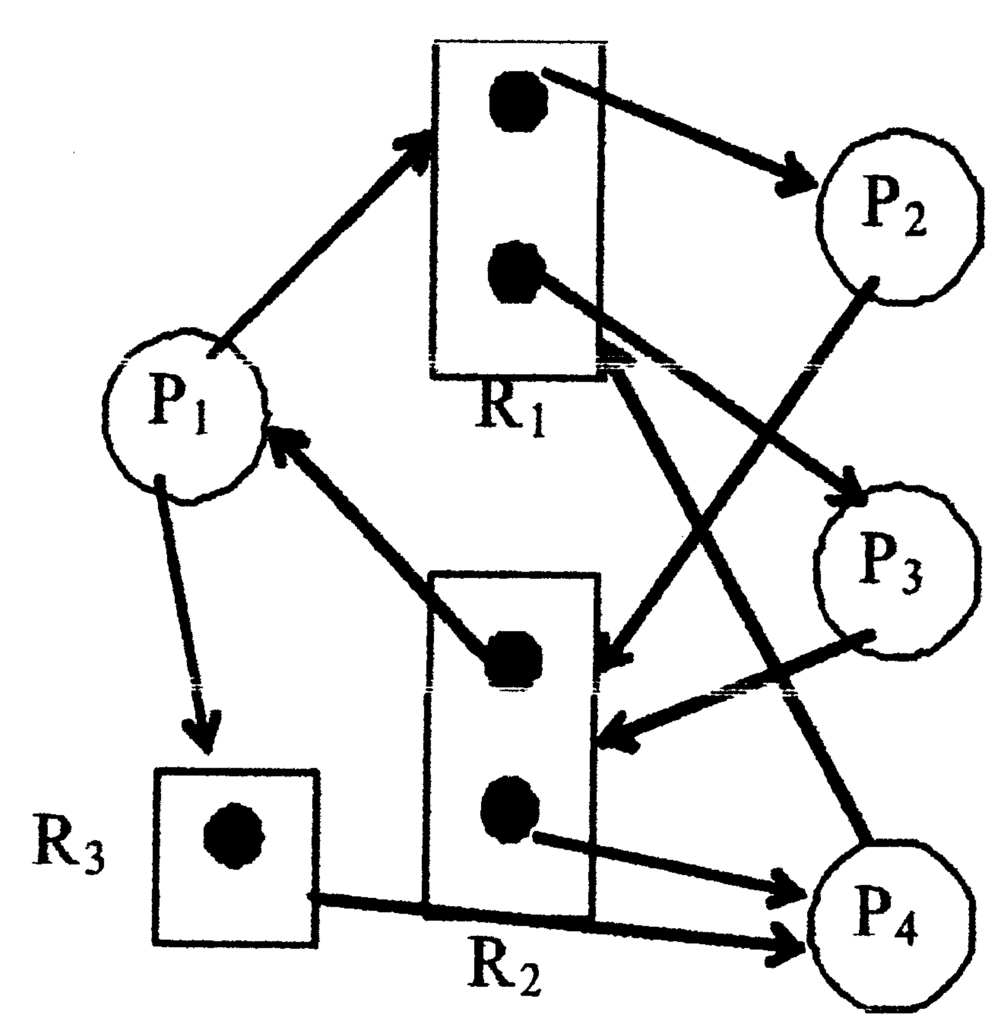


Philosopher 1 gets chopstick1 and waits for chopstick2. Philosopher 2 also gets chopstick2 and waits for chopstick 1 at this time. Both continue waiting for another chopstick. This causes a deadlock.

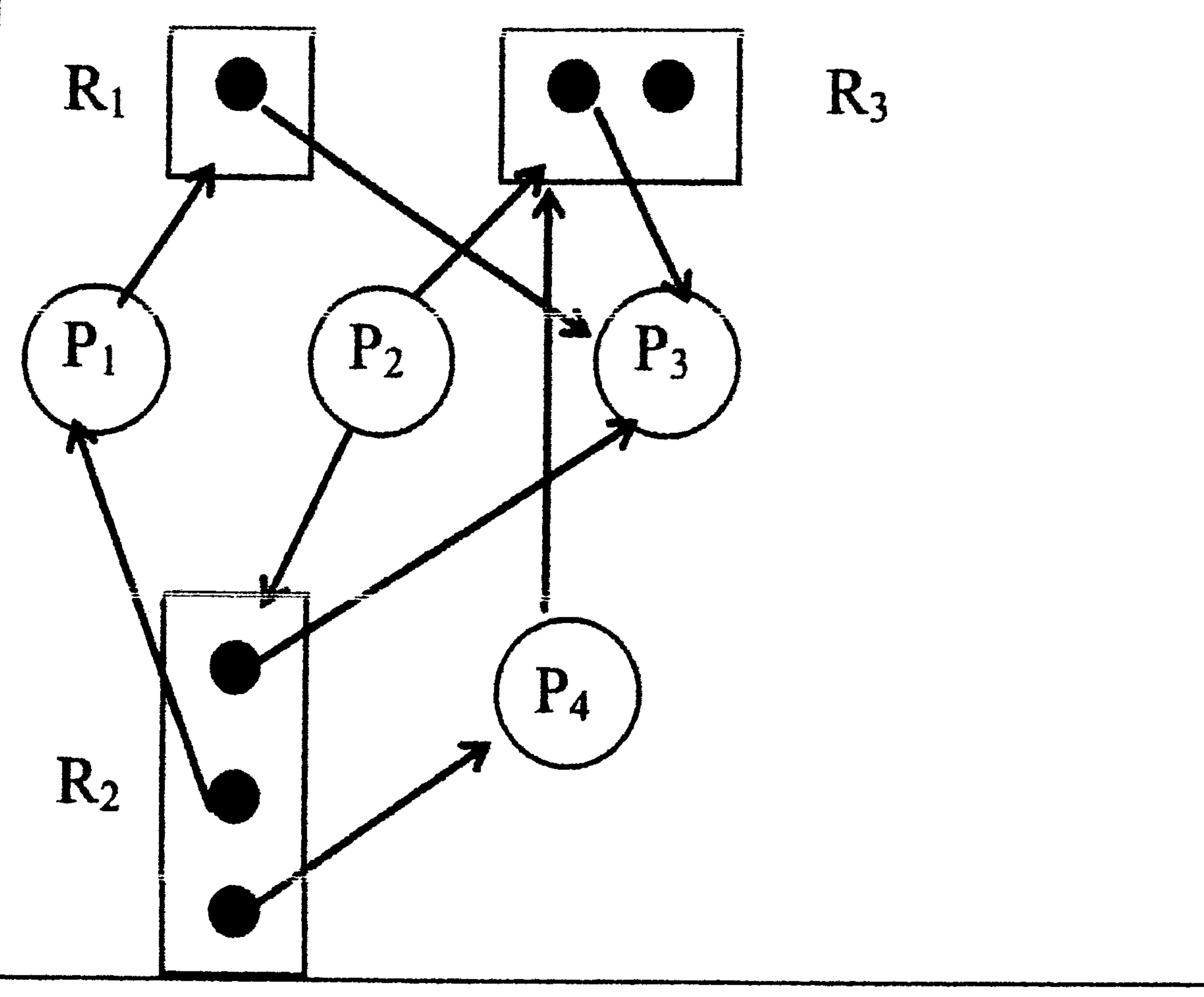
(b) (5 points). Give your solution for the above problem if you think the above program is not correct.

Philosopher1	Philosopher2
Wait(chopstick1)	Wait(chopstick1)
Wait(chopstick2)	Wait(chopstick2)
Philosopher 1 eats	Philosopher 2 eats
Signal (chopstick1)	Signal (chopstick1)
Signal (chopstick2)	Signal (chopstick2)

Problem 3 (15 points). Answer if there is a deadlock in each of the following resource-allocation graphs.



Answer: ___P1, P2, P3, P4________



Answer: ______No Deadlock ____________

Problem 4 (20 points). For the following ***decimal*** virtual addresses compute the virtual ***decimal*** page number and offset for a 1-KB page and for an 2-KB page: 15554, 39766, 58444, 93334. Note: The enumeration of pages and frames is started from the zero number.

Fill the following Table.

Virtual Address	1-KB Page		2-KB Page	
	Page Number	Offset	Page Number	Offset
15554	15	194	7	1218
39766	38	854	19	854
58444	57	76	28	1100
93334	91	150	45	1174

Problem 5 (25points). Consider the following page reference string: 3, 6, 2, 1, 5, 2, 3, 7, 6, 3, 2, 1, 2, 6, 2, 4, 2, 1, 7, 3. How many page faults would occur for the LRU (Least Recently Used), OPT (Optimal) and FIFO (First In First Out) replacement algorithm, assuming four frames? Remember all frames are initially empty, so your first unique pages will all cost one fault each.

(a) (10 points). **LRU; frames=4** **Answer:______12______**

LRU	3	6	2	1	5	2	3	7	6	3	2	1	2	6	2	4	2	1	7	3
	3	3	3	3	5		5	5	6			6				6			7	7
		6	6	6	6		3	3	3			3				4			4	3
			2	2	2		2	2	2			2				2			2	2
				1	1		1	7	7			1				1			1	1
P.Fault	*	*	*	*	3		6	1	5			7				3			6	4

(b) (10 points). **OPT; frames=4** **Answer:______9______**

OPT	3	6	2	1	5	2	3	7	6	3	2	1	2	6	2	4	2	1	7	3
	3	3	3	3	3			3				1				1				3
		6	6	6	6			6				6				4				4
			2	2	2			2				2				2				2
				1	5			7				7				7				7
P.Fault	*	*	*	*	1			5				3				6				1

(c) (5 points). **FIFO; frames=4**
Answer:______13______

FIFO	3	6	2	1	5	2	3	7	6	3	2	1	2	6	2	4	2	1	7	3
	3	3	3	3	5		5	5	5		2	2				2		2	7	
		6	6	6	6		3	3	3		3	3				3		3	3	
			2	2	2		2	7	7		7	7				4		4	4	
				1	1		1	1	6		6	6				6		1	1	
P.Fault	*	*	*	*	3		6	2	1		5	3				7		6	2	