長庚大學112學年度第一學期 資工所博士班資格考試
科目：作業系統

1. Please illustrate the concepts about memory fragmentation by answering the following questions:
   (1) Give an example to explain the external fragmentation. **(5 pts)**
   (2) Give an example to explain the internal fragmentation. **(5 pts)**

2. Please define the following issues of OS:
   (1) Race condition **(5 pts)**
   (2) Thrashing (of memory management) **(5 pts)**

3. Please briefly define the following terms related to deadlock and explain how to avoid them.
   (1) Mutual exclusion **(4 pts)**
   (2) Hold and wait **(4 pts)**
   (3) No preemption **(4 pts)**
   (4) Circular wait **(3 pts)**

4. (1) Please explain the difference between a program and a process. **(5 pts)** (2) Please explain the difference between a process and a thread by describing the advantage of multi-threading compared to multi-process programming. **(5 pts)**

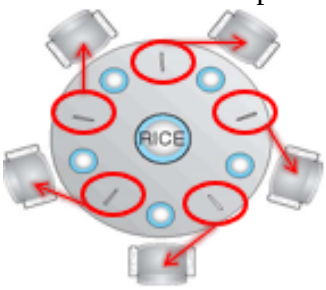
5. Banker's Algorithm is a deadlock avoidance algorithm. Assume there are 5 processes {P_0, P_1, P_2, P_3, P_4} and three types of shared resources {A, B, C} in the system, and the details are in the following table. (1) By Banker's Algorithm, is the system in a safe state? If your answer is yes, please provide a safe sequence. If your answer is no, please provide the reason. **(5 pts)** (2) Now, P_0 further has a request (2, 1 , 0) to use 2 more instances of A and 1 more instances of B. Should the request be granted? Again, provide the reason to support your answer. **(5 pts)**

	Allocation			Max			Need			Available		
	A	B	C	A	B	C	A	B	C	A	B	C
P0	0	1	0	7	5	3	7	4	3	3	3	2
P1	2	0	0	3	2	3	1	2	3			
P2	3	0	2	9	0	2	6	0	0			
P3	2	1	1	2	2	2	0	1	1			
P4	0	0	2	4	3	3	4	3	1			

6. (1) Please briefly explain the mechanism of inverted page table architecture for getting the physical address. **(5 pts)** (2) What is the main problem for using the inverted page table architecture? **(5 pts)**

7. There is system with only 3 memory frames. Given a reference string of pages {5→1→1→2→1→3→1→4→6→3→5}. Please illustrate the page replacement of (1) the LRU (least recently used) algorithm **(5 pts)** and (2) the optimal algorithm. **(5 pts)** (3) Please count the numbers of page faults with the LRU algorithm and the optimal algorithm, respectively. **(5 pts)**

8. For the Dining-Philosophers problem with the following figure, there could be a deadlock with the situation that each philosopher has picked up a chopstick on the right hand and just waits for the other at left. Please provide one remedy to the deadlock problem. **(10 pts)**



9. Let's consider the Readers and Writers Problem. We now have two mutex instances, $mutex_1$ and $mutex_2$, and both are available at the beginning. Please complete the code of writers and readers. (Hint: you should fill in all [?] with $mutex_1$ or $mutex_2$ in the following sample code.) **(10 pts)**

Writer:

```
wait( ? );
… writing … ;
signal( ? );
```

Reader:

```
wait( ? );
readcount++;
if (readcount == 1) {wait( ? );}
signal( ? );
… reading … ;
wait( ? );
readcount--;
if (readcount== 0) {signal( ? );}
signal( ? );
```