長庚大學112學年度第二學期 資工所博士班資格考試
科目：作業系統

1. Please illustrate the concept of 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)**
   (3) When paging management is used, is it possible to have internal fragmentation? **(5 pts)**

2. For Symmetric Multiprocessing, there are two approaches for load balancing: Push Migration and Pull Migration. Please define (1) Push Migration **(5 pts)** and (2) Pull Migration. **(5 pts)**

3. We assume that all the fork functions are successfully executed. Please provide the output of the following program: **(10 pts)**

```
#include<sys/types.h>
#include<stdio.h>
#include<unistd.h>
int main()
{
    pid_t pid, pid2;
    pid = fork();
    if (pid == 0)
    {
        printf("Hello\n");
        pid2 = fork();
        if (pid2 != 0)
        {
            wait(NULL);
            printf("Hi\n");
        }
        else
        {
            printf("Hola\n");
        }
    }
    else
    {
        wait(NULL);
        printf("Bonjour\n");
    }
    printf("Guten tag\n");
    return 0;
}
```

4. For five ready processes with the arriving order: P1, P2, P3, P4, P5, let's use FCFS, SJF and RR for the process scheduling, where the time quantum of RR is 4 ms. (a) Please draw scheduling results of the three scheduling algorithms. **(9 pts)** (b) Provide the waiting time of each process for the three scheduling algorithms respectively. **(6 pts)**

Process	Burst Time
P1	6 ms
P2	4 ms
P3	3 ms
P4	5 ms
P5	2 ms

5. Let's consider the Bounded-Buffer Problem. The pseudo code of Consumer is provided as follows. Please provide the pseudo code of Producer. After the Producer produces an item in a valuable nextp at the beginning of the loop, you have to note the position for adding the item into the buffer. **(10 pts)**

```
Consumer:
  do {
       wait(full);  /* control buffer availability */
       wait(mutex);  /* mutual exclusion */
       …….
       remove an item from buffer to nextp;
       ……
       signal(mutex);
       signal(empty);  /* increase item counts */
       consume nextp;
  } while (1);
```

6. (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)**

7. (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)**

8. (1) Please explain the Copy-on-Write technique. **(5 pts)** (2) What is the benefit of using Copy-on-Write? **(5 pts)**

9. For the Second-Chance Algorithm of page replacement, operating systems have to maintain a reference bit for each page. Please explain the Second-Chance Algorithm in detail. **(10 pts)**