CURTIN UNIVERSITY

Discipline of Computing
School of Electrical Engineering, Computing and Mathematical Sciences

Test – S1 / 2019

SUBJECT: OPERATING SYSTEMS Code COMP2006

TIME ALLOWED:

90 minutes test preceded by a 10-MINUTE READING PERIOD during which time only notes may be made. The supervisor will indicate when answering may commence.

AIDS ALLOWED:

To be supplied by the Candidate: Nil

To be supplied by the University: Nil

Calculators are NOT allowed.

GENERAL INSTRUCTIONS:

This paper consists of Four (4) questions with a total of 100 marks.

ATTEMPT ALL QUESTIONS

Name: _____

Student No: _____

Tutorial Time/Tutor: _____

QUESTION ONE (total: 25 marks): Operating Systems.

a) **(6 marks).** Describe each of the following terms.

- System call.
- Timesharing system
- Privilege instruction.

Answer:

b) **(4 marks).** One of the main purposes of OS is to simulate features not available on hardware. List two such features, and describe one of the two listed features.

Answer:

c) **(4 marks).** Explain the difference between a CPU's *instruction register* (IR) and *Program Counter* (PC).

Answer:

d) **(3 marks).** Explain if the following statement is **true** or **false**: *Setting the program counter register is a privileged operation*.

Answer:

e) **(4 marks).** Explain why using direct access memory (DMA) is more efficient as compared to using interrupt to communicate with the I/O controller.

Answer:

f) **(4 marks).** Explain one main advantage and one main disadvantage of the microkernel approach to system design.

Answer:

END OF QUESTION ONE

QUESTION TWO (total: 24 marks): Processes and threads

a) **(Total: 6 marks).** Assume the following four process states: **ready, waiting, running, terminated.** For each of the following events, you must mention in which state and to which state a process will be moved. Explain your answers.

(i) **(2 marks).** There is a *context switch* between user-level threads.

(ii) **(2 marks).** The requested I/O from a process is completed.

(iii) **(2 marks).** A *divide by zero* instruction is executed in a process.

Answer:

(i)

(ii)

(iii)

b) **(6 marks).** Each process is represented in the OS by a *process control block* (PCB). List four sets of information stored in a PCB. Describe each of the sets.

Answer:

c) **(8 marks).** Consider the two major communication schemes: shared memory and message passing. Describe the responsibility of the OS and the application programs when using each of the mechanisms.

Answer:

d) **(4 marks).** Discuss one advantage and one disadvantage of implementing user/kernel-level thread using one-to-one model.

Answer:

END OF QUESTION TWO

QUESTION THREE (total: 25 marks): Process Synchronization

a) **(4 marks).** Describe each of the following terms:

- Atomic instruction
- Progress condition for correct solution to the critical section problem.

Answer:

- Atomic instruction:

- Progress condition:

b) **(3 marks).** Does a program containing a race condition will **always** / **sometimes** / **never** result in data corruption or some other incorrect behavior? Explain your answer.

Answer:

c) **(6 marks).** Describe how the priority inversion problem occurs, and one possible solution to solve the problem.

Answer:

d) **(Total: 6 marks).** Consider the following definition of semaphore and its wait() and signal() operators. The integer value of S shows if there is a process in the critical section and the number of processes in the waiting queue.

```
typedef struct {
    int value;
    struct process *list;
} semaphore;

wait(semaphore *S) {
    S->value--;
    if (S->value < 0) {
            add this process to S->list;
            block();
    }
}

signal(semaphore *S) {
    S->value++;
    if (S->value <= 0) {
            remove a process P from S->list;
            wakeup(P);
    }
}
```

(i) **(2 marks).** How many processes are there in the waiting queue if the value of S is 1? Is there any process in the critical section? **Hint.** Assume S is initialized to one.

(ii) **(4 marks).** Is it possible that the value of S become -2? If yes, explain what the value of -2 means in terms of the number of processes in the waiting queue and the number of processes in critical section. Otherwise explain why it is not possible.

Answer:

(i) S = 1:

(ii) S = -2:

e) **(Total: 6 marks).**

(i) **(4 marks).** Describe the synchronization construct *monitor*.

(ii) **(2 marks).** What is the main advantage of using *monitor* than *semaphore*?

Answer:

(i)

(ii)

END OF QUESTION THREE

QUESTION FOUR (total: 26 marks): CPU Scheduling

a) **(4 marks).** Briefly explain the different between preemptive and nonpreemptive types of CPU scheduling. For each type, give two examples.

Answer:

Preemptive:

Non-preemptive:

b) **(Total: 6 marks).**

(i) **(2 marks).** Describe the main difference between an I/O bound process and a CPU-bound process.

(ii) **(4 marks).** To make better use of computer resources, which process type, i.e., I/O bound or CPU-bound, should be given a higher priority in CPU scheduling? Justify your answer.

Answer:

(i)

(ii)

c) **(Total: 4 marks).**

(i) **(2 marks).** In the context of CPU scheduling, briefly explain the performance metrics throughput and turnaround time.

(ii) **(2 marks).** Does a scheduling algorithm that maximizes throughput necessarily minimises turnaround time? Justify your answer.

Answer:

(i) Throughput:

Turnaround time:

(ii)

d) **(4 marks).** Describe the main advantage and the main disadvantage of setting a short quantum in the round robin scheduling algorithm.

Answer:

Advantage:

Disadvantage:

e) **(Total: 8 marks).** Given the following set of processes with their arrival times and burst time:

Process	Arrival Time	Burst Time
A	0	7
B	1	3
C	5	2
D	7	2

(i) **(4 marks).** Draw a Gantt chart for the round-robin scheduling (quantum=2).

(ii) **(2 marks).** Compute the average waiting time.

(iii) **(2 marks).** Compute the average turn around time.

Answer:

(i) Gantt chart:

(ii) Average waiting time:

(iii) Average turn around time:

END OF TEST PAPER