Sri Lanka Institute of Information Technology

B.Sc. Special Honours Degree/Diploma

in

Information Technology

Final Examination

Year 2, Semester II (2018)

IT2060– Operating System and System Administration

Duration: 2 Hours

October 2018

Instructions to Candidates:

- This paper has 4 questions. Answer all questions.
- Total marks 80.
- This paper contains 5 pages including the cover page.
- Electronic devices capable of storing and retrieving text, including calculators and mobile phones are not allowed.

Question 1 (20 marks)

a) Briefly explain the following terms in relation to the process synchronization:

i. Atomic Instruction
ii. Busy waiting (2 marks)

b) List the tree requirements that must be satisfied by solution to critical section problem. (3 marks)

c) Semaphore operations (*wait()* and *signal()*) can be implemented in the kernel by busy waiting or by blocking and wakeup process.

I. Briefly discuss how the busy waiting is done.
II. Briefly discuss how the blocking implementation is done. (6 marks)

d) Assume the following data structure, which is written for the reader and writer process to solve the first-readers-writers problem.

```
semaphore mutex, wrt;
int readcount;

// writer process

wait(wrt);
      ...
      writing is performed;
      ...
signal (wrt);
```

```
//reader process
wait(mutex);
      readcount++;
      if (readcount == 1)
            wait(wrt);
signal(mutex);
            ...
            reading is performed
            ...
wait(mutex);
      readcount--;
      if (readcount == 0)
          signal(wrt);
signal(mutex);.
```

i) What should be the initial values for the variables ***mutex***, ***wrt***, and ***readcount***? Briefly justify your answer.
ii) Briefly describe the uses of semaphores *wrt* and *mutex* in the solution (9 marks)

Question 2 (20 marks)

a) What is a deadlock in a computer system?

(2 marks)

b) List four necessary conditions to have a deadlock in a system.

(2 marks)

c) How does the modern general purpose operating system solve the deadlock problem?

(2 marks)

d) Briefly describe a difference between deadlock prevention and deadlock avoidance

(4 marks)

e) Consider the following snapshot of a system:

Processes	Allocation	Max	Available
	A B C	A B C	A B C
P_1	0 0 2	0 1 2	1 1 1
P_2	1 0 1	2 2 2	
P_3	2 2 0	3 4 0	
P_4	0 1 1	0 2 2	

Answer the following questions using the banker's algorithm:

1) What is the content of the matrix need?
2) Is the system in a safe state?
3) If a request from a process P_3 arrives for (0 ,1 ,0), can the request be granted immediately?

(10 marks)

Question 3 (20 marks)

a) Briefly explain the following terms in relation to Operating System:

i. Process Control Block
ii. Page table

(2 marks)

b) Explain the difference between internal and external fragmentation.

(4 marks)

c) The address binding of instruction and data to memory address can be done at compile time of the program. Briefly explain what it means by compile time address binding. What address binding method uses the most general purpose operating systems?

(4marks)

d) Consider a simple paging system with 2^{18} bytes of physical memory, 4096 pages of logical address space, and a page size of 8KB.

a) How many bits are there in the physical address?

(2 marks)

b) How many bits are there in the logical address?

(2 marks)

c) How long is the page table? (How many entries are there in the page table?)

(2 marks)

d) Assume each entry of a page table requires 16 bits of information. How large is the page table (in bytes)?

(2 marks)

e) When a process starts, the page table is copied to the hardware from memory at a speed of 200 nanoseconds per bytes. How long is the loading time?

(2 marks)

Question 4 (20 marks)

a) Briefly explain the following terms in relation to the secondary storage:

i. Seek time
ii. Swap out

(4 marks)

b) Disk requests come in the disk driver for cylinders 10, 22, 2, 40, 6, and 38, in that order. A seek takes 6 msec per cylinder moved. Assuming the arm is initially at cylinder 20, and moving toward larger cylinder number for a disk with 64 cylinders, how much seek time is needed for:

i. LOOK algorithm.
ii. C-SCAN

(6 marks)

c) Given the following set of processes with their arrival times and burst times.

Process	Arrival time in milliseconds	Burst time in milliseconds
A	0	8
B	2	5
C	4	1
D	5	5

i. Draw a Gantt chart for round-robin (quantum = 3 milliseconds) schedling considering the **context switching** time as 0.1 milliseconds.
ii. Compute the average waiting time.

(10 marks)