00375

Sri Lanka Institute of Information Technology

B.Sc. Honours Degree in Information Technology

Specialized in Information Technology

Final Examination

Year 2, Semester 1 (2022)

IT2060 – Operating System and System Administration

Duration: 2 Hors

June 2022

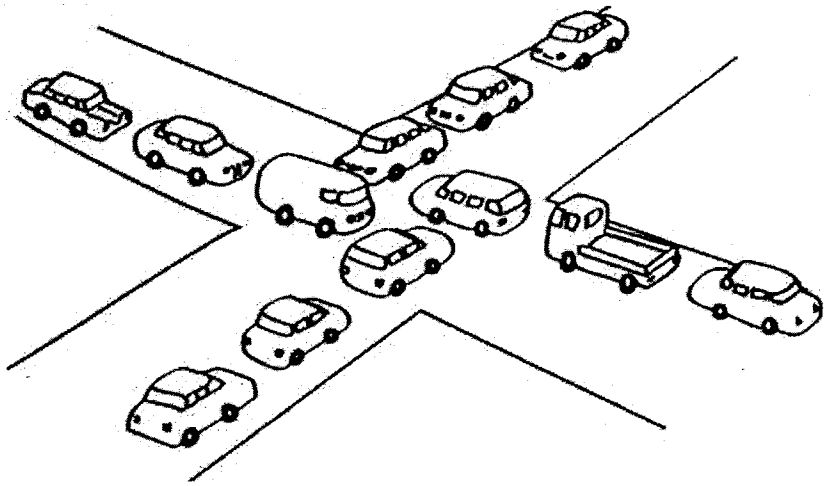
Instructions to Candidates:

- This paper is preceded by a 10 minute reading period.
- This paper has 4 questions.
- Answer all questions in the booklet given.
- The total marks for the paper is 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) Compare and contrast the *system resource allocation graph* and *wait for graph*. (2 marks)

b) Consider the following diagram showing a deadlock in a four way junction. (10 marks)



i. List the four necessary conditions to have a deadlock.
ii. Explain whether above deadlock shown in the four-way junction satisfy the four necessary conditions.
iii. Can a traffic light system solve the above problem? If so explain the solution and if not propose an appropriate solution.
iv. Draw the system resource allocation graph for the above real world deadlock situation. State your assumptions.
v. How do modern operating systems handle the deadlock problem?

c) Consider the following resource allocation graph of a system and answer the answer the questions. The system has 6 resources and four processes. (8 marks)

Process	Current Allocation	Maximum Need
A	2	6
B	2	4
C	1	2
D	1	5

i. Is the current system in *safe state*? Justify your answer
ii. If the process D requests two resource instances, will the system accept the request or reject the request? Justify your answer.

Question 2 **(20 marks)**

a) Briefly describe the following terms: (2 marks)

i. Critical section
ii. Semaphore

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

```
// 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);.
```

```
semaphore mutex, wrt;
int readcount;

        // writer
        process

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

i) Briefly explain the use of *wait()* and *signal()* methods in the above codes.
ii) What is the purpose of the *readcount* variable?
iii) What should be the initial values for the variables *mutex*, *wrt*, and *readcount*? Justify your answer.
iv) Briefly describe the uses of semaphores *wrt* and *mutex* in the solution
(12 marks)

c) Assume that there are two semaphores named A and B. Initial values are A=2 and B =1 Consider the two processes in which semaphore A and B are used as follows
(6 marks)

Process 01	**Process 02**
Wait(A)	Wait(B)
Wait(B)	Wait(A)
Critical section	Critical section
Signal(A)	Signal(B)
Signal(B)	Signal(A)

i) Are the two processes in deadlock? Justify your answer.
ii) Which process has to access the critical section first?
iii) If the initial values are A=1 and B =1, does it create a deadlock. Justify the answer.

Question 3 **(20 marks)**

a) Briefly describe the uses of the protection bit and the valid/invalid bit in the paging system. (2 marks)

b) Compare and contrast the physical memory and virtual memory. (2 marks)

c) A simple paging system consist of 2^{20} bytes of physical memory, 4096 pages of logical address space, and a page size of 64 KB.

   a. What is the number of bits in the logical address?
   b. How many bits in a physical address are used to specify the frame?
   c. How long is the page table? (How many entries are in the page table?)
   d. Assuming that each page table entry contains a valid/invalid bit in addition to the page frame number, how wide is the page table? (How many bits are needed to store an entry in the page table)

(8 marks)

d) Consider a paging system in which the page table is stored in memory.

1) When the CPU generates a logical address, explain how the operating system finds the physical location of the logical address.

2) If a memory reference takes one microsecond, how long does a paged memory reference take?

3) Assume that a system consists of associative registers, and 60 percent of all page-table references are found in the associative registers. What is the effective memory reference time? (Assume that finding a page-table entry in associative registers takes 100 nanoseconds, if the entry is there.)

(8 marks)

Question 4 **(20 Marks)**

a) Briefly explain the following terms in a file system: (2 marks)

   i. File Control Block (FCB)

   ii. Open File Table

b) A file has 400 data blocks and the linked allocation strategy is used. FCB is stored in the physical memory. (8 marks)

   i. List two disadvantages using the linked allocation strategy in file system.

   ii. To remove the third data block, how many disk I/O operations are needed?

   iii. To add new block after the 3rd data block, how many disk I/O operations are needed?

c) A set of Disk requests are received in the disk driver (0 to 999 cylinders) for cylinders 100, 600, 10, 40, 300, and 700, in that order. A seek takes 10 msec per cylinder moved. Assuming the arm is initially at cylinder 600, and moving toward larger cylinder number for a disk with 1000 cylinders, how much seek time is needed for: (6 marks)

   i. C-SCAN algorithm.

   ii. SSTF algorithm

d) Compare and contrast the Trap door and the stack overflow issue in security. (4 marks)