00378

Sri Lanka Institute of Information Technology

B.Sc. Special Honours Degree/Diploma
in
Information Technology

Final Examination
Year 2, Semester I (2023)

IT2060 – Operating System and System Administration

Duration: 2 Hours

May/ June 2023

Instructions to Candidates:

- This paper contains 5 pages including the cover page.
- This paper has 4 questions with a total of 100 marks.
- Answer all questions in the booklet given.
- Electronic devices capable of storing and retrieving text, including calculators and mobile phones are not allowed.

Question 1 (25 Marks)

a) Briefly explain the following. (3 marks)

i. Critical section of a program
ii. Atomic operations
iii. Semaphore

b) List the three solutions for critical section problem of a program. (3 marks)

c) Consider the Peterson's solution provided as a solution for synchronization issue.

// Peterson's solution:

Process P_i

repeat
flag[i] = true;
turn = j;
while (*flag[j]* **and** *turn = j*) **do** *no-op;*
critical section
flag[i] = false;
remainder section
until ***false;***

Process P_j

repeat
flag[j] = true;
turn = i;
while (*flag[i]* **and** *turn =i*) **do** *no-op;*
critical section
flag[j] = false;
remainder section
until ***false;***

Note: The initial values for turn is 'i' and the flag[i], flag[j] are set to false.

i. Evaluate the Peterson's solution and briefly discuss whether it satisfies the three solutions for critical section problem. (9 Marks)

d) Consider the following code segment for the producer processes: (10 marks)

```
Do {
 wait(empty);
 wait(mutex);
    ...
 /* produce an item in next_produced */
    ...
 signal(mutex);
 signal(full);
    ...
 /* add next produced to the buffer */
    ...
} while (true);
```

i. List the semaphores used in this code.

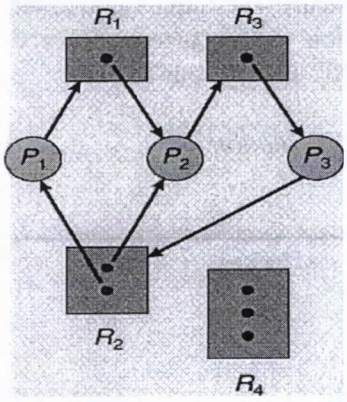
ii. What are the initial value of mutex, empty and full variables?

iii. Complete the consumers' code for consumer process using the above variables.

Question 2 (25 Marks)

a) List four necessary conditions to create a deadlock in the system? (4 marks)

b) Consider the resource allocation graph given in the figure below.



i. Is the graph containing a deadlock? Justify your answer. (3 marks)

c) In a system 3 process named P1, P2, and P3 are available. There are 2 printers and 1 tape drive in the system. P1 process is currently holding a printer and requesting for a tape drive. P2 process is holding only a printer. P3 process is holding a tape drive and requesting for a printer.

i. Draw the resource allocation graph for above scenario using the correct symbols.

ii. Is there a deadlock in this system? Justify your answer. (8 marks)

d) Deadlock recovery can be done by **preempting** some resources from one or more of the deadlocked processes. Briefly discuss at least **two factors** that must be considered when preempting a resource.

(2 marks)

e) For a state described in the following table:

Process	Current Allocation	Maximum Allocation
	R_1	R_1
P_1	2	4
P_2	2	3
P_3	4	10
P_4	3	8

i. Is the **system safe** if the number of resources currently available is 4? Justify your answer. (4 marks)

ii. In above table, for a given state and there are 4 resources available. If the Process 3 requests for **three resources** (in addition to the current resource allocation of 4 resources), should the request be granted? Justify your answer. (4 marks)

Note: draw the table and illustrate the calculation

Question 3 (25 Marks)

a) Briefly explain the followings. (2 marks)
   i. Internal fragmentation
   ii. External fragmentation

b) Consider a simple paging system with 2^{19} bytes of physical memory, 4096 pages of logical address space, and a page size of 4KB. Answer the following. (10 marks)

   i. What is the difference between logical and physical addresses?

   ii. How many bits are in the physical address?

   iii. How many bits are in the logical address?

   iv. Where does the page table store in the computer?

   v. How long is the page table mentioned above?

c) Virtual memory is a technique that allows the execution of processes that are not completely in memory.

   i. List two advantages of virtual memory. (2 Marks)

   ii. List the actions taken by the operating system when there is a **page fault**.

(2 Marks)

iii. How can the system distinguish between the pages that are in main memory from the pages that are on the disk? (2 Marks)

iv. Consider the page reference sequence given below and find the number of page faults using FIFO algorithm. Assume that there are three frames available, and they are initially empty. (7 marks)

Page reference sequence: 7,0,1, 2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1

Question 4 (25 Marks)

a) List two **program threats**. (4 marks)

b) List the three methods of allocating disk blocks to files. (3 Marks)

c) In a disk drive, Disk requests are generated for cylinders 9, 17, 2, 40, 8, and 90, in the order. It takes 5 msec for a cylinder movement. Assuming that the arm head is initially at cylinder 20 (the previous request was at cylinder 5) for a disk with 100 cylinders (1 to 100). How much seek time is needed for the following algorithms? (10 marks)

i. LOOK

ii. SCAN

d) Consider a file currently consisting of 200 blocks. Assume that the file control block is already in memory. Calculate how many disk I/O operations are required for linked allocation strategy if:

i. The second block from the beginning is removed.
ii. The middle block is removed.
iii. One block is added at the beginning.
iv. One block is added to the middle.

(8 Marks)

*** End of Paper ***