

UNIVERSITY OF RUHUNA

**BACHELOR OF COMPUTER SCIENCE (GENERAL) DEGREE LEVEL II
(SEMESTER I) EXAMINATION – JUNE 2023**

COURSE UNIT : CSC2133 - Operating Systems

Time: 2 hours

Answer ALL questions.

- a. Briefly explain the “New” and “Waiting” states of any given finite process. (10 marks)
- b. State whether the following statements are True or False with the justification. (20 marks)
- i. The virtual-machine concept provides complete protection of system resources.
 - ii. Context-switch time is pure overhead.
- c. Write corresponding UNIX system calls for the given Windows system calls and briefly explain each of them (i.e. Unix calls) (30 marks)
- i. CreateProcess()
 - ii. CreatePipe()
 - iii. ExitProcess()
- d. Consider the following system with five (05) processes: P₀, P₁, P₂, P₃ and P₄. Its four (04) resource types: R₀, R₁, R₂ and R₃ are composed of 1, 5, 2 and 0 available resources respectively.

	Allocated	Maximum	Need
	R ₀ R ₁ R ₂ R ₃	R ₀ R ₁ R ₂ R ₃	R ₀ R ₁ R ₂ R ₃
P ₀	0 0 1 2	0 0 1 2	
P ₁	1 0 0 0	1 7 5 0	
P ₂	1 3 5 4	2 3 5 6	
P ₃	0 6 3 2	0 6 5 2	
P ₄	0 0 1 4	0 6 5 6	

Table 1

Use Banker's Algorithm to answer the following questions.

- i. Fill the Need column in Table 1.
- ii. Is the system in a safe state? Briefly explain.
- iii. If a request from process P₁ arrives for (0,4,2,0) resources, can the request be granted immediately? Explain your answer. (40 marks)

2.

a. State whether the following statements are True or False. (15 marks)

- The cost of switching between threads is much higher than the cost of switching between processes.
- Threads within a single process share address spaces.
- Kernel threads are supported directly by the operating system.

b. Consider the following situations in a resource allocation graph and decide whether there is a deadlock/possibility of a deadlock or not. (20 marks)

- If the graph contains a cycle and only one instance per resource type
- If the graph contains a cycle and several instances per resource type

c. Suppose Queue 0 (Q_0) and Queue 1 (Q_1) are foreground queues and use Round Robin (RR) algorithm while Queue 2 (Q_2) uses FCFS algorithm to schedule the processes. (25 marks)

Q_0 – RR with time quantum 4 milliseconds

Q_1 – RR time quantum 8 milliseconds

Q_2 – FCFS

Fill in the blanks assuming the multilevel feedback queue scheduling for the given three queues and Q_0 and Q_1 are empty.

- A new process entering a ready is put in the queue
- When it gains CPU, it receives milliseconds
- If it does not finish, process is moved to queue(tail)
- At Q_2 it again receives additional milliseconds
- If it still does not complete, it is preempted and put into queue

d. Explain the problem of starvation that could be occurred during priority scheduling and a possible solution for that problem. (20 marks)

e. A set of processes, their arrival times and burst times are given in Table 02. Use the table in answering the questions. (20 marks)

Process	Arrival Time (ms)	Burst Time(ms)
P_1	0	16
P_2	2	10
P_3	5	4
P_4	7	6
P_5	8	11

Table 2

- i. Draw a Gantt chart to depict the scheduling under First-Come First-Served scheduling algorithm.
- ii. Calculate the average waiting time of the processes under First-Come First-Served scheduling.

- a. Memory protection is provided by using two registers. Name these two (02) registers and briefly mention the contents of them. (10 marks)
- b. Explain the difference between **external** and **internal fragmentation** in memory management with an example diagram. (20 marks)
- c. Briefly explain "page fault trap". (05 marks)
- d. Consider a simple paging system with a page table containing 64 entries of 11 bits (including valid/invalid bit) each, and a page size of 512 bytes. Choose answers from the given box.

8,9,10,12,15,19,64, 512,32 ,

- i. What is the frame size?
 - ii. How many bits are used in the offset?
 - iii. How many bits are used in a physical address? (15 marks)
- e. "vfork() does not use copy-on-write concept." State whether this statement is true/false and justify your answer. (15 marks)
- f. Write the main difference between I/O bound and CPU bound processes. (20 marks)
- g. Consider a system that supports the strategies of contiguous, linked, and indexed allocation. Which criteria should be used in deciding which strategy is best utilized for a particular file? Select the given suitable criteria from the brackets for the above given file allocation methods (*files that are small and accessed sequentially, for large files accessed sequentially, best for large, randomly accessed files*) (15 marks)

4.

- a. State the three (03) requirements that a solution to the **critical section** should satisfy. (15 marks)
- b. List two (02) atomic hardware instructions, which can be used as a solution to the critical section problem. (10 marks)
- c. Imagine that five (05) philosophers who spend their lives just thinking and eating. In the middle of the dining room is a circular table with five (05) chairs. The table has a big plate of rice. However, there are only five chopsticks available. They do not interact with their

neighbors, occasionally try to pick up 2 chopsticks (one at a time) to eat from bowl. The structure of philosopher i can be defined as follows:

```
do{
    wait ( chopstick[i] );
    wait ( chopstick[ (i + 1) % 5] );
    // eat
    signal ( chopstick[i] );
    signal ( chopstick[ (i + 1) % 5] );
    // think
} while (TRUE);
```

- i. Explain a situation in which the above algorithm won't be working as usual.
- ii. Suggest a possible solution for the above problem. (20 marks)

- d. Assume an old computer has four page (04) frames and the following reference string has been used for the evaluation of page replacement algorithms: First-In-First-Out (FIFO) and Optimal page replacement.

Reference string = 1, 2, 3, 4, 1, 5, 2, 3, 4, 5

How many page faults would occur using following page replacement algorithms? Show the steps. (Assume all the frames are empty at the beginning)

- i. FIFO
 - ii. Optimal page replacement. (40 marks)
- e. What is Belady's anomaly in terms of page replacement? (10 marks)
 - f. State whether FIFO suffers from Belady's anomaly or/not (05 marks)
