Xi'an Jiaotong-Liverpool University
西交利物浦大學

PAPER CODE	EXAMINER	DEPARTMENT	TEL
CPT104		Department of Computing	

2020/21 SEMESTER 2 – Resit

BACHELOR DEGREE – Level 2

Operating Systems Concepts

TIME ALLOWED: 2 hours

INSTRUCTIONS TO CANDIDATES

1. **Total marks available are 100, accounting for 100% of the overall module marks.**
2. **Answer all FOUR questions.**
3. **The number in the column on the right indicates the marks for each question.**
4. **Relevant and clear steps should be included in the answers.**
5. **The university approved calculator - Casio FS82ES/83ES can be used.**
6. **All the answers must be in English in the answer script provided.**
7. **Your solutions should be submitted electronically through the Learning Mall via the submission link.**
8. **The naming of answer sheets (in pdf) is as follows: ModuleCode_StudentID.pdf (e.g., CPT104_123456.pdf)**
9. **Answers can also be handwritten, fully and clearly scanned or photographed for submission as one single PDF document through the Learning Mall via the submission link.**

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QUESTION I. Fundamentals (39 marks)

1. **Redundant Arrays of Independent Disks RAID** consists of a set of physical disk drives that is viewed as a single logical unit by the operating system. The **RAID** scheme consists of seven levels, zero through six. Briefly discuss any four (4) of the seven levels. (12 marks)

2. What is the meaning of the term **busy waiting**? What other kinds of waiting are there in an operating system? Explain your answer. (6 marks)

3. There are many reasons why the system administrator would want to **restrict access** to areas of memory. Give the three reasons you believe are most important. (6 marks)

4. Compare and contrast a **process** and a **thread**. (6 marks)

5. What is **Role-based access control** (RBAC)? (4 marks)

6. What is the **context switch**? Briefly explain. (5 marks)

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QUESTION II. CPU scheduling, Memory management, Disk scheduling

(37 marks)

1. Calculate the number of page faults for the following reference string using **Least Recently Used LRU page-replacement algorithm** with frame size as **3**.

5 0 2 1 0 3 0 2 4 3 0 3 2 1 3 0 1 5

(6 marks)

2. In a paging system with **Translation Lookaside Buffer** TLB, it takes 30 ns to search the TLB and 90 ns to access the memory. If the Translation Lookaside Buffer TLB hit ratio is 70%, find the effective memory access time.

What should be the hit ratio to achieve the effective memory access time of 130 ns?

(9 marks)

3. Three processes **P1**, **P2**, and **P3** of size 19900, 19990, and 19888 bytes, respectively, need space in memory.

If partitions of equal size, that is, 20000 bytes, are allocated to P1, P2, and P3, will there be any **fragmentation** in this allocation? If, yes, then what is the size of the space left? (4 marks)

Can a process of 200 bytes be accommodated? (3 marks)

4. Consider the following scenario of processes:

Process	Arrival time	Burst time
P1	0	9
P2	1	5
P3	2	3
P4	3	4

Draw the Gantt chart for the execution of the processes, showing their start time and end time, using ***Shortest-Job-First SJF*** scheduling algorithm. (2 marks)

Calculate average turnaround time, and average waiting time for the system in ***Shortest-Job-First SJF*** scheduling algorithm. (8 marks)

5. Consider a disk queue with I/O requests on the following cylinders in their arriving order:

6, 10, 12, 54, 97, 73, 128, 15, 44, 110, 34, 45

The disk head is assumed to be at **cylinder 23** and moving in the direction of decreasing number of cylinders. The disk consists of total 150 cylinders.

Write the sequence in which requested tracks are serviced using **LOOK algorithm** and calculate the total head movement (in number of cylinders) incurred while servicing these requests.

(5 marks)

QUESTION III. Resource allocation (12 marks)

There are **4** processes P0 to P3 and three resources **A**, **B**, and **C**.

Consider the following snapshot of a system:

Process	Allocation			Max			Available		
	A	B	C	A	B	C	A	B	C
P0	1	0	1	2	1	1	2	1	1
P1	2	1	2	5	4	4			
P2	3	0	0	3	1	1			
P3	1	0	1	1	1	1			

Create the need matrix. (4 marks)

Is the system in a safe state? Why or why not? Explain your answer. (8 marks)

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QUESTION IV. Operating System in C Language (12 marks)

Suppose the following two processes, **P1** and **P2**, are executed concurrently and share the semaphore variables **S** and **R** (each initialized to 1) and the integer variable **x** (initialized to 0).

void P1( ) {
do {
wait(S);
wait(R);
x++;
signal(S);
signal(R);
} while (1);
}
	void P2( ) {
	do {
	wait(R);
	wait(S);
	x--;
	signal(S);
	signal(R);
	} while (1);
	}

a. Can the concurrent execution of these two processes result in one or both being blocked forever? If *yes*, give an execution sequence in which one or both are blocked forever.

(6 marks)

b. Can the concurrent execution of these two processes result in the indefinite postponement of one of them? If *yes*, give an execution sequence in which one is indefinitely postponed.

(6 marks)

END OF EXAM PAPER