M.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING
FIRST YEAR FIRST SEMESTER EXAM - 2025
OPERATING SYSTEM

Time: Three Hours — Full Marks: 100

*Answer **any five** question*

All the sub-parts of the questions should be written altogether

1. a) On all current computers, at least part of the interrupt handlers is written in assembly language. Why?

   b) Consider the following piece of C code:

```
void main( ) {
fork( );
fork( );
exit( );
}
```

   How many child processes are created upon execution of this program?

   c) What is process in OS?

   d) Assume you have the following processes to execute with one processor. All five processes arrive at time 0, in the order given, with the length of the CPU – burst time given in milliseconds.

Process	Burst Time
P1	6
P2	4
P3	13
P4	7
P5	15

   Consider the FCFS and RR (quantum = 5 milliseconds) scheduling algorithms for this set of processes. Which algorithm would give the minimum average waiting time?

   4+4+2+10 = 20

2. Consider the set of five processes whose allocated resources, maximum resources and available resources of the system are given below:.

	Allocation Matrix (N0 of the allocated resources By a process)				Max Matrix Max resources that may be used by a process				Available Matrix Not Allocated Resources			
	A	B	C	D	A	B	C	D	A	B	C	D
P_0	0	1	1	0	0	2	1	0	1	5	2	0
P_1	1	2	3	1	1	6	5	2				
P_2	1	3	6	5	2	3	6	6				
P_3	0	6	3	2	0	6	5	2				
P_4	0	0	1	4	0	6	5	6				

Using Banker's algorithm, answer the following questions:-

i) How many resources of type A, B, C, D are there?

ii) What are the contents of need matrix?

iii) Find if the system is in safe state? If it is, find the safe sequence.

b) A system has four processes and five resources. The current allocation and maximum needs are as follows:

	Allocated	*Maximum*	*Available*
Process A	1 0 2 1 1	1 1 2 1 3	0 0 x 1 1
Process B	2 0 1 1 0	2 2 2 1 0	
Process C	1 1 0 1 0	2 1 3 1 0	
Process D	1 1 1 1 0	1 1 2 2 1	

What is the smallest value of x for which this is a safe state?

12 + 8 = 20

3. a) Given references to the following pages by a program:

1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5

How many page faults will occur if the program uses First-in-First-Out (FIFO) replacement strategy and has

i. three frames available

ii. four frames available

b) Given references to the following pages by a program:

7, 2, 3, 1, 2, 5, 3, 4, 6, 7, 7, 1, 0, 5, 4, 6, 2, 3, 0, 1, 1

How many page faults will occur if the program has three frames available to it and uses

i. Least-Recently-Used (LRU) replacement strategy.

ii. Optimal Replacement strategy.

c) Suppose the time to service a page fault is on average 10 milliseconds, while a memory access takes 1 microsecond. Then a 99.99% hit ratio results in an average memory access time of __________. (correct up to two decimal points)

8 + 8 + 4 = 20

4. a) Define a critical section and the critical section problem, and explain the requirements of a solution to the critical section problem.

b) Consider a logical address space of 8 pages of 1024 words each, mapped on to a physical memory of 32 frames.

i. How many bits are there in the logical address?

ii. How many bits are there in the physical address?

c) Consider a machine with 64 MB physical memory and a 32-bit virtual address space. If the page size is 4KB, what is the approximate size of the page table?

6 + 7 + 7 = 20

5. a) Write differences between logical and physical addresses.
   b) Why page are sizes always powers of 2?
   c) Given six memory partitions of 300 KB, 600 KB, 350 KB, 200 KB, 750 KB, and 125 KB (in order), how would the first-fit, best-fit, and worst-fit algorithms place processes of size 115 KB, 500 KB, 358 KB, 200 KB, and 375 KB (in order)?

$4 + 4 + 12 = 20$

6. a) Consider a computer system that runs 5,000 jobs per month and has no deadlock-prevention or deadlock-avoidance scheme. Deadlocks occur about twice per month, and the operator must terminate and rerun about ten jobs per deadlock. Each job is worth about two dollars (in CPU time), and the jobs terminated tend to be about half done when they are aborted. A systems programmer has estimated that a deadlock-avoidance algorithm (like the banker's algorithm) could be installed in the system with an increase of about 10 percent in the average execution time per job. Since the machine currently has 30 percent idle time, all 5,000 jobs per month could still be run, although turnaround time would increase by about 20 percent on average.

   i. What are the arguments for installing the deadlock-avoidance algorithm?
   ii. What are the arguments against installing the deadlock-avoidance algorithm?

   b) Define external fragmentation. What are the causes for external fragmentation?
   c) What is thrashing? What are the causes for thrashing?

$6 + 7 + 7 = 20$

7. a) What are the four necessary and sufficient conditions for deadlock occurrence?
   b) Write differences between Paging and Segmentation.
   c) Write differences between Process and Threads.

$4 + 8 + 8 = 20$