FUNDAMENTALS OF OPERATING SYSTEMS
(CSEN 4121)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Which of the following is a single-user operating system?
(a) Windows (b) MS-DOS
(c) MAC (d) UNIX.

(ii) A benefit of the microkernel organization is
(a) Extensibility (b) Portability
(c) Flexibility (d) All of these.

(iii) CPU fetches the instruction from memory according to the value of
(a) program status word (b) instruction register
(c) program counter (d) status register.

(iv) The time to move the disk arm to the desired sector in a hard disk is known as
(a) rotational latency (b) positioning time
(c) seek time (d) hashed time.

(v) Which scheduling algorithm is inherently pre-emptive?
(a) RR (b) SJF
(c) Priority Scheduling (d) FCFS.

(vi) A thread is a
(a) Light weight Process (b) Process
(c) Task (d) Program.

(vii) In which of the following cases Banker's algorithm is used?
(a) Deadlock Avoidance (b) Deadlock Recovery
(c) Mutual Exclusion (d) Context Switching.

(viii) Which of the following schemes suffers from External Fragmentation?
(a) Segmentation (b) Paging
(c) Paged Segmentation (d) All of these.

(ix) To enable a process to be larger than the amount of memory allocated to it, one can use
(a) Swapping (b) Compaction
(c) Paging (d) Thrashing.

(x) If a process has 24 K byte of logical address space and the page size is 4096 bytes, the number of pages in the process is
(a) 12 (b) 6
(c) 16 (d) 8.

Fill in the blanks with the correct word

(xi) To access the services of the operating system, the interface is provided by the _____.

(xii) The circular wait condition can be prevented by _____.

(xiii) A problem encountered in multitasking when a process is perpetually denied necessary resources is called _____.

(xiv) Semaphore is a/an _____ to solve the critical section problem.

(xv) No cycle in the resource allocation graph means _____

Group - B

2. (a) Define operating system. What are the functions of operating system? *[(CO3)(Remember/LOCQ)]*

(b) What are the advantages of multiprocessor systems over single processor system? *[(CO4)(Remember/LOCQ)]*

(c) What do you mean by the dual mode operation? Explain the working principle of dual mode operation. *[(CO2)(Apply/IOCQ)]*

(2 + 2) + 3 + (2 + 3) = 12

3. (a) What is Spooling? *[(CO2)(Remember/LOCQ)]*

(b) Draw the Microkernel and Layered architecture of Operating System and explain both architectures. *[(CO4)(Understand/IOCQ)]*

(c) What is the advantage of using Virtual Machine Architecture? *[(CO4)(Understand/IOCQ)]*

2 + 6 + 4 = 12

Group - C

4. (a) Consider the following set of processes, with the length of the CPU burst time is given in milliseconds.

Process	Burst time	Arrival time
P1	6	0
P2	10	3
P3	8	5
P4	5	7
P5	6	10

Draw a Gantt chart for a round robin scheduling policy with time quantum = 4 units. Illustrate the execution of these processes using preemptive priority. (higher number implies a higher priority) scheduling.
Find the completion time and response time.
Find the average waiting time and average turnaround time. *[(CO4)(Analyse/IOCQ)]*

(b) What is a thread? What is the difference between a thread and a process? *[(CO4)(Remember/LOCQ)]*

(c) What is Ageing? *[(CO4)(Remember/LOCQ)]*

(2 + 2 + 2) + (1 + 2) + 3 = 12

5. (a) What are the various states of a process? Describe each state. *[(CO4)(Remember/LOCQ)]*

(b) Compare ready queue and waiting queue. Do all processes in ready queue get into waiting queue? If yes, explain your answer. If no, why not. *[(CO2)(Analyze/HOCQ)]*

(c) Contrast the three different types of process scheduling i.e., short term scheduling, medium term scheduling, long term scheduling. *[(CO3)(Apply/IOCQ)]*

5 + 4 + 3 = 12

Group - D

6. (a) Consider the following pseudo code:

```
semaphore S = 1;
semaphore E = 1;
If (thread_count++ &lt; 100) spawnnewthread();
wait(E);
// critical section – begin
-----------------------------
-----------------------------
// critical section – end
signal(S);
```

Assume that above pseudocode gets called a hundred times, what is the count of semaphore E? *[(CO4)(Understand/HOCQ)]*

(b) At a particular time of computation the value of a counting semaphore is 7. Then 20 P operations and 15 V operations were completed on this semaphore. Find out the resulting value of the semaphore. *[(CO2)(Understand/IOCQ)]*

(c) Consider the following snapshot of a system.

Process	Allocation	Max	Available
	R1 R2 R3 R4	R1 R2 R3 R4	R1 R2 R3 R4
P1	0 0 1 2	0 0 1 2	2 1 0 0
P2	2 0 0 0	2 7 5 0	
P3	0 0 3 4	6 6 5 6	
P4	2 3 5 4	4 3 5 6	
P5	0 3 3 2	0 6 5 2	

Is the system in a safe state? Justify your answer.
If a request from process P3 arrives for(0, 1, 0, 0), can it be granted immediately? Explain your answer. *[(CO3)(CO4)(Analyze/HOCQ)]*

3 + 3 + (4 + 2) = 12

7. (a) What is the sequence of operation by which a process utilizes a resource? *[(CO3)(Understand/IOCQ)]*

(b) What is resource-allocation graph? Explain with an example. *[(CO4)(Remember/LOCQ)]*

(c) Given 3 processes A,B and C, three resources x,y and z and following events,

(i) A requests x
(ii) A requests y
(iii) B requests y
(iv) B requests z
(v) C requests z
(vi) C requests x
(vii) C requests y

Assume that requested resources should always be allocated to the request process if it is available. Draw the resource allocation graph for the sequences. And also mention whether it is a deadlock? *[(CO2)(Apply/IOCQ)]*

3 + (2 + 2) + (3 + 2) = 12

Group - E

8. (a) Consider a virtual memory system with combined implementation, segmentation and paging. Describe the address translation scheme along with necessary data structures. *[(CO3)(Analyse/IOCQ)]*

(b) Given references to the following pages by a program.

0,9,0,1,8,1,8,7,8,7,1,2,8,2,7

How many page faults would occur for the following page replacement algorithms? Assuming 3 frames available. Also assume that initially none of page is in main memory.

(i) FIFO
(ii) LRU
(iii) Optimal. *[(CO2)(Apply/IOCQ)]*

6 + (2 + 2 + 2) = 12

9. (a) How many pages of size 512 words each, are contained in a program with a logical address having 16 bits? *[(CO1)(Analyse/HOCQ)]*

(b) Define fragmentation. Explain how external fragmentation is solved. *[(CO4)(Remember/LOCQ)]*

(c) How would each of the first fit, best fit and worst fit algorithms place processes of 212KB, 417KB, 112KB and 426KB (in order). Which algorithm makes the most efficient use of memory? *[(CO3)(Understand/IOCQ)]*

3 + (2 + 2) + (3 + 2) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	29.17	54.16	16.67