(c) In a UNIX system, suppose a process first executes a new program P1 (of owner U1) whose *setuid bit* is set. The process then executes another program P2 of that owner. What would be the *euid* of the process at that point if P2 (a) has or (b) has not *setuid bit* on?

(d) In UNIX systems, how can we allow a group of users to read and write a particular file, but they cannot delete the file? Rest of users of the system can only read the file.

(e) When can we say a system is secured?

(f) In the domain of security, what are threat and attack?

(6 × 2) = 12

OPERATING SYSTEMS
(CSEN 3103)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i) The process related to process control, file management, device management, information about system and communication that is requested by any higher level language can be performed by _____.
   (a) editors   (b) compilers
   (c) system   (d) caching.

   (ii) The TestAndSet instruction is executed
   (a) after a particular process   (b) periodically
   (c) atomically   (d) none of these.

   (iii) Consider P1 and P2 executes the following code to implements critical section problem. The initial value of shared Boolean variables s1 and s2 are randomly assigned. Which of the following properties achieved?

P1	P2
while(s1==s2);	while(s1!=s2)
Critical section	Critical section
s1=s2;	s2=not(s1);

   (a) Mutual Exclusion but not progress
   (b) Progress but not mutual exclusion
   (c) Neither mutual exclusion nor progress
   (d) Both mutual exclusion and progress

   (iv) The code that changes the value of the semaphore is
   (a) remainder section code
   (b) non–critical section code
   (c) critical section code
   (d) none of these

(v)   Which process can be affected by other processes executing in the system?
(a) cooperating process   (b) child process
(c) parent process   (d) init process.

(vi)   Which one of the following is not true?
(a) Kernel is the program that constitutes the central core of the operating system
(b) Kernel is the first part of operating system to load into memory during booting
(c) Kernel is made of various modules which cannot be loaded in running operating system
(d) Kernel remains in the memory during the entire computer session.

(vii) If a process has 32 k bytes logical address space and the page size is 2048 bytes then the number of frames of that process is
(a) 4   (b) 16   (c) 8   (d) 32.

(viii) Dirty bit for a page in a page table
(a) helps avoid unnecessary writes on paging device
(b) helps maintain LRU information
(c) allows only read on a page
(d) none of the above.

(ix)   A system is in a safe state only if there exists a
(a) safe allocation   (b) safe resource
(c) safe sequence   (d) all of these.

(x)   Run time mapping from virtual to physical address is done by
(a) memory management unit   (b) CPU
(c) PCI   (d) none of the mentioned.

Group – B

2. (a)   How is the kernel different from the OS? Why do we say that an operating system is more than a kernel?

(b)   Why do we say utilities are a part of the OS, but not a part of the kernel? How does the kernel differ from utilities? Can we include all utilities in the kernel? Justify your answer.

(c)   In what way are utilities similar to user applications? In what way are they different?

(d)   Compare and contrast microkernel and monolithic kernel.

2 + 4 + 4 + 2 = 12

strategy. Which replacement strategy in the above performs better and why?

(b)   Differentiate between external and internal fragmentation with example. Suggest any suitable solution for external fragmentation.

(c)   What is pure demand paging?

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

7. (a)   Consider a system with a 32-bit logical address space, a two-level paging scheme, 4 byte page table entries, 1 KB pages and a 4 entry TLB. The page-table base register access time is 0 ns, TLB access time 10 ns and memory access time is 100 ns.

(i)   How many address bits are needed for the page offset?

(ii) How much memory in bytes is required to store the outer page table entirely in main memory?

(iii) What is the average memory access time?

(b)   Given memory partition of 100 K, 500 K, 200 K, 300 K and 600 K. How would each of the First Fit, Best Fit and Worst Fit algorithm place processes of 212 K, 417 K, 112 K and 426 K. Which algorithm makes the most efficient use of memory?

(2 + 3 + 3) + 4 = 12

Group – E

8.   What are the goals of protection? Explain how access matrix can be implemented using global table and access list.

For each of the following security attacks, say if public key encryption can help prevent the attack. (Justify your answer.)

(i) Abuse of valid privileges (ii) Denial of Service attack (iii) Listener or eavesdropper attack and (iv) Buffer overflow attack.

(2 + 4 + 6) = 12

9. (a)   Consider that the maximum length of a password in a system is 3 characters (2 alphabets and 1 numeral). How many guesses are needed to find the correct password?

(b)   Suppose you are a supervisor and supervising some employees. For each employee, you have a separate file where you store employee-specific data. You have to write a program that any employee can execute but he/she only access data related to his/her and not to others. What will be the *protections of this program and other data file*?

3. (a) (i) If we execute kernel programs in the user mode and applications in the kernel mode, what are the consequences?

(ii) What is the difference between (processor) preemption and interruption? In what way are they similar?

(b) (i) In UNIX systems, the superuser is very special and has the most privileges. When he/she runs an application, can it execute privileged instructions in the user mode? Justify your answer.

(ii) Why do processes interact with one another? What are the two classes of process interactions?

(c) (i) Why do we say that the operating system is a resource manager?

(ii) Why do we say that the operating system is a reactive program?

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

Group – C

4. (a) We are using a *32*-bit machine. We have a shared variable of type long (*64-bit*). Only *one* thread can write the variable, but several threads can read it. The variable can be read and written concurrently. Can this variable assumed to be a 1-writer multi-reader atomic long variable? Justify your answer.

(b) Discuss the problems created due to busy waiting.

(c) An operating system uses the Banker's algorithm for deadlock avoidance when managing the allocation of three resource types X, Y, and Z to three processes P0, P1, and P2. The table given below presents the current system state. Here, the Allocation matrix shows the current number of resources of each type allocated to each process and the Max matrix shows the maximum number of resources of each type required by each process during its execution.

	Allocation			Max		
	X	Y	Z	X	Y	Z
P0	0	0	1	8	4	3
P1	3	2	0	6	2	0
P2	2	1	1	3	3	3

There are 3 units of type X, 2 units of type Y and 2 units of type Z still available. The system is currently in a safe state. Consider the following independent requests for additional resources in the current state:

REQ1: P0 requests 0 units of X, 0 units of Y and 2 units of Z
REQ2: P1 requests 2 units of X, 0 units of Y and 0 units of Z

Justify the assertion that "Out of REQ1 and REQ2, only REQ2 would be permitted by the system".

(d) Semaphore $s = \{1, 0\}$; code: $P(s); ...; P(s)$; the process is perpetually blocked now. Explain whether or not this is a deadlock.

2 + 2 + 6 + 2 = 12

5. (a) Snapshot of a system given.

Process	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P1	0	0	1	2	0	0	1	2	1	5	2	0
P2	1	0	0	0	1	7	5	0				
P3	1	3	5	4	2	3	5	6				
P4	0	6	3	2	0	6	5	2				
P5	0	0	1	4	0	6	5	6				

What is the content of Need matrix? Is the system is in safe state? Explain. If a request from process P1 arrives for (0, 4, 2, 0), can the request be granted immediately.

(b) Consider the following table of arrival time and burst time for four processes P1, P2 and P3, P4.

Process	Arrival time	Burst Time	Priority
P1	0 ms	9	1
P2	1 ms	14	5
P3	2 ms	10	2
P4	3 ms	8	1

Draw the Gantt chart and find out average waiting time, average turnaround time and average weighted turnaround time for the following scheduling algorithms. SRT, Priority.

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

Group – D

6. (a) 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 will occur if the program has three (3) page frames available to it and uses FIFO replacement strategy and LRU replacement