# COMSATS University Islamabad, Lahore Campus
## Department of Computer Science

☐ **Sessional-1** ☐ **Sessional-II** ■ **Terminal Examination – Spring 2020**

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|---|---|---|---|---|---|---|---|
| Course Title: | Operating Systems | | | Course Code: | CSC322 | Credit Hours: | 3(2,1) |
| Course Instructor/s: | Ms Sehar Ali | | | Program Name: | BCS, BSE | | |
| Semester: | 5th | Batch: SP18-BSE | Section: | B, C | Date: | 20-08-2020 | |
| **Time Allowed:** | **3 Hours** | | | **Maximum Marks:** | | **50** | |
| Student's Name: | | | | Reg. No. | | | |

# Objectives

**Note:** Each question carries ONE mark except question 4 which carries TWO marks. Choose only ONE correct option and make it bold on the same document. Selecting multiple options will result in zero marks.

1. A semaphore is a shared integer variable _____
   a) that can contain a negative value
   b) that is always greater or equal to 0
   c) that cannot drop below one
   d) that cannot be more than one

2. In bounded buffer, which of the statement is true
   i. Buffer is shared between producer and consumer
   ii. Empty is initialized to 0 and full is initialized to N
   iii. Buffer has the size N, each can hold at most one item
   iv. The mutex is used to provide mutual exclusion to the access of buffer and is initialized to 0
   v. The mutex is used to provide mutual exclusion to the access of buffer and is initialized to 1

   a) i, ii and iii
   b) ii, iii, iv
   c) i, iii, v
   d) ii, iii, v

3. All processes share a semaphore variable mutex, initialized to 1. Each process must execute wait(mutex) before entering the critical section and signal(mutex) afterward. Suppose a process executes in the following manner.
   *signal(mutex);*
   */* critical section*/*
   *wait(mutex);*

   a) a deadlock will occur
   b) processes will starve to enter critical section

c) several processes maybe executing in their critical section
d) All the above

4. In reader writer problem, multiple processes can acquire reader-writer lock concurrently in read mode, but only one process may acquire the lock for _____ as the exclusive access is required for _____.
   a) Reading, readers
   b) Writing, writers
   c) Reading, writers
   d) None

5. A computer has 9 instances of tape drive. Given the safe sequence below which of the following sequence will be a safe sequence.

| Processes | Allocation | Remaining Need |
|---|---|---|
| P1 | 2 | 5 |
| P2 | 1 | 5 |
| P3 | 2 | 3 |
| P4 | 1 | 6 |

a) P4, P1, P3, P2
b) P4, P2, P1, P3
c) P3, P4, P1, P2
d) P3, P1, P2, P4

6. Suppose we are using banker's algorithm for deadlock avoidance. There are 3 resource types A, B and C are available for 5 processes P0, P1, P2, P3 and P4. Currently the system is in safe state.

| Processes | Allocation | | | Remaining Need | | | Available | | |
|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | A | B | C | A | B | C |
| P0 | 0 | 1 | 0 | 7 | 4 | 3 | 2 | 3 | 0 |
| P1 | 3 | 0 | 2 | 0 | 2 | 0 | | | |
| P2 | 3 | 0 | 2 | 6 | 0 | 0 | | | |
| P3 | 2 | 1 | 1 | 0 | 1 | 1 | | | |
| P4 | 0 | 0 | 2 | 4 | 3 | 1 | | | |

If P4 requests (3,3,0) resources and P0 requests (0,2,0) resources then which one of the following is true.

a) Request for P4 cannot be granted.
b) Request for P0 can be granted.
c) Request for P0 cannot be granted because it leads to unsafe state.
d) Both A and C

7. Mutual exclusion must exist for:
a) A sharable resource
b) Non-sharable resource
c) Both A and B
d) None of the above

8. A computer uses 9 tape drives. There are four processes in the system for which the resource allocation and remaining need are given below:

| Processes | Allocation | Remaining Need |
|---|---|---|
| P1 | 3 | 6 |
| P2 | 1 | 5 |
| P3 | 3 | 2 |
| P4 | 0 | 10 |

Which of the following is true?

a) Safe, Deadlocked
b) Not Safe, Deadlock
c) Safe, Not Deadlocked
d) Not Safe, Not Deadlocked

9. Consider a system in which there are total 7 instances of resource type A, 5 instances of resource type B and 4 instances of resource type C. If 6 instances of resource type A ,2 instances of resource type B and 3 instances of resource type C are allocated to a process then how many resources of A, B and C are still available:
a) 7,5,2
b) 6,3,2
c) 1,3,3
d) None of the above

10. If there are 32 segments, each of size 1KB, then the logical address should have :
a) 13 bits
b) 14 bits
c) 15 bits
d) 16 bits

11. Consider the following segment table

| Segment | Base | Length |
|---|---|---|
| 0 | 219 | 600 |
| 1 | 1300 | 14 |

| | | |
|---|---|---|
| 2 | 90 | 100 |
| 3 | 1327 | 580 |

What is the physical addresses for the logical addresses (2, 100)?

a) 100
b) 190
c) 290
d) Trap

12. In a given memory system, addresses are 16-bits and the page size is 512 bytes. Using the page table below, determine the physical addresses for logical address 0101101011010111

| Page # | Frame # |
|---|---|
| 10101 | 11010 |
| 111000 | 100 |
| 101101 | 10101 |
| 10100 | 110010 |
| 100010 | 101111 |

a) 1000101011010111
b) 0010101011010111
c) 0111000011010111
d) trap

13. Assuming a 1-KB page size, what will be the page number and offset for address reference “3065” (provided as decimal number):
Options are pair of page no and offset
    a) (3, 65)
    b) (3, 065)
    c) (2, 1017)
    d) (2, 07)

14. In paged memory systems, if the page size is decreased, then the internal fragmentation generally

a) becomes less

b) becomes more

c) remains constant

d) None of these

15. _____ is the concept in which a process is copied into the main memory from the secondary memory according to the requirement.
    a) Paging
    b) Demand paging
    c) Segmentation
    d) Swapping

16. _____ is responsible for swapping pages in/out of/from main memory to virtual memory.
    a) Short term scheduler
    b) Long term scheduler
    c) Medium term scheduler
    d) CPU scheduler

17. Which algorithm chooses the page that has not been used for the longest period of time whenever the page required to be replaced?
    a) first in first out algorithm
    b) additional reference bit algorithm
    c) least recently used algorithm
    d) counting based page replacement algorithm

18. A process is thrashing if _____
    a) it is spending more time paging than executing
    b) it is spending less time paging than executing
    c) page fault occurs
    d) swapping can not take place

19. In the working set model, for:
    2 6 1 5 7 7 7 7 5 1 6 2 3 4 1 2 3 4 4 4 3 4 3 4 4 4 1 3 2 3
    if DELTA = 10, then the working set at time t1 (….7 5 1) is?
    a) {1, 2, 4, 5, 6}
    b) {2, 1, 6, 7, 3}
    c) {1, 6, 5, 7, 2}
    d) {1, 2, 3, 4, 5}

# Subjective

**Note**: Attempt ALL questions. Read the following statements carefully and give appropriate answers.

**Question 1:** Consider the set of 4 processes whose arrival time and burst time are given below- **(3 Marks)**

| Process Id | Arrival time | Burst time | Completion Time | Turn Around Time | Waiting Time |
|---|---|---|---|---|---|
| P1 | 0 | 9 | | | |
| P2 | 3 | 6 | | | |
| P3 | 8 | 5 | | | |
| P4 | 11 | 7 | | | |

If the CPU scheduling policy is Round Robin with time quantum = 4 unit, calculate the average waiting time and average turnaround time.

**Question 2:** The two processes, *P*0 and *P*1, share the two variables. Consider the algorithm below

**(3 Marks)**

```
boolean flag[2];
int turn = 0;

1.    do {
2.    flag[i] = true;
3.    while (flag[j])
4.    {
5.        if (turn == j)
6.        {
7.            flag[i] = false;
8.            while(turn == j)
9.                ;
10.           flag[i] = true;
11.       }
12.   }

      /* Enter Critical Section */
      /* Exit Critical Section */
13.   turn = j;
```

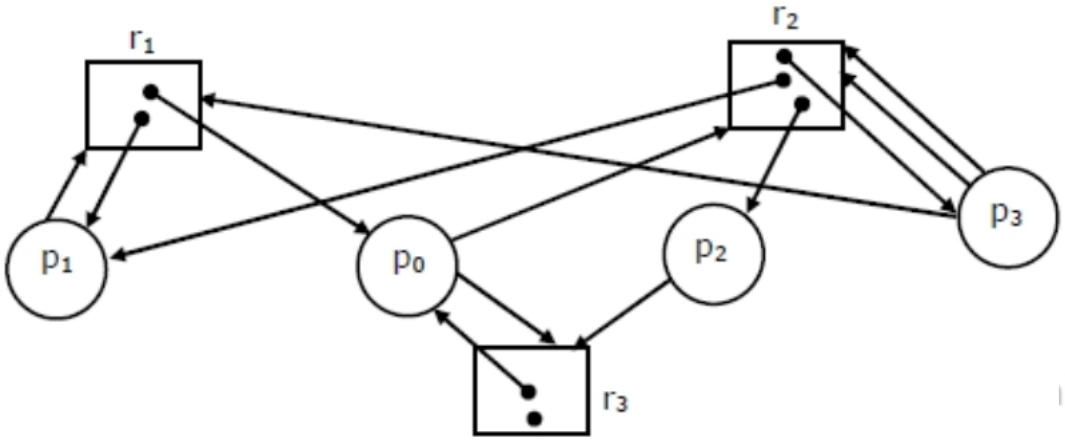
14. flag[i] = false;
15. } while (true);

*Note: Boolean flag is initialized to false*

a. State three condition that are required for synchronization.
b. Does these two processes satisfy all three conditions of synchronization. Discuss with respect to the given code.

**Question 3:** A shared variable **x** is initialized to **zero** and operated on by four concurrent processes **W, X, Y, Z** as given. Each of the processes **W and X** reads x from memory, **increments by one**, stores it to memory, and then terminates. Each of the processes **Y and Z** reads x from memory, **decrements by two**, stores it to memory, and then terminates. Each process before reading x invokes the P operation (i.e., wait) on a counting semaphore S and invokes the V operation (i.e., signal) on the semaphore S after storing x to memory. Semaphore S is initialized to **one**. What is the **maximum** possible value of x after all process complete execution? Explain how did you achieved that value?
*(Hint: Context switch will be occurring right after reading)* **(1+2 Marks)**

**Question 4:** Given the following resource allocation graph:
**(2+1)**




(a) Draw the wait for graph and find if the system is in a deadlock state?
(b) If the system is in safe state then find a safe sequence.

**Question 5**: Suppose there are three processes P0, P1 and P2 in the system and A, B and C are resource types. The current state of the system is shown in the following table:
**(3+1)**

| Processes | Maximum Need | Allocation | Available |
|---|---|---|---|

| | A | B | C | A | B | C | A | B | C |
|---|---|---|---|---|---|---|---|---|---|
| P0 | 4 | 1 | 2 | 1 | 0 | 2 | 2 | 2 | 0 |
| P1 | 1 | 5 | 1 | 0 | 3 | 1 | | | |
| P2 | 1 | 2 | 3 | 1 | 0 | 2 | | | |

(a) Using banker's algorithm calculate the contents of need and available matrix and also show whether the system is in safe state or unsafe state.
(b) If the Process P0 requests (2,3,0) resources will the request be immediately granted?

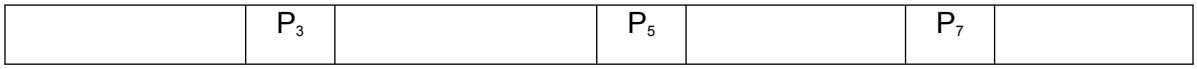
**Question 6:** Consider a demand-paged virtual memory system with a 24-bit logical address space, 8KB pages, and 8MB of main memory. **(3)**

a) When we split a logical address into a page number and offset within the page,

_____ bits of a logical address are used to determine the page number and
_____ bits of a logical address are used to determine the offset

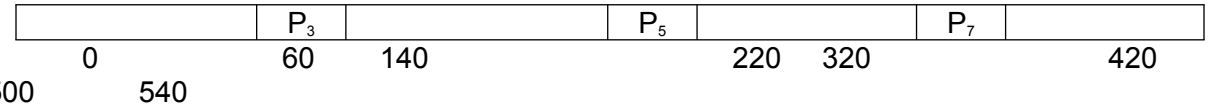
b) If the operating system reserves 1 MB (128 frames) of physical memory for kernel code, buffers, and so on, how many physical memory frames are left for demand paging?

**Question 7:** Consider a swapping system in which dynamic memory consists of 540K as shown below:

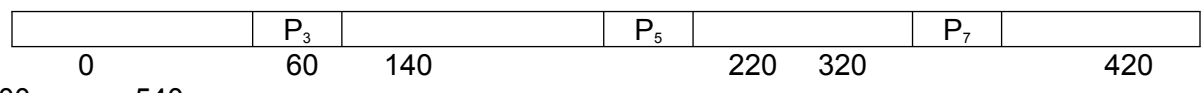



Note that the processes $P_3$, $P_5$, and $P_7$ are already in the memory. The new processes arrive in the order $P_8$, $P_9$, $P_{10}$, $P_{11}$ and are of size 70K, 50K, and 80K, 40K respectively. How would each of the first fit, best-fit, and worst-fit algorithms place processes of $P_8$, $P_9$, $P_{10}$, and $P_{11}$? If a process won't fit, write 'out of memory' in the appropriate slot. **(3)**

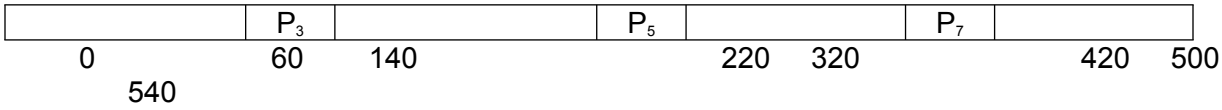
**First Fit**




**Best Fit**



**Worst Fit**




**Question 8:**
In a given memory system, addresses are 16-bits and the page size is 2048 Bytes. Using the page table below, determine the physical addresses for the following logical addresses. **(2)**

| Page # | Page Table Entry |
|---|---|
| 112 | 26 |
| 28 | 4 |
| 44 | 13 |
| 11 | 50 |
| 34 | 47 |

| | Logical Address | Physical Address |
|---|---|---|
| 1 | 01011101011010111 | 11001001011010111 |
| 2 | 11100000010110100 | 00010000010110100 |

**Question 9:** Read the following statements carefully and give appropriate answers. **(2+2+3)**

a) Diagrammatically depict the steps involved in handling a page fault. Assume there is a free frame available in main memory.
b) How does thrashing result in low CPU utilization?

c) Consider a reference string: 4, 7, 6, 1, 7, 6, 1, 2, 7, 2. the number of frames in the memory is 3. Find out the number of page faults respective to:
   1. FIFO Page Replacement Algorithm
   2. Optimal Page Replacement Algorithm

3. LRU Page Replacement Algorithm