BG/K/TY

Reg. No:

VIT
Vellore Institute of Technology

Final Assessment Test – November 2025

Course: BITE303L - Operating Systems

Class NBR(s): 3226/3233/3239 Slot: E1+TE1

Time: Three Hours Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

COs	CO Statements
CO1	Knowledge on Operating systems and its different subsystems in controlling computer hardware.
CO2	Apply principles of process management, CPU scheduling and deadlocks.
CO3	Design the process synchronization and Inter Process Communication.
CO4	Develop memory management schemes.
CO5	Design and manipulate file system.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions
(10 X 10 = 100 Marks)

1. a) Analyse how the distinction between kernel mode and user mode functions as a fundamental mechanism for ensuring protection and security in an operating system. [3] CO1 BL2

   b) The services and functions provided by an operating system can be divided into two main categories. Briefly describe the two categories, and discuss how they differ [7]

2. a) Analyse the sequence of actions performed by the kernel during a context switch between processes. [3] CO3 BL2

   b) In an Inter-Process Communication (IPC) mechanism where both direct and indirect communication methods are used, assume that Process P intends to send a message to Process Q. [7]

   Answer the following:

   i) Explain how communication is established between the two processes and message transfer takes place between the processes under each method.

   ii) Identify and discuss the important properties of the communication link in both methods

3. You are part of an operating system design team developing a multithreaded web server that must handle multiple client requests concurrently. During implementation, the team faces several challenges such as improper signal handling, inconsistent data access, and difficulties in managing thread termination. Analyse the different threading issues that can arise in this multithreaded environment. Evaluate how each issue can affect system reliability and performance, and propose suitable design strategies to handle them effectively. CO2 BL4

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receive data items from shared buffer and uses them. All the processes communicate using a shared buffer of maximum size, N.

producer:	consumer:
P(X);	P(Y);
P(Z);	P(Z);
Put item into shared buffer;	Remove item from shared buffer;
V(Z);	V(Z);
V(Y);	V(X);

(i). What are the initial values of the three semaphores for correct execution and maximum performance?

(ii). Explain the function of each semaphore.

(iii). In the implementation of a P() operation, some processors continuously execute an atomic instruction (spinlock) instead of blocking the process. Provide the advantages and disadvantages of this spinlock implementation.

OR

6.(b) i) Race conditions are possible in many computer systems. Consider a banking system that maintains an account balance with two functions: deposit(amount) and withdraw(amount). These two functions are passed the amount that is to be deposited or withdrawn from the bank account balance. Assume that a husband and wife share a bank account. Concurrently, the husband calls the withdraw() function, and the wife calls deposit(). Describe how a race condition is possible and what might be done to prevent the race condition from occurring. [5] CO3 BL3

ii) Consider two concurrently running processes: P_1 and P_2. The process P_1 and P_2 are contain following statements: [5]

1) **Process P_1:**
   i) Statement X1;
   ii) Statement X2;
   iii) Statement X3;
2) **Process P_2:**
   i) Statement Y1;
   ii) Statement Y2;
   iii) Statement Y3;

Suppose we require that Statement Y2 of Process P_2 be executed only after Statement X2 of Process P_1 has completed. Apply the semaphore to solve this synchronization problem.

7. A computer has **2500 KB** of main memory. The processes arrive and terminate in the following sequence: CO4 BL3

- Process 1, requiring **100 KB**, arrives.
- Process 2, requiring **150 KB**, arrives.
- Process 3, requiring **500 KB**, arrives.
- Process 4, requiring **250 KB**, arrives.
- Process 5, requiring **200 KB**, arrives.
- Process 6, requiring **100 KB**, arrives.
- Process 7, requiring **300 KB**, arrives.
- Process 8, requiring **300 KB**, arrives.

Then the following processes terminate (in order): Process 1, Process 3, Process 5, Process 7.

Allocate and deallocate memory space for the above processes and identify the resulting memory holes. Apply the First-Fit, Best-Fit, and Worst-Fit algorithms, and illustrate how each algorithm would place these incoming processes in this order: **210 KB, 410 KB, 110 KB, 100 KB, 420 KB**. Identify which algorithm makes the most efficient use of memory.

8. a) Consider the following segment table: [5] CO4 BL4

Segment	Length	Base
0	200	1450
1	1200	3445
2	1225	5600
3	800	250
4	750	7250

Determine the physical addresses for the following logical addresses.

i) 4, 500
ii) 2, 1500
iii) 0, 185
iv) 1, 1110
v) 3, 687

b) Differentiate between [5]

i) Paging and segmentation.
ii) Internal and External Fragmentation.

9. Suppose that a disk drive has 5000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order, is: CO4 BL4

86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130.

Apply each of the following disk scheduling algorithms to determine the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests starting from the current head position.

i) FCFS
ii) SSTF
iii) SCAN
iv) LOOK

10.a) Explain the following memory allocation methods with suitable example. CO5 BL2

i) Linked Allocation.
ii) Indexed Allocation.

OR

10.b) Illustrate various types of file directory structure with relevant diagram. CO5 BL2

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