| 1 | a) | Define deadlock. Explain the **four necessary conditions** for a deadlock to occur. Give an example. |  |
| --- | --- | --- | --- |
|  | b) | Consider the following system with 3 processes (P1, P2, P3) and 3 resource types (A, B, C).   * Total resources: A=10, B=5, C=7 * Allocation and Maximum matrices are given:  | Process | Allocation (A,B,C) | Max(A,B,C) | | --- | --- | --- | | P1 | (0,1,0) | (7,5,3) | | P2 | (2,0,0) | (3,2,2) | | P3 | (3,0,2) | (9,0,2) |   (i) Compute the **Need matrix**.  (ii) Use **Banker’s Algorithm** to determine if the system is in a **safe state**. Show the sequence (if any). |  |
|  | c) | A system has two types of resources: Printers (5) and Plotters (3).   * P1 holds 2 printers, P2 holds 2 printers + 1 plotter, P3 holds 1 plotter. * P1 requests 1 printer, P2 requests 1 plotter, P3 requests 1 printer.  Determine whether the system can enter a deadlock. Justify with the **deadlock conditions**. |  |
| 2 | a) | A process of size 212 KB needs to be allocated in memory. Free partitions are of sizes: 100 KB, 500 KB, 200 KB, 300 KB, and 600 KB.   * Show allocations using **First Fit, Best Fit, and Worst Fit**. * Which allocation leaves the **least external fragmentation**? |  |
|  | b) | Explain the difference between **internal** and **external fragmentation** with suitable diagrams. |  |
|  | c) | Explain the difference between **internal** and **external fragmentation** with suitable diagrams. |  |
|  | d) | A process generates the following **logical addresses**: 212, 417, 1023, 2999. If the base register = 1000, find the corresponding **physical addresses**. |  |
| 3 | a) | Explain **paging** in memory management. What problem does it solve compared to continuous allocation? |  |
|  | b) | A system uses paging with:   * Logical Address = 12 bits * Page Size = 256 bytes  (i) Find the **number of pages** in the logical address space.  (ii) If the physical memory is 4 KB, how many frames are available? |  |
|  | c) | Give an example of how logical address is converted to physical address by MMU |  |
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| 4 | a) | A system uses **3 frames**. The following reference string is given:  7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2  (i) Show the step-by-step page replacement using **FIFO**.  (ii) How many **page faults** occur?  (iii) Calculate hit rates and fault ratio |  |
|  | b) | A system uses **4 frames**. The following reference string is given:  1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5  (i) Show the step-by-step page replacement using **LRU**.  (ii) How many **page faults** occur?  (iii) Calculate hit rates and fault ratio |  |
|  | c) | A system uses **3 frames**. The following reference string is given:  2, 3, 2, 1, 5, 2, 4, 5, 3, 2, 5, 2  (i) Show the step-by-step page replacement using **MRU**.  (ii) How many **page faults** occur?  (iii) Calculate hit rates and fault ratio |  |
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