B.Tech Third Year 6th Semester Examination
Department of Computer Science and Engineering
Course Name: Operating System Code: CS 341
Full Marks-100 Time: 3 hours

1. Write the differences between segmentation and paging, and explain with figures. What is external fragmentation? What are the remedies for external fragmentation? Define internal fragmentation. 3+2+2+1

2. Write short notes on the following: 6x4

   a. File allocation policies, b. Directory structures, c. Belady's anomaly, d. Memory-mapped I/O, e. Global and Local page replacement algorithms, f. Thrashing

3. Consider a process executing on an operating system that uses demand paging. The average time for memory access in the system is M units if the corresponding memory page is available in memory, and D units if the memory access causes a page fault. It has been experimentally measured that the average time taken for memory access in the process is X units. What will be the correct expression for the page fault rate experienced by the process? 3

4. Consider a computer system with 40-bit virtual addressing and page size of sixteen kilobytes. If the computer system has a one-level page table per process and each page table entry requires 48 bits, then what will be the size of the per-process page table? (answer in megabytes) 3

5. Assume that for a certain processor, a read request takes 50 nanoseconds on a cache miss and 5 nanoseconds on a cache hit. Suppose while running a program, it was observed that 80% of the processor's read requests result in a cache hit. Find the average read access time in nanoseconds. 4

6. Suppose a disk has 201 cylinders, numbered from 0 to 200. At some time the disk arm is at cylinder 100, and there is a queue of disk access requests for cylinders 30, 85, 90, 100, 105, 110, 135, and 145. If Shortest-Seek Time First (SSTF) is being used for scheduling the disk access, the request for cylinder 90 is serviced after servicing how many requests? 5

7. Consider the following page reference string : 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6. Calculate the number of page faults related to LRU, FIFO, and optimal page replacement algorithms, respectively, assuming 05-page frames and all frames are initially empty. 6

8. A file system with a 300 GByte disk uses a file descriptor with 8 direct block addresses, 1 indirect block address and 1 doubly indirect block address. The size of each disk block is 128 Bytes and the size of each disk block address is 8 Bytes. What will be the maximum possible file size in this file system? 5

9. What is the swap space in the disk used for? What is the usage of dirty bit in the page table? 2+2

10. Consider a program P that consists of two source modules M1 and M2 contained in two different files. If M1 contains a reference to a function defined in M2, the reference will be resolved at (a) Edit time (b) Compile time (c) Link time (d) Load time? (pick the write option) Please explain your answer. 3

11. Consider the two-dimensional array A: Int A[][]=new int[100][100]; 7
where A[0][0] is stored at location 200, in a paged memory system with pages of size 200. A small process resides in page 0 (locations 0 to 199) for manipulating the A matrix; thus, every instruction fetch will be from page 0. With three page frames, how many page faults are generated by the following array initialization loops, using LRU replacement, and assuming page frame 1 has the process in it, and the other two are initially empty:

A. For (int j=0;j<100;j++)
For(i=0;i<100;i++)
A[i][j]=0;

B. For (int i=0;i<100;i++)
For(int j=0;j< 100;j++)
A[i][j]=0;

12. What are the steps in handling an interrupt (Explain with a figure)? Explain the steps of direct memory access. 5+3
13. What is an Access matrix? Write different ways of implementing access matrix. 2+5

14. Consider a computer system with ten physical page frames. The system is provided with an access sequence (a1, a2, a3, a4, a5, a6, a7,..... a20,a1,a2,a3,a4,a5,a7,....a20) where each ai is a distinct virtual page number. Calculate the difference in the number of page faults between the last-in-first-out page replacement policy and the optimal page replacement policy. 6
15. A FAT (file allocation table) based file system is being used and the total overhead of each entry in the FAT is 4 bytes in size. Given a 100 x 106 bytes disk on which the file system is stored and data block size is 10^3 bytes, calculate the maximum size of a file that can be stored on this disk in units of 10^6 bytes. 7