National University of Computer and Emerging Sciences, Lahore Campus				
	Course:	**Operating Systems**	**Course Code:**	**CS2006**
	Program:	**BSCS, BSSE, BSDS**	**Semester:**	5th
	Section:	**5A,5B**	**Total Marks:**	**30**
	Submission deadline:	**14-12-2023**	**Weight**	3.3
	Assignment:3		**Page(s):**	3
	Instruction/Notes:	1. Understanding of the problems is part of the assignments. So, no query please. 2. You will get Zero marks if found any type of cheating. 3. 25 % deduction of over marks on the one-day late submission after due date 4. No submission after two days. 5. MUST BE HANDWRITTEN.		

Q:1- Consider a system with a 6-bit virtual address space, and 16-byte pages/frames. The mapping from virtual page numbers to physical frame numbers of a process is (0,8), (1,3), (2,11), and (3,1). Translate the following virtual addresses to physical addresses. Note that all addresses are in decimal. You may write your answer in decimal AND binary. **[marks:5]**

(a) 17

(b) 35

Q:2- Consider a 64-bit system running an OS that uses hierarchical page tables to manage virtual memory. Assume that logical and physical pages are of size 4KB andeach page table entry is 4 bytes in size. **[marks:5]**

(a) What is the maximum number of levels in the page table of a process, including both the outermost page directory and the innermost page tables?

(b) Indicate which bits of the virtual address are used to index into each of the levels of the page table.

Q:3-Consider a process with 4 logical pages, numbered 0–3. The page table of the process consists of the following logical page number to physical frame number mappings: (0, 11), (1, 35), (2, 3), (3, 1). The process runs on a system with 16-bit virtual addresses and a page size of 256 bytes. Answer the following questions, showing suitablecalculations. **[marks:5]**

(a) Show Logical address format and page table entries in term of binary number system for the above given frame numbers.

(b) Which logical page number and offset number does this virtual address correspond to and

(c) Which physical address does these virtual addresses translate to?

if process access virtual addresses are: 772 and 456? (Showing suitable calculations in binary and Decimal numbers).

Q:4- In a paging system, the logical address is formed of 20 bits. The most significant 8bits denote the page number, the least significant 12 bits denote the offset. Memory sizeis 256K bits. **[marks:10]**

a. What is the page size (in bits)?

b. What is the maximum number of pages per process?

c. How many frames does this system have?

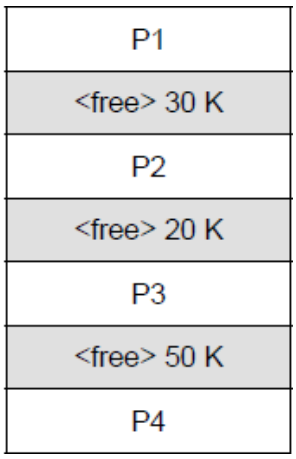
d. Give the structure of the page table of a process executing in this system. Assume 2 bits are reserved for attributes.

e. How many bits are required for each page table entry?

f. If physical memory is upgraded to 1024 K bits, how will your answer to c and e change?

Q:5- **[marks:5]**

Step	event	required contiguous memory size (K)
i)	process 5 arrives	16
ii)	process 6 arrives	40
iii)	process 7 arrives	20
iv)	process 8 arrives	14
v)	process 5 leaves	-
vi)	process 9 arrives	30



Given above the memory map in the figure, where areas not shaded indicate free regions, assume that the following events occur:

a. Draw the memory maps after step (iv) and (vi) using first fit, best-fit and worst-fit allocation techniques, without compaction.

b. Draw the same memory maps as in part (a) if compaction is performed whenever required. Also show the maps after each compaction.