1998 Paper 4 Question 7

Operating System Functions

What is a *translation lookaside buffer* (TLB)? Describe its operation with the aid of a diagram. How is the TLB affected by processor context switches for (*i*) threads and (*ii*) processes? [10 marks]

A process has four page frames allocated to it. (All of the following numbers are decimal, and all numbers start from zero.) The time of the last loading of a page into each page frame, the time of last access to the page, the virtual page number in each frame and the Referenced (R) and Modified (M) bits for each page frame are shown in the table below. Times are in clock ticks from the process start time at time 0.

Virtual Page #	Frame #	Time Loaded	Time Referenced	M	R
2	0	60	161	0	1
1	1	130	160	0	0
0	2	26	162	1	0
3	3	20	163	1	1

A page fault to virtual page 4 has occurred. Which page frame will have its contents replaced under each of the following replacement algorithms? Briefly explain why in each case.

(*a*) FIFO

(*b*) LRU

(*c*) Second Chance (Clock)

(*d*) Enhanced Second Chance

[6 marks]

Given the above state of memory before the fault, and the reference string of virtual page numbers: (4, 0, 0, 0, 2, 4, 2, 1, 0, 3, 2), calculate how many page faults would occur under the LRU policy if a working set with a window size of 4 were used instead of a fixed allocation of 4 frames. Show clearly when each page fault would occur. [4 marks]