DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

PhD Qualifier Examination, Paper II

Total time: 2 Hours **March 18, 2010** **Maximum Marks: 120**

Answer from ALL the three parts

Part A: Computer Organisation and Architecture

Answer FOUR questions in this part

A.1 Illustrate the working of Booth's multiplication algorithm for multiplying -5 and -13. 10

A.2 Answer the following with respect to floating point addition:

i) Represent 1024.25 in IEEE 754 format 6

ii) Give an example to show that floating point addition is not associative for a finite precision representation of floating point numbers. 4

A.3 The `HLT` instruction of a CPU is for suspending instruction execution and waiting for an interrupt. List the logical steps (micro instructions) that need to be carried out to implement it. 10

A.4 Depict the steps followed to resolve a logical address to a physical address in a virtual memory environment. How will the scheme cope with context switching (whereby a different process is made to execute)? 7+3

A.5 Answer the following:

i) Explain the process of interrupt handling. 5

ii) Compare the following two modes of DMA transfer: (*i*) cycle stealing DMA (*ii*) burst mode DMA. 3+2

Part B: Operating Systems

Answer ALL questions in this part

B.1 There are five concurrent processes A, B, C, D and E, with the first three trying to add 50 to a shared variable M, while the last two trying to subtract 75 from M. Assume that the initial value of M is 0 and memory add and subtract operations are non-atomic. Is it possible that after all five processes have executed, the final value of M is 75? If yes, show an execution sequence that will result in the final value being 75. If not, justify why. Give a solution that will ensure that the final value is always zero. 7+3

B.2 Consider the following page trace of memory accesses in a demand paging system with three page frames: $2, 3, 1, 5, 2, 3, 4, 1, 2, 3, 4, 5, 1, 2, 3$. Determine the number of page faults if the Least Recently Used (LRU) algorithm is used for page replacement. 10

B.3 In a multiuser operating system, a user program must not be allowed to access the memory locations corresponding to other user programs. How is such memory protection ensured in the following memory management schemes: (*a*) Single contiguous allocation (*b*) Paging? 5+5

B.4 i) N processes share M resource units that can be reserved and released only one at a time. Each process needs a maximum of two units. Show that a deadlock cannot occur in the system. 3

ii) Draw the process state transition diagram of a typical multiuser operating system, which includes the swapped out states (in disk). 7

Part C: Programming

Answer ALL questions in this part

C.1 Write code for the following in 'C'. Where functions are to be written, ensure that the function prototype matches the requirements expressed in the problem statement.

i) type definition to represent a node of a binary search tree (BST) 4

ii) a function to check whether a given element is present in a given BST 4

iii) a function to sort the elements in a given BST 6

iv) a function to insert a given key in a given BST 8

C.2 Write code for the following in 'C'. Where functions are to be written, ensure that the function prototype matches the requirements expressed in the problem statement.

i) type definition to (approximately) represent a point in 2-D real space 2

ii) type definition to represent a circle in 2-D real space 2

iii) a function to return the points of intersection of two given circles if they intersect; return value must indicate how the circles intersect (whether they do not intersect, etc.) 10+4