

國立臺灣科技大學 109 學年度碩士班招生試題

系所組別：資訊工程系碩士班

科目：資訊工程概論

(總分為 100 分)

1. Give the infix form of the following postfix expression? (Include parentheses as needed please.) (4%)
 $AB + CD + EF - * /$
2. A binary tree has a total of 45 nodes. Answer the following questions please.
 - (a) What is the minimum possible height of the tree? (Assume that the height of a binary tree with one node is one.) (2%)
 - (b) Assume that we use linked representation for each node in the tree with two links pointing respectively to the left child and the right child of the node. How many links in the 45 nodes of the tree are set to NULL? (3%)
3. A binary tree has a total of 24 nodes, among which 10 are nodes of degree 2. How many nodes of degree one are there in the binary tree? (7%)
4. There are 11 elements (or nodes) in a binary search tree (*BST*). The integer keys of the elements are 4, 28, 31, 7, 10, 25, 1, 16, 19, 13, 22 (the order is irrelevant). Assume that the left subtree and the right subtree of the root in the *BST* are both complete binary trees with 3 elements and 7 elements, respectively.
 - (a) What is the key of the root in the *BST*? (4%)
 - (b) Draw the entire *BST*. (5%)
5. Assume that L_1 and L_2 are both nonempty circular lists with access pointers pointing to the last nodes of the lists. Let m and n represent the lengths of L_1 and L_2 , respectively. If we concatenate these two circular lists, what is the time complexity of the concatenation operation (in terms of m and n using $O(\)$ notation)? (4%)
6. An array contains a list of n items whose keys are distinct and happen to be in ascending order already. Unaware of this fact, we want to sort the list into ascending order. For each of the following sorting methods, give the corresponding time complexity (in terms of n using $O(\)$ notation) of the sorting operation.
 - (a) Insertion Sort (3%)
 - (b) Quick Sort (3%)



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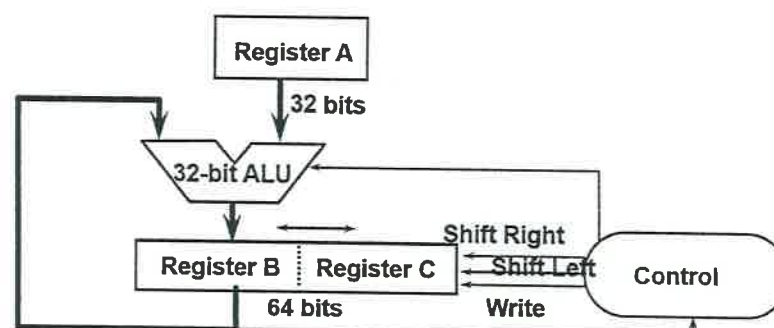
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7. Assume that base CPI of an ideal processor is 1.0 if all memory accesses hit in the L1 cache. The clock frequency of the processor is 4 GHz and the miss penalty is 100 ns (including cache handling time and main memory access time). Suppose the actual miss rate of the L1 cache to main memory is 2.5%.
- (a) What is the actual CPI of the processor? (2%)
- (b) How is the performance improvement if we add an L2 cache which has 10 ns access time and 0.5% miss rate to main memory? (4%)
8. Given the control codes of the ALU. Please design a 1-bit ALU by using the following logic gates: AND, OR, NOT, MUX, and 1-bit full adder. (8%)

ALU Control	ALU Function
0000	Logic AND of input A and input B
0001	Logic OR of input A and input B
0010	Arithmetic addition of input A and input B
0110	Arithmetic subtraction of input A and input B
1100	Logic NOR of input A and input B
1101	Logic NAND of input A and input B

9. Consider a virtual memory system with 36-bit virtual byte address, 16KB page size, and 34-bit physical address. Suppose there are extra 10 bits for each page table entry (valid, dirty, replacement bits, and so on).
- (a) How many page table entries in this virtual memory system? (3%)
- (b) What is the **total size** of the page table in terms of bits? (3%)
10. Hardware for combined multiplication and division is drawn below. Please specify the corresponding operand register and shift direction.
- (a) Multiplicand (2%)
- (b) Multiplier (2%)
- (c) Dividend (2%)
- (d) Remainder (2%)
- (e) Quotient (2%)



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11. Consider the following set of processes, with the length of the CPU burst time given in milliseconds:

Process	Burst time	Priority
P_1	2	2
P_2	10	1
P_3	2	3
P_4	4	4

The processes are assumed to have arrived in the order P_1, P_2, P_3, P_4 , all at time 0.

- (a) Draw 4 Gantt charts to illustrate the execution of these processes using the following scheduling algorithms: FCFS, SJF, RR (quantum=1), non-preemptive priority. (4%)
- (b) What is the turnaround time of each process when using the scheduling algorithms in part (a)? (8%)
- (c) What is the waiting time of each process when using the scheduling algorithms in part (a)? (8%)
12. Given a string of page references: 5, 6, 1, 2, 6, 3, 6, 4, 2, 3, 6, 3, 2, 1, 2.
If the working set consists of three page frames and it is empty now, please write down the total number of page faults for the given string of page references when the following page replacement algorithm is used. Explain your answer to receive full credit.
- (a) FIFO (5%)
- (b) LRU (5%)
- (c) Optimal (5%)

