ENEE 350
TEST 1-Spring 2005
CLOSED BOOK AND NOTES
EXAM PERIOD 75 MINUTES

Instructions:

- Points for each problem are indicated right after the problem. The total score is 100 points.
- Use the space provided below each problem. if you need more space, please ask a proctor.
- Write your name and student id on the cover sheet.
- Promptly hand in your test to a proctor when the test is over.

NAME:

STUDENT ID:

Problem 1 (20 points): Consider the following vesp program. Specify the values in memory locations 0, 1, and 10 after the execution of the program is completed, and explain why.

```
100     LDA   0, 50;
102     LDA   1,-15;
104     ADD;
105     MOV   10,0;
107     JPS   104;
108     HLT;
```

Note: All addresses and operand values are expressed in decimal.

Problem 2 (20 points):

The computation engine of a given processor executes four logic instructions on a pair of 4-bit operands,

A =[a_0,a_1,a_2,a_3]

B =[b_0,b_1,b_2,b_3]

whose instruction format is given below:

Instruction	Op-code	Operation
Copy B	00	A = B
Complement A	01	A = ~A
Left shift A	10	A = A << 1
Right shift A	11	A = A >> 1

Design a combinational circuit that can carry out these four instructions in the computation engine of this processor. (*Note: You are only required to describe a combinational circuit that performs these logic instructions, not the entire computation engine of the processor.*)

Problem 3 (20 points): Consider the following expression

a *(4+ b *(8+ c *(16 + d*(e + f))))

(a) Draw a binary tree that represents this expression

(b) Show a post-order expression that is equivalent to this expression

(c) Show a pre-order expression that is equivalent to this expression

(d) Write a CodeMill stack program for the pre-order expression you obtained in part (c)

(e) Clearly show the first 5 frames of CodeMill's stack during the execution of your program assuming that the stack pointer is initially set to the floor of the stack.

Problem 4 (20 points): The following code describes the instruction sequencer of a central processor unit. Give a control circuit that implements this instruction sequencer, clearly indicating the events that occur in each state.

```
while(reset == 0)
{
Step 1: X = Y; Y =  Y +4;
Step 2: U = MEMORY[X];
Step 3: switch(U[0:2])
{
case 0: A = A +1;  break; case 1: A = A - 1; break;
case 2: A = A + B; break; case 3: A = A - B; break;
case 4: A = 2A;    break; case 5: A = A/2;   break;
case 6: A = 0;     break; case 7: A = 1;     break;
}
}
```

Problem 5 (20 points): Write a vesp program to sort the numbers in memory locations 120,121,122 in ascending order. For example, if the numbers in locations 120, 121, and 122 are 4, -2 17, after sorting, they will be -2, 4, 17.