1. (10%) Answer the following questions:
   (a) Is A5h a valid hexadecimal constant?
   (b) In real-address mode, convert the following segment-offset address to a linear address: 0CD1:02E0.
   (c) Declare an uninitialized array of 50 unsigned doublewords name dArray.
   (d) Write a constant expression that divides 10 by 3 and returns the integer remainder.
   (e) The CALL instruction pushed the offset of the CALL instruction on the stack.

2. (6%) What is the 8-bit binary and hexadecimal representations of the following signed decimal integers?
   a. -8
   b. -47

3. (6%) (a) What is -4.6E+15 in hexadecimal? (b) What does 420F0000 represent when interpreted as a real number?

4. (8%) (a) What is the truth table for the Boolean function XOR? (b) Implement XOR function with only logic gates AND, OR and NOT. (c) Use only NAND gates to implement XOR function.

5. (5%) Given a 8-bit register \( R_7 R_6 \cdots R_0 \), what are the boolean expressions for the Sign, Zero and Parity flags as defined in IA-32.
6. (10%) Convert the following assembly code into machine code as we did in the class. Draw the memory layout and the content after the program is loaded. Write down contents of the registers PC, IR, ACC, B and FLAG(NGEL) after executing each instruction.

```
.DATA
CTR   004
TWO  002
.CODE
   LDA  CTR
   L1   SUB  TWO
   JN    END
   JMP  L1
   END  HLT
```

7. (10%) Assume that the address of arrayA is 0, what is the content of the memory? Specify it as a byte string and represent each byte in hexadecimal. What is the value of size?

```
arrayA BYTE 10h, 20h, 30h, 40h
arrayB WORD 1234h, 5678h
size = ($ - arrayA)
stringA BYTE "Asm"
```

8. (5%) What is the result for the following example?

```
MOV EAX, 0
MOV ECX, 10
L1: MOV EAX, 3
    MOV ECX, 5
L2: ADD EAX, 5
    LOOP L2
    LOOP L1
```

9. (15%) Write an MASM program to calculate and print the first seven values in the Fibonacci number sequence. The Fibonacci sequence $F(i)$ is defined as $F(1) = 1, F(2) = 1, F(n) = F(n-1) + F(n-2)$ for $n \geq 3$. Your program should print a number per line.

10. (15%) Write a complete MASM procedure to convert the given string into a palindrome. A palindrome is a string which has the property of reading the same in either direction, for example, abccba. The input string is given at ESI and the length of characters of the string is specified by ECX. The output should be placed at the same array as the input. Note that your procedure should avoid possible side effects.

11. (10%) Design a binary multiplier that multiplies two 4-bit numbers.