Midterm Exam

(February 16th @ 7:30 pm)

Presentation and clarity are very important! Show your procedure!

PROBLEM 1 (20 PTS)

- Compute the result of the following operations. The operands are signed fixed-point numbers. The result must be a signed fixed-point number. For the division, use $x = 5$ fractional bits.

1.0111 + 1.101001	1.010101 − 1000.0101	01.11111 + 0.10001
10.101 × 1.01101	0.111 × 1.0101	10.101 ÷ 0.101

PROBLEM 2 (10 PTS)

- Represent these numbers in Fixed Point Arithmetic (signed numbers). Use the FX format [12 4].
  - ✓ -16.125
  - ✓ 19.25

- Complete the table for the following fixed point formats (signed numbers): (6 pts.)

Integer bits	Fractional Bits	FX Format	Range	Resolution
8	6			
6	4			

PROBLEM 3 (40 PTS)

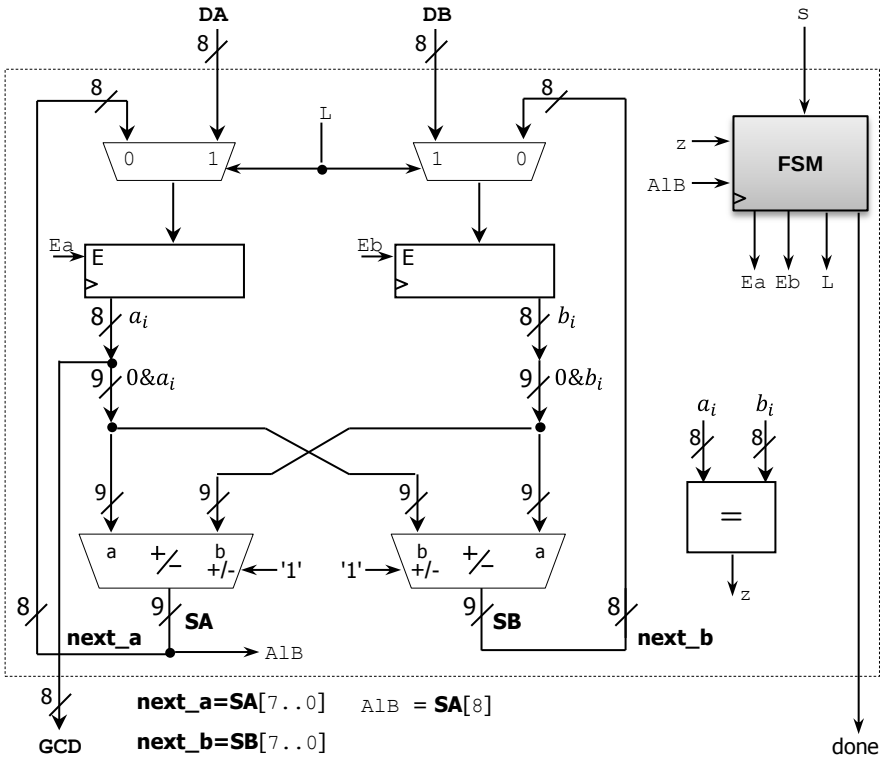
- Perform the following 32-bit floating point operations. For fixed-point division, use 4 fractional bits. Truncate the result when required. Show your work: how you got the significand and the biased exponent bits of the result. Provide the 32-bit result.

✓ 40D00000 + C2EA0000	✓ 50A90000 − 4F480000	✓ 80200000 × 7AB80000	✓ FB380000 ÷ 48C00000

PROBLEM 4 (30 PTS)

- **Greatest Common Divisor** (GCD): This circuit computes the GCD of two n-bit unsigned numbers (A, B). For example:
  - ✓ A = 216, B = 192 → GCD = 24.
  - ✓ A = 132, B = 72 → GCD = 12.
  - ✓ A = 169, B = 63 → GCD = 1.

- The digital system is depicted below (FSM + Datapath) for $n = 8$. This iterative circuit is based on Euclid's GCD algorithm.
  - ✓ Input Data: DA, DB Output data: GCD



- ✓ z=1 when $a_i = b_i$, else z=0.

Sequential Algorithm

```
a,b: unsigned integers
while a ≠ b
    if a > b
        a ← a-b
    else
        b ← b-a
    end
end while
return a
```

- Sketch the Finite State Machine diagram (in ASM form) given the sequential algorithm (for $n = 8$). (18 pts.)
  - ✓ The process begins when s is asserted, at this moment we capture DA and DB on register a_i and b_i (respectively). Then the process continues by updating a_i and b_i and it is concluded when $a_i = b_i$. The signal done is asserted when the result is computed and appears on output GCD.

- Complete the timing diagram where $n = 8$. DA and DB are provided as unsigned decimals. You can provide a_i and b_i as unsigned decimals. (12 pts.)