Topics for mid-term exam: You will have 6 questions covering these topics: closed book

Topic	Section	material
Number system	1.1-1.6, Hwk1	Radix conversion; 2's complement & signed arithmetic
Boolean algebra	2.4-2.8, Hwk2	Sum of products; Simplify the function to minimum number of literals
Complete problem statement to gate implementation	Hwk4	Implementation of logic expression using NAND gates
Karnaugh maps	3.2-3.6 Up to p.94 Hwk3	3 and 4 variable maps, don't cares (x's)
MSI circuits; Combinational circuit building blocks	4.1-4.3; 4.9, 4.11; Hwk5	Multiplexers and decoders: block diagram; implementation of combinational circuits using MUX and Decoders

Sample questions:

1. (4 X 5 = 20 points) Number system and Radix Conversion

For the numbers given below convert the radix as specified.

a. 1234 decimal to binary $(1234)_{10} \rightarrow (\ ?\ )_2$
b. 1011.11 to decimal $(1011.11)_2 \rightarrow (\ ?\ )_{10}$
c. 1011.11 to octal $(1011.11)_2 \rightarrow (\ ?\ )_8$
d. 1011.11 to hexadecimal $(1011.11)_2 \rightarrow (\ ?\ )_{16}$

2. (20 points) Boolean Algebraic Simplification

Simplify using only Boolean algebraic laws and theorems. Clearly show all the intermediate steps. Provide the result in sum of products form.

F(A, B, C) = A.B.C + A'.B.C + A'.B.C' + A.B'.C + A.C'

3. (4+ 2 + 9 + 5 = 20 points) Word Problem to Gate implementation

Consider a 4-input (**W, X, Y, Z**) and 1-output function that has logic-1 output whenever the majority of the inputs are logic-0.

a. Draw the truth table representing this function.
b. Express the function in sum of minterms format.
c. Simply the expression from above using algebraic simplification method.
d. Draw the combinational circuit for the simplified expression.

4. (10 + 10 = 20 points) NAND only implementations

Draw **the NAND only** implementations for the Boolean expression given below:

F (A,B, C, D) = A.B + B'.C'+ B.(C'+D)

5. (20 points) Signed Binary Arithmetic

Consider 8-bit binary containers with 1 bit for sign and 7 bits for magnitude. Consider numbers A = 65 and B= 72. Assume negative numbers are represented as 2's complement and the operations are in 2's complement. Perform the operations below in binary. **Specify if the result is positive, negative or overflow and explain your answer.**

a. X = A + B
b. Y = A – B
c. Z = –A –B
d. W = –A + B

6. (20 points) MSI Circuits

Obtain a 4X16 decoder using 2 3X8 decoders. Implement $\sum(2,5,6,8,11)$ using (i) 4X16 decoder and (ii) 16X1 MUX.