CENG 244 Introduction to Digital Systems

Final Exam Topics & Notes

Topics and potential questions that you can expect on the final exam include:

Chapter 1

1) Positional number systems- how to convert numbers (both integer and fractional) from one system to another (e.g., binary, octal, decimal, duodecimal, & hexadecimal).
2) Expressing binary integers in octal & hexadecimal.
3) Binary arithmetic
4) Diminished radix complement (e.g., 9s complement, 1s complement)
5) Radix complement (e.g., 10s complement, 2s complement).
6) Subtraction with complements
7) Signed binary numbers- signed-magnitude, signed 1s-complement, and signed 2s-complement representations
8) Binary addition and subtraction using signed 2s-complement representation.
9) Binary Coded Decimal (BCD) and BCD addition.

Chapter 2

1) Truth Tables for Boolean functions
2) Simplification of Boolean expressions using Boolean algebra postulates and theorems. Operator precedence for Boolean algebra.
3) Find complement of a Boolean function.
4) Derive canonical Sum-of-Minterms or Product-of-Maxterms expressions for a Boolean function from a Truth Table or by using Boolean algebra. Be able to put in shorthand forms.
5) Put Boolean functions in standard Sum-of-Products or Product-of-Sums forms using Boolean algebra.
6) Understand fundamental Boolean operations (NOT, AND, OR, NAND, NOR, XOR, and XNOR).
7) Wiring and functionality of logic circuits, e.g., draw logic circuit/wiring diagram to implement given Boolean function or get Boolean function from given logic circuit/wiring diagram/wiring (similar to work in labs 1-3). Any required IC schematics will be given.

Chapter 3 Gate-Level Minimization

1) Know how to make Karnaugh Maps (AKA: K-Maps) for 2, 3, & 4 variable Boolean functions
2) Know how to use K-Maps to simplify 2, 3, & 4 variable Boolean functions into sum-of-products form
3) Know how to use K-Maps to simplify 2, 3, & 4 variable Boolean functions into product-of-sums form
4) Know how to use K-Maps of 2, 3, & 4 variable Boolean functions with don't-care conditions
5) NAND and NOR logic gate circuit implementation

Chapter 4 Combinational Logic

1) Know how to find the Boolean function(s) from a combinational logic circuit
2) Know how to design a combinational logic circuit to implement Boolean function(s) from a truth table
3) Know how a half adder, full adder, binary adder, and adder-subtractor work (includes carry and overflow).
4) Know how a binary multiplier works.
5) Know how a magnitude comparator works.
6) Know how decoders work and how to use a one to implement a combinational circuit in sum-of-minterms form.
7) Know how encoders work.
8) Know how multiplexers work and how to use a one to implement a combinational circuit in sum-of-minterms form.

Chapter 5 Synchronous Sequential Logic

1) Know how to identify a synchronous sequential logic circuit
2) Understand operation of *SR* and *D* latches
3) Understand operation of *D, JK,* & *T* flip-flops, e.g., characteristic equations & tables as well as excitation tables
4) Know how to analyze a clocked sequential circuit, e.g., find state & output equations from state tables and/or state diagrams
5) Be able to determine flip-flop input equations (AKA excitation equations) & design a clocked sequential circuit, e.g., need state table for circuit & excitation table for flip-flop

Chapter 6 Registers and Counters

1) Understand operation of parallel-load and shift registers
2) Understand operation of serial adder
3) Understand operation of universal shift registers
4) Understand operation of binary & BCD ripple counters
5) Understand operation of binary, up-down binary, binary /w parallel load, and BCD synchronous counters
6) Understand operation and be able to design counters (e.g., counters with arbitrary sequence)
7) Understand operation of ring counters
8) Understand operation of switch-tail ring counters and Johnson counters

Notes:

(1) The use of calculators and electronic devices of any kind will not be permitted on the exam.

(2) The exam is closed book and closed notes.

(3) However, you may print out and use the following page (both sides). You may put equations, notes, or circuits. Rule- no worked problems or examples.

Table 2.1
Postulates and Theorems of Boolean Algebra

Postulate 2	(a)	$x + 0 = x$	(b)	$x \cdot 1 = x$
Postulate 5	(a)	$x + x' = 1$	(b)	$x \cdot x' = 0$
Theorem 1	(a)	$x + x = x$	(b)	$x \cdot x = x$
Theorem 2	(a)	$x + 1 = 1$	(b)	$x \cdot 0 = 0$
Theorem 3, involution		$(x')' = x$		
Postulate 3, commutative	(a)	$x + y = y + x$	(b)	$xy = yx$
Theorem 4, associative	(a)	$x + (y + z) = (x + y) + z$	(b)	$x(yz) = (xy)z$
Postulate 4, distributive	(a)	$x(y + z) = xy + xz$	(b)	$x + yz = (x + y)(x + z)$
Theorem 5, DeMorgan	(a)	$(x + y)' = x'y'$	(b)	$(xy)' = x' + y'$
Theorem 6, absorption	(a)	$x + xy = x$	(b)	$x(x + y) = x$