Name _____ GT#_____

ECE 2030b, Intro. To Computer Eng., Final Exam

Dec. 13, 2002
Prof. John A. Copeland
School of Electrical and Computer Engineering

RULES.

i This quiz is closed book.
ii. Calculators may not be used.
iii Answer all questions and show all work to receive full credit.
iv All questions have the same weight. (10 Points). All sub-questions within a question are weighted equally.
v Please do not ask the proctors any questions during the exam about exam questions. Part of the test is understanding the question as written, without supplemental information. If you feel additional data is needed to solve the problem, make (and state) an assumption and then work the problem.

Question 1 – Minterm and Maxterm Indices

For the truth tables below, show the minterm sum of products, and the maxterm product of sums. Below that list the minterm indices and the maxterm indices

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

sum of products **A'BC' + A'BC + AB'C' + ABC'**

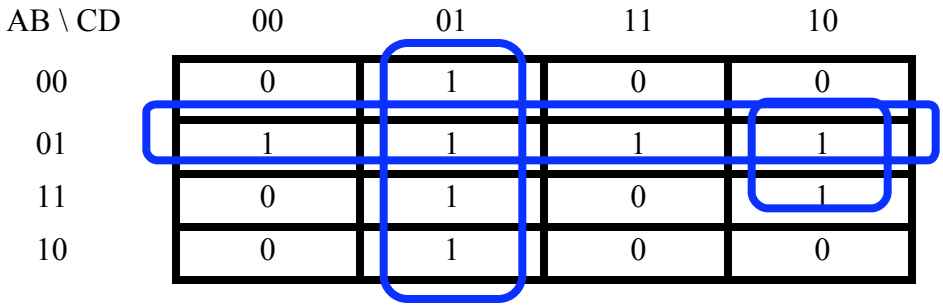
product of sums **(A+B+C) (A+B+C') (A'+B+C') (A'+B'+C')**

minterm indices **2,3,4,6**

maxterm indices **0,1,5,7**

Name _____

Question 2 – Karnaugh Map For the Karnaugh map below, circle the Prime Implicants and label the Essential Prime Implicants with "EPI".



AB \ CD	00	01	11	10
00	0	1	0	0
01	1	1	1	1
11	0	1	0	1
10	0	1	0	0

Write the reduced logic expression: **A'B + C'D + BCD'**_

minterm indices (decimal) **1, 4, 5, 6, 7, 9, 13, 14**__

Question 3 – Mixed Logic. Design a logic circuit for the logic function with NOR gates.

X = ((AB' + C) + D)'

using the mixed logic technique. Assume only signals A, B, C, and D are available. A' = NOT A..

Step 1.

Step 2. Show gates in standard form (not DeMorgan alternate forms) and no bars.

Name _____

Question 4 – CMOS Logic Gates. Draw a CMOS circuit to implement the logic function

A + B' C.

Question 5. Write the missing integer numbers in binary, hex, and decimal representations. For hex and binary show the number as an eight-bit 2's compliment number.

Decimal	Hex	Binary
112	**70**	**0111 0000**
180	B4	**1011 0100**
149	**95**	1001 0101

Question 6. Memory. Complete the table below. A "2M x 16" memory has 2M words of 16 bits.

Memory	Total Bits	# of addresses	# of address lines	# of data lines
4M x 8	**32M**	**4M**	**22**	**8**
1K x 32	**32K**	**1K**	**10**	**32**
128K x 16	**2M**	**128K**	**17**	**16**
1M x 4	**4M**	**1M**	**20**	**4**

Name _____

Question 7 – Binary Arithmetic in Two's Complement Notation

Do the arithmetic below in two's compliment binary arithmetic (8-bit integers, -128 to +127).

+28 _____ **0001 1100** _____

- 48 add (-48) _____ **1101 0000** _____ 48 = 0011 0000, -48 = 1100 1111 + 1

= -20 _____ **1110 1100**_____ absolute value = 0001 0011 +1 = 0001 0100 = 20

Question 8. Our MIPS architecture has only "Branch on Equal" (BEQ $X, $Y) and "Branch on Not Equal" (BNE $X, $Y) commands. Show how to use the "Set on Less Than" (SLT $1, $X, $Y) and BEQ or BNE to make as two-command equivalent of the following (note: $0 always = 0):

BLT $2, $3
SLT $1, $2, $3
BNE $0, $1, label branch if $1 == 1

BGT $2, $3
SLT $1, $3, $2 $1 = 1 if $3 < $2, $1 = 0 if $3 >= **$2**
BNE $0, $1, label branch if $1 == 1

Question 9. Branch and Jump Commands (for R4000). Please write answers in the box at left.

[____ **Conditional** _____] Branch commands are always (conditional, unconditional)

[____ **relative** _____] and (absolute, relative).

[_____ **Unconditional** ___] Jump commands are always (conditional, unconditional)

[_____ **absolute** _____] and (absolute, relative).

[_____ **X + 4** _____] If a subroutine is called by an instruction at memory location X, what is the location of the first instruction executed after the subroutine returns.

[_____ **on the stack** _____] If there are nested subroutines, where are the return locations kept?.

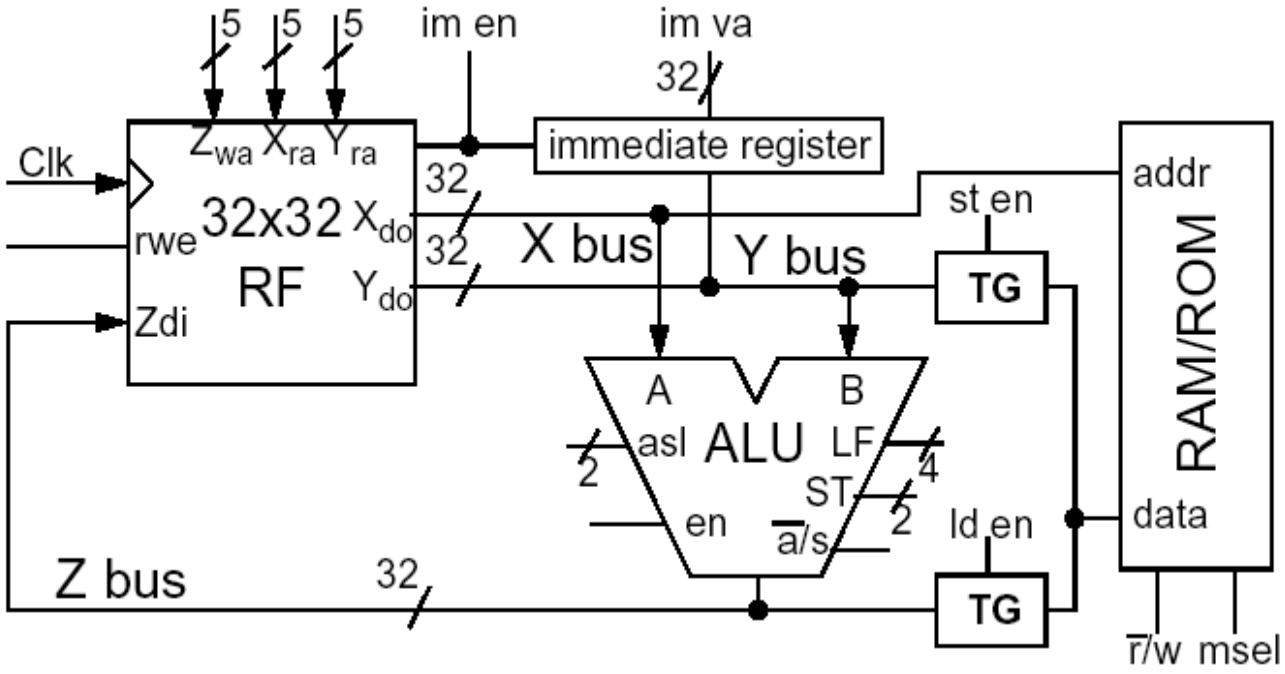
[_____ **recursive** _____] A subroutine that can calls itself is called ____.

[_ **push the current value**__] What must a subroutine do before it can use a register.

[_ **pop the old values back** _] What must a subroutine do before it can return with regard to registers that were used.

Name _____

Question 10 – CPU Control Lines



Show how the control lines are set to achieve the operations below. Assume msel = 1;

asl: 0=AU, 1=LU, 2=SU, 3 = invalid; ST: 0=arithmetic, 1=logical, 2=rotate, 3 = invalid;

LF: 0=AND, 1=OR, 2=XOR, 3 = invalid; a'/s: 0=add, 1= subtract rwe: 1=write, 0= do not write

Add $2 to the value in memory (address=$9) and put the result into $2. $5 = M[$9] + $2

(note: loading or storing data requires a separate CPU clock cycle)

Mem r'/w	X	Y	Z	rwe	asl	a'/s	en	ld en	st en	im en	im va (Immediate Value)