**ECE 2030b, Intro. To Computer Eng., QUIZ 1**

**Quiz No. 1: Sept. 20, 2001**
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RULES.

i This quiz is closed book, but one hand-written ref. page may be used.
ii. Non-programmable calculators may be used.
iii Answer all questions and show all work to receive full credit.
iv All questions have the same weight. (20 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 – Logic Identities and Binary Arithmetic:** Simplify the follow Boolean expressions

A. X + XYZ — X

B. X Y (X+Z) — $XXY + XYZ = XY + XYZ = XY$ (absorption)

C. (X' Y')' — $\bar{X}\bar{Y} = \bar{\bar{X}} + \bar{\bar{Y}} = X + Y$

D. X + XY — X

E. X(Y +Z') + YZ — $XY + XZ' + YZ = XY + XZ' + YZ = XZ' + YZ$

F. Two's compliment of 00001011 — $11110101_2$

G. +13 as an 8-bit 2's compliment binary number — $00001101_2$

H. Add binary radix numbers 1101.1 and 110.011 — $10011.111_2$

I. Convert 101.101 to a base-10 number. — $5.625_{10}$

J. Write 37 .42 as a binary radix number. — $100101.01101_2$

ONLY OUT TO 5 PLACES

Use the bottom of this page for your work sheet.

37 mod 2 = 1
18 mod 2 = 0
9 mod 2 = 1
4 mod 2 = 0
2 mod 2 = 0
1 mod 2 = 1

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  1 1
  1101.100
+ 0110.011
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 10011.111
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$101.101_2 \rightarrow N_{10}$

$(4\times1)+(2\times0)+(1)$

5

$\frac{1}{2}+\frac{1}{8}=$

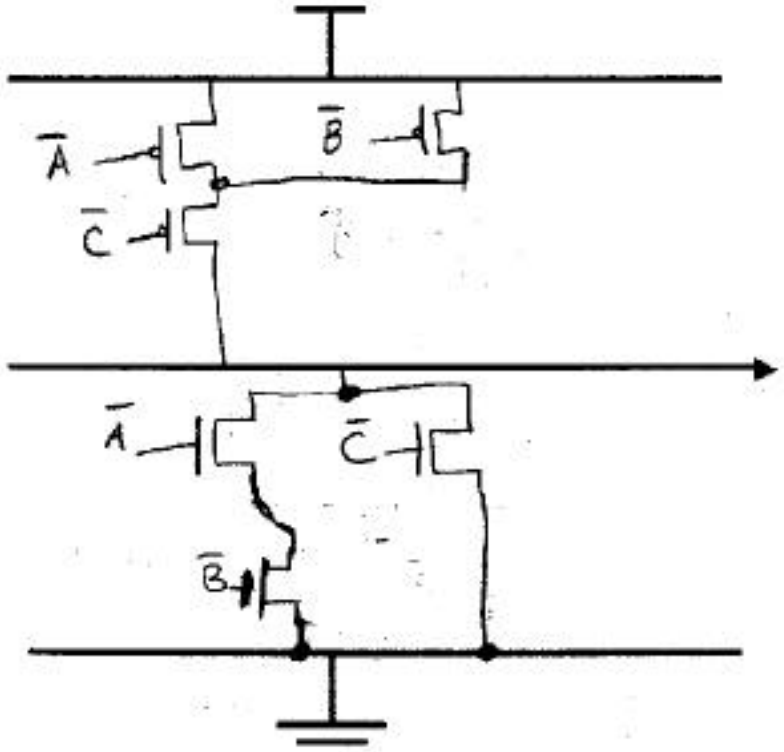
$\frac{1}{2}+\frac{1}{8}+$

.42 x 2 = 0
.84 x 2 = 1
.68 x 2 = 1
.36 x 2 = 0

.72 x 2 = 1
.44 x 2 = 0

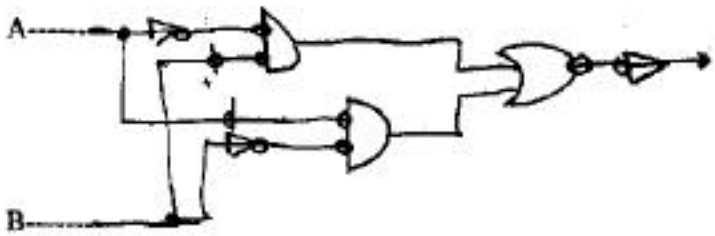
## Question 2 – CMOS Logic

Draw the CMOS transistor diagram for **AC +BC**. Assume A, A', B, B', C, C',D' and D' signals are available for inputs. Use only three p-FETs and three n-FETs.




## Question 3 –Mixed-Logic and DeMorgan's Square

Use the mixed logic technique to design a logic circuit for AB'+ A'B using only inverters and 2 input NOR gates. The inputs available are A and B. You may show the NOR gates in either form.



## Question 4 – Minterm and Maxterm Indices

For the truth tables below, express the minterm sum of products, and the maxterm product of sums:

| A | B | C | F |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |

sum of products $(\bar{A}\bar{B}C) + (\bar{A}BC) + (A\bar{B}\bar{C}) + (A\bar{B}C) + (ABC)$

product of sums $(A+B+C)(A+\bar{B}+C)(\bar{A}+\bar{B}+C)$

Draw a Karnaugh Map for the truth table in Question 4. Circle the Prime Implicants with a solid line. Label the Essential prime implicants with "EPI".

| A \ BC | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 0 | 1 | 1 | 0 |
| 1 | 1 | 1 | 1 | 0 |

EPI EPI

**Question 5 – 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 | 0 | 0 | 0 |
| 01 | 1 | 0 | 1 | 1 |
| 11 | 1 | 0 | 1 | 1 |
| 10 | 0 | 1 | 1 | 0 |

EPI EPI 0101

Write the reduced logic expression: $B\bar{D} + Bc + A\bar{B}D$

maxterm indices (decimal) $\Pi M(0, 1, 2, 3, 5, 8, 10, 13)$