ECE2020 Test 1 Summer 2013 GTL
May 31, 2013 Name: _____
5 pages, 100 possible points. **Show your work for any possible partial credit.**

Switch level circuits:

1) (15 total point) For the expression below, create a switch level implementation using N and P type switches. Assume both inputs and their complements are available. Your design should contain no shorts or floats. Implement the equations exactly as they are (no simplifying).

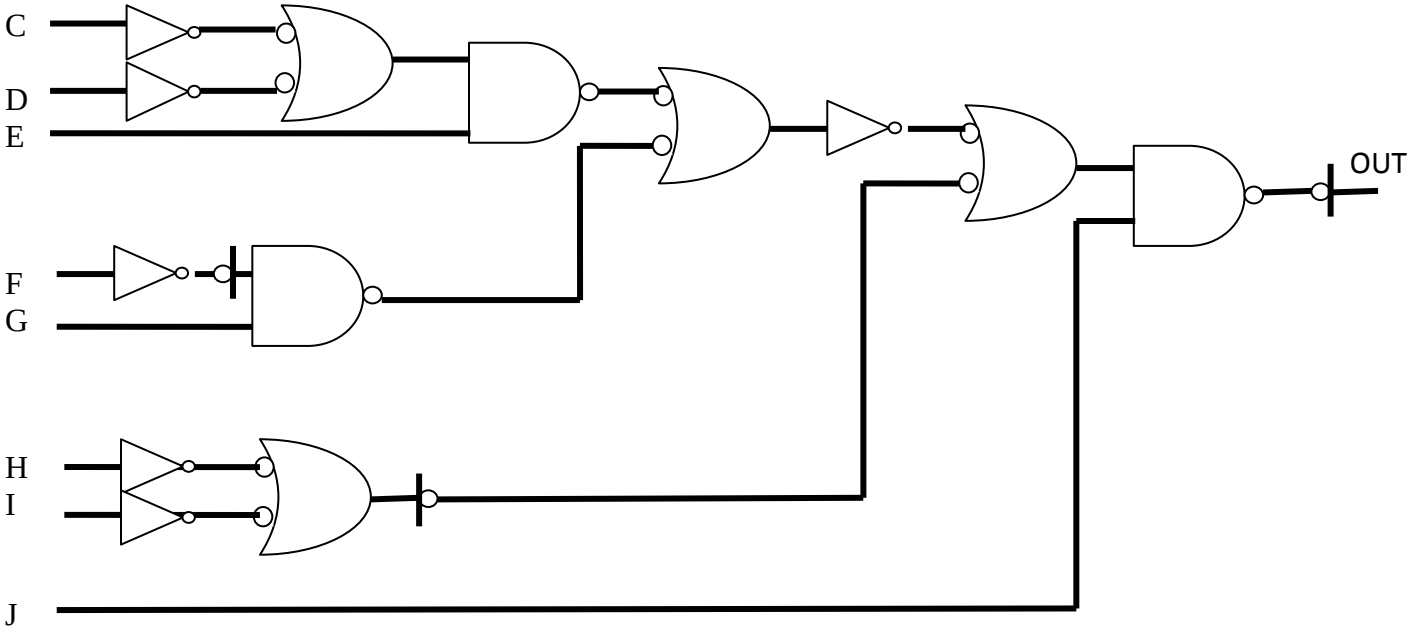
$Out_x = (C + \overline{D}) \cdot (E + F) \cdot \overline{A} \cdot B$

Switch-Ready Expressions:

2) (15 points) Transform each of the following Boolean expressions to a form where they are ready for switch level implementation (i.e., there should only be bars over input variables, not over operations). The behavior of the expression should remain unchanged. **Do not implement**, just show the new Boolean equation without any "big bars".

$$Outx = \overline{(A + B)}\,(C + D)\,\overline{(E + F)}$$

3) Part A (15 points) Write the boolean output expression for the gate design shown below. Also determine the number of switches used in its implementation.



Out _____

number of switches _____

3) Part B (15 points) Implement the following expression using only two input OR gates and inverters so as to minimize the number of switches required. Then determine the number of switches required. **Use proper mixed logic notation**. Do not modify the expression, do not simplify the expression. Do not assume complements of inputs are available.

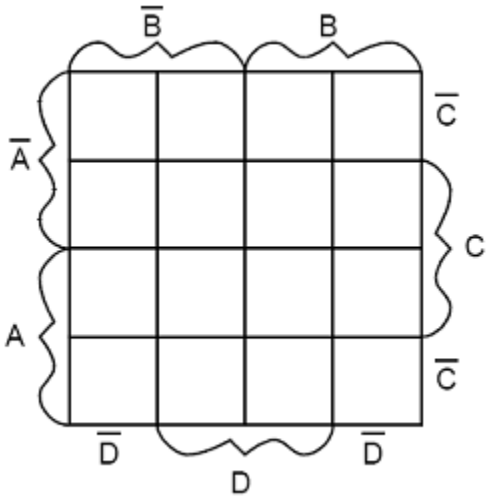
Out= $(\overline{(A+B+C)} \cdot \overline{D} + \overline{\overline{E}\overline{F}}) \cdot G$

Number of switches _____

Karnaugh Maps:

4) (15 points) For the following expression, derive a simplified ***sum of products*** expression using a Karnaugh Map. Circle and list **ALL** the prime implicants, indicating which are essential.

$A\cdot\overline{C} + A\cdot B\cdot\overline{C} + B\cdot\overline{D} + B\cdot C\cdot D$



prime implicants	essential? yes	no
_____	☐	☐
_____	☐	☐
_____	☐	☐
_____	☐	☐
_____	☐	☐
_____	☐	☐
_____	☐	☐
_____	☐	☐
_____	☐	☐

Simplified sum of products _____

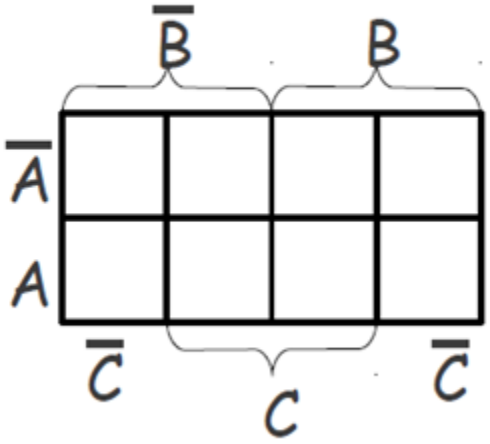
5) (10 points) Determine the canonical product of sums (using maxterms) expressions for the truth table below:

A	B	C	OUT
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

POS (maxterms) = _____

6) (15 points) For the following expression, derive a simplified ***product of sums*** expression using a Karnaugh Map. Circle and list **ALL** the prime implicants, indicating which are essential.

out = (A+B+C) (A+$\bar{B}$+C) (A+B+$\bar{C}$) ($\bar{A}$ + $\bar{B}$ + $\bar{C}$) ($\bar{A}$ + B+ $\bar{C}$)



prime implicants | essential? yes | no

_____ ☐ ☐
_____ ☐ ☐
_____ ☐ ☐
_____ ☐ ☐
_____ ☐ ☐

Simplified product of sums = _____