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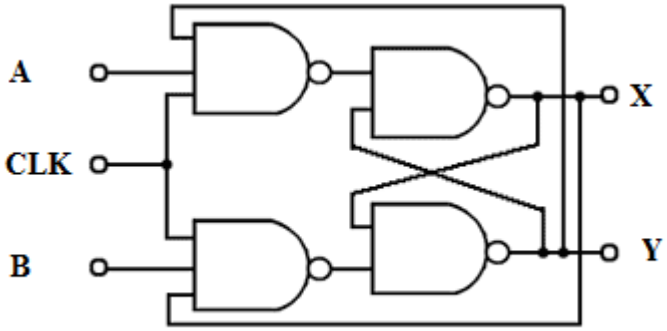
EHB205E Introduction to Logic Design
MIDTERM II

Duration: 120 Minutes
Grading: 1) 20%, 2) 20%, 3) 20%, 4) 40%
Exam is in closed-notes and closed-books format; calculators are allowed
For your answers please use the space provided in the exam sheet
GOOD LUCK!

1) Consider a Boolean function $f = (x_1x_2x_3x_4x_5x_6)+(x_1+x_2+x_3+x_4x_5x_6)'$. Use only variables x_1, x_2, x_3, x_4, x_5, x_6 as inputs (**not their negated forms)**. Implement f using **two 3-to-8 decoders** and **minimal number of two-input NAND gates.**

2) Implement a 4-variable Boolean function $\boldsymbol{f(x_1, x_2, x_3, x_4)} = \sum(1,4,6,7,12,14,15)$ using **minimal number of 2-to-1 multiplexers**. Use only variables x_1, x_2, x_3, x_4 as inputs (**not their negated forms)**. You can also use 0's and 1's as inputs.

3) Consider a sequential circuit shown below. It has three input A, B, and CLK and two output X and Y. **Obtain its truth table**.



4) Consider a flip-flop consisting of one inverter, one XOR gate, and four NAND gates, shown below. Suppose that the inverter has a delay of **1ns;** each of the NAND gates has a delay of **3ns;** the XOR gate has a delay of **5ns** . Sketch the **waveforms at the outputs Q and Q′** if the input signals A and CLK shown below are applied. Suppose that initial values of Q and Q' are 0 and 1, respectively.