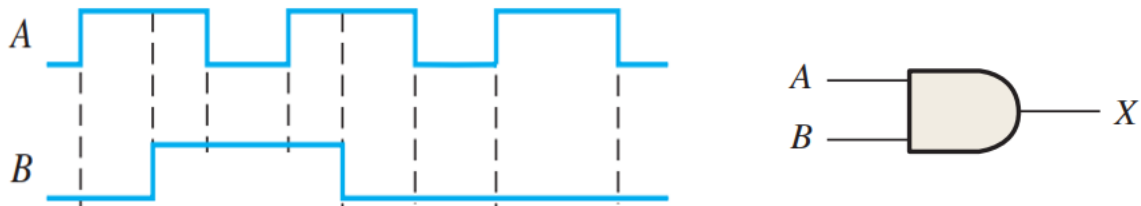


Exam 2  
EET 241 (Fall 2021)  
Logic Circuits  
Time: 50 Minutes

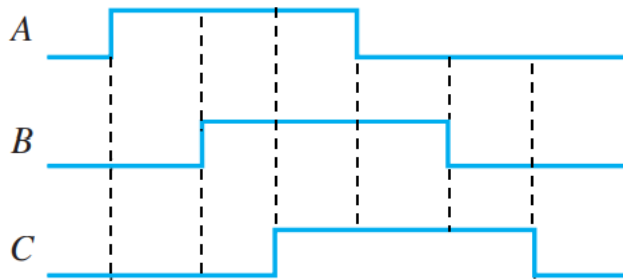
Name:

N.B: You need to clearly show the steps of your calculation (especially for logic simplification).

1. For the 2 input AND gate (following figure), determine the output waveform with its proper relation to the inputs. (15 Points)



2. For the 3 input NAND gate (following figure), determine the output waveform with its proper relation to the inputs. (20 Points)



3. Apply DeMorgan's theorems to the following expression:  $\overline{\overline{A} + B + C}$  (10 Points)

4. Using Boolean algebra, simplify following expression:  $A + \overline{\overline{A} + \overline{B}} + ABC$ . Clearly state the laws, rules, and identities used. (20 Points)

5. Use a Karnaugh map to minimize the following SOP expression: (15 Points)

$$\overline{A}\overline{B} + AB\overline{C} + ABC$$

6. Use a Karnaugh map to minimize the following SOP expression: (20 Points)

$$\bar{A}BC\bar{D} + ABC\bar{D} + AB\bar{C}\bar{D} + ABCD$$

### Basic rules of Boolean algebra.

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**1.**  $A + 0 = A$

**2.**  $A + 1 = 1$

**3.**  $A \cdot 0 = 0$

**4.**  $A \cdot 1 = A$

**5.**  $A + A = A$

**6.**  $A + \bar{A} = 1$

**7.**  $A \cdot A = A$

**8.**  $A \cdot \bar{A} = 0$

**9.**  $\bar{\bar{A}} = A$

**10.**  $A + AB = A$

**11.**  $A + \bar{A}B = A + B$

**12.**  $(A + B)(A + C) = A + BC$

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$A$ ,  $B$ , or  $C$  can represent a single variable or a combination of variables.