Software and Systems Engineering

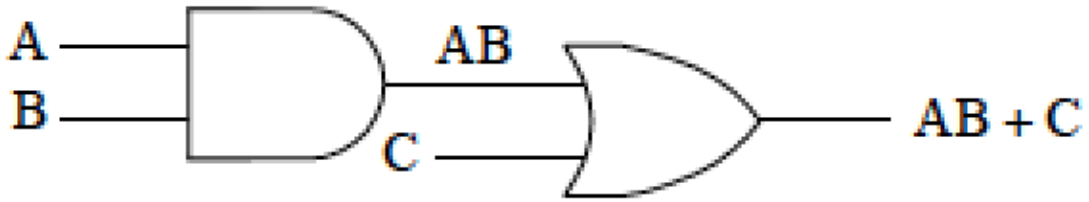
CPE3202

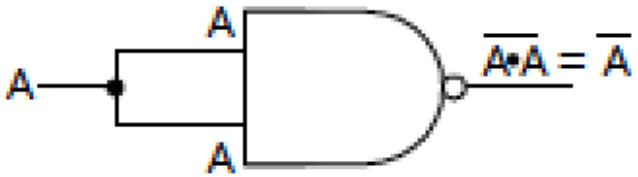
Pornpawit Boonsrimuang

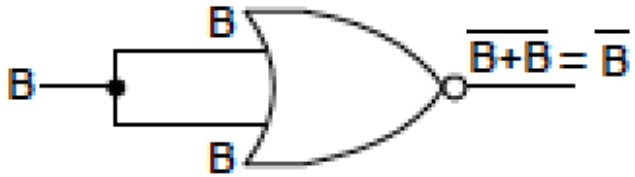
Combinational Logic Circuits

- Implementation of Logic Diagrams from Boolean Expressions
- Using NAND and NOR gates
- Using NAND and NOR gates for the inversion operation
- Implementation of DeMorgan’s theorem
- Implementation of the XOR
- Implementation of the XOR function with NAND gate only
- Implementation of the Boolean expression

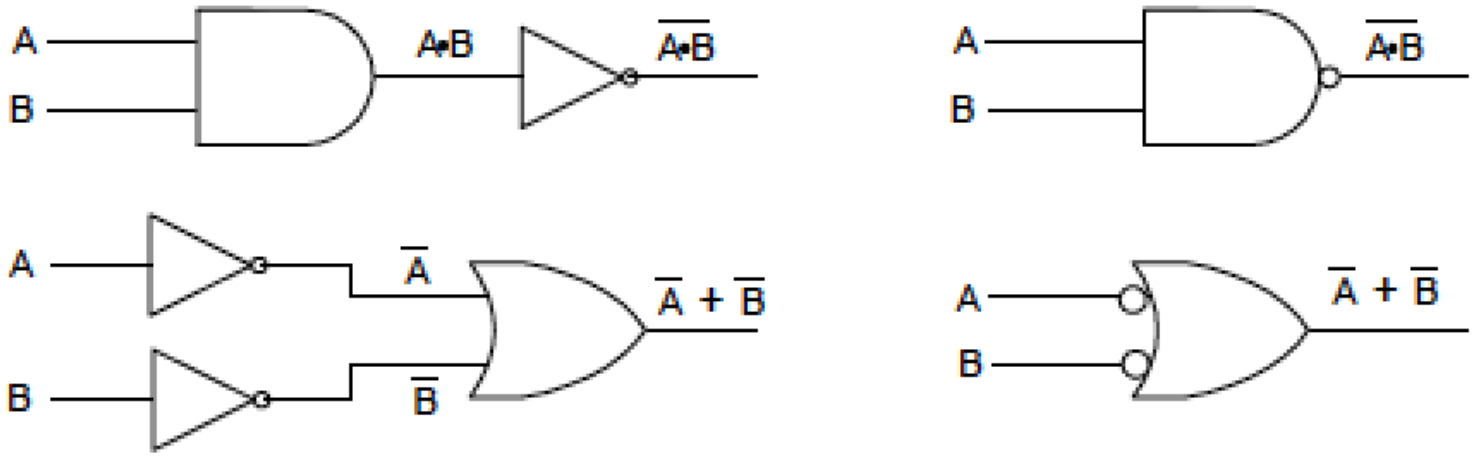
Implementation of the Boolean expression



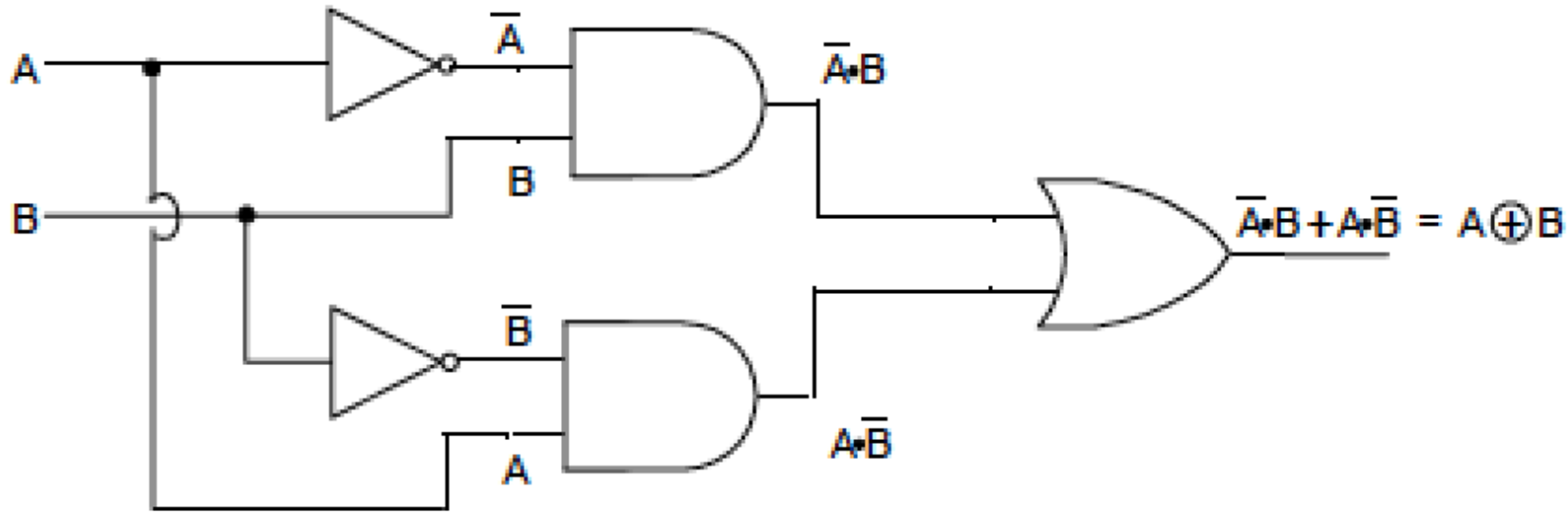




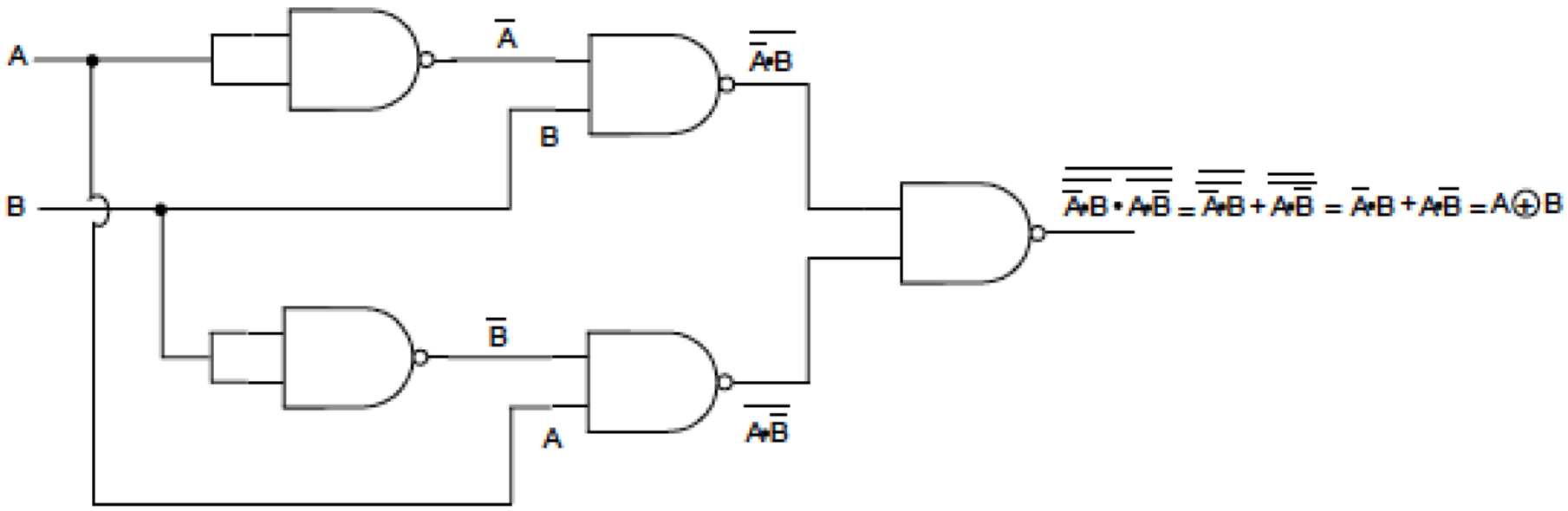
Implementation of DeMorgan's theorem



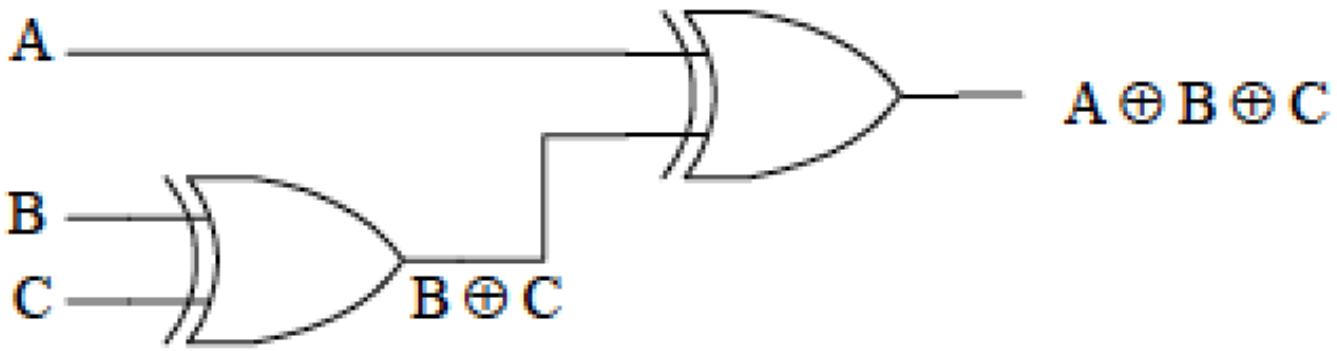
Implementation of the XOR function with AND gates



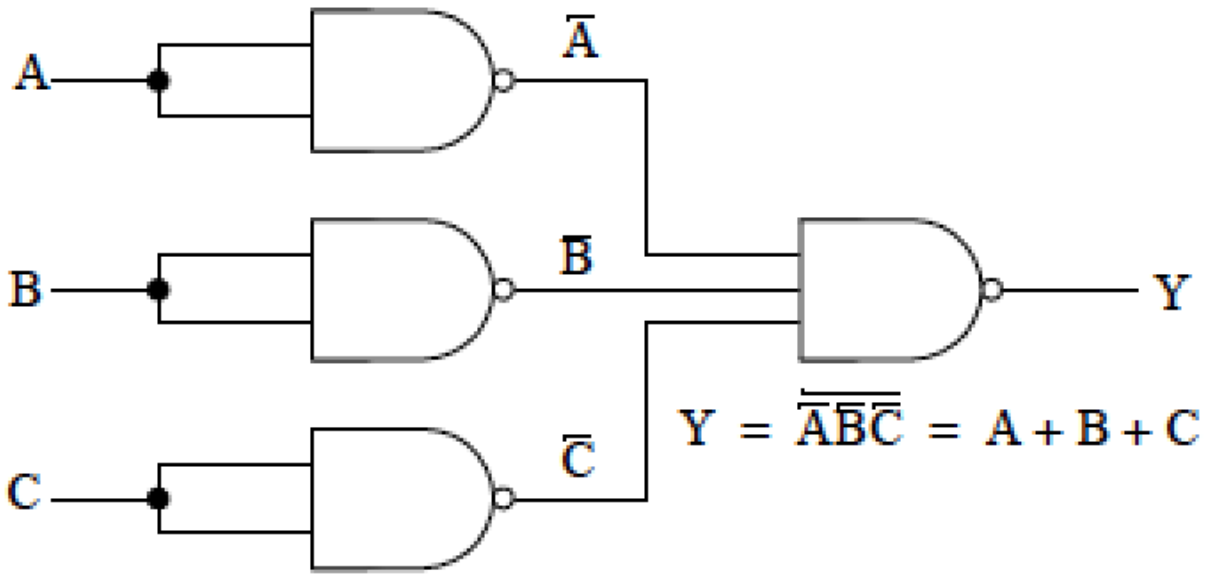
Implementation of the XOR function with NAND gates only

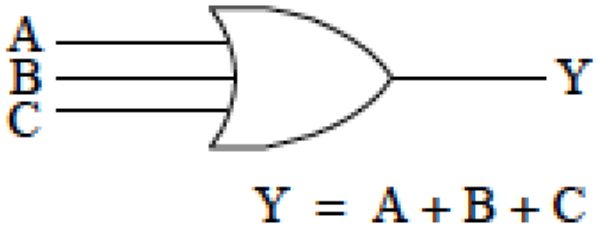


Implementation of the Boolean expression

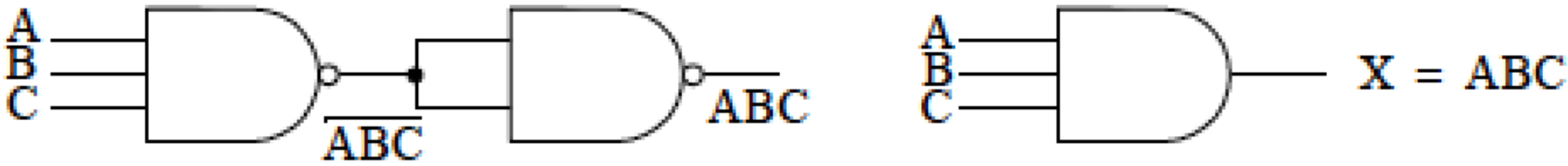


Implementation of the OR operation

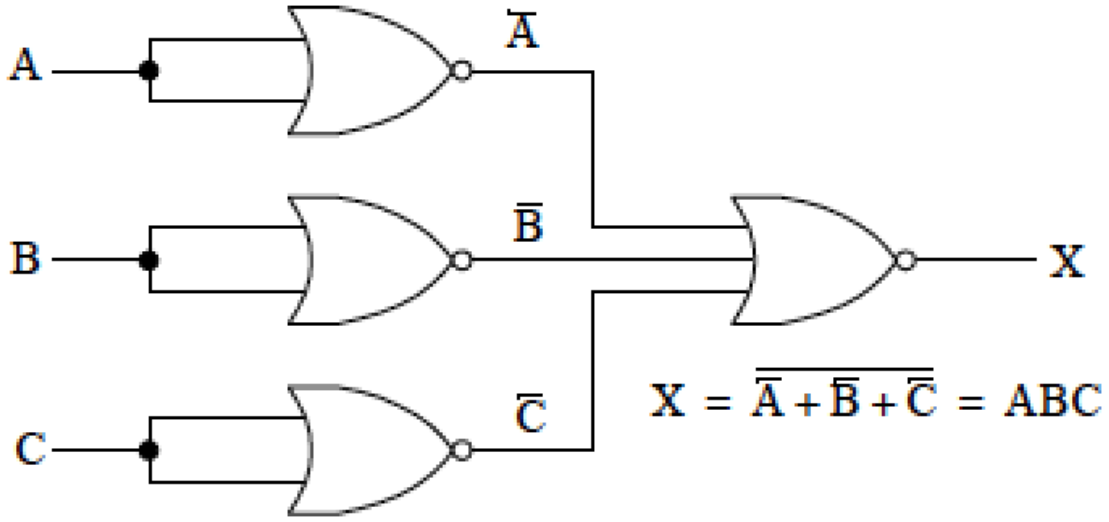


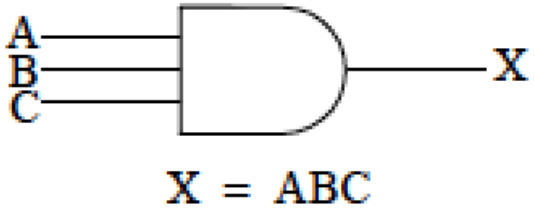


Implementation of the AND operation

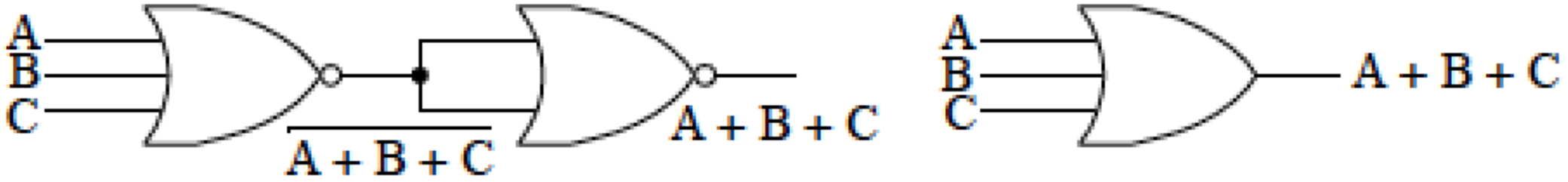


Implementation of the AND & NOR

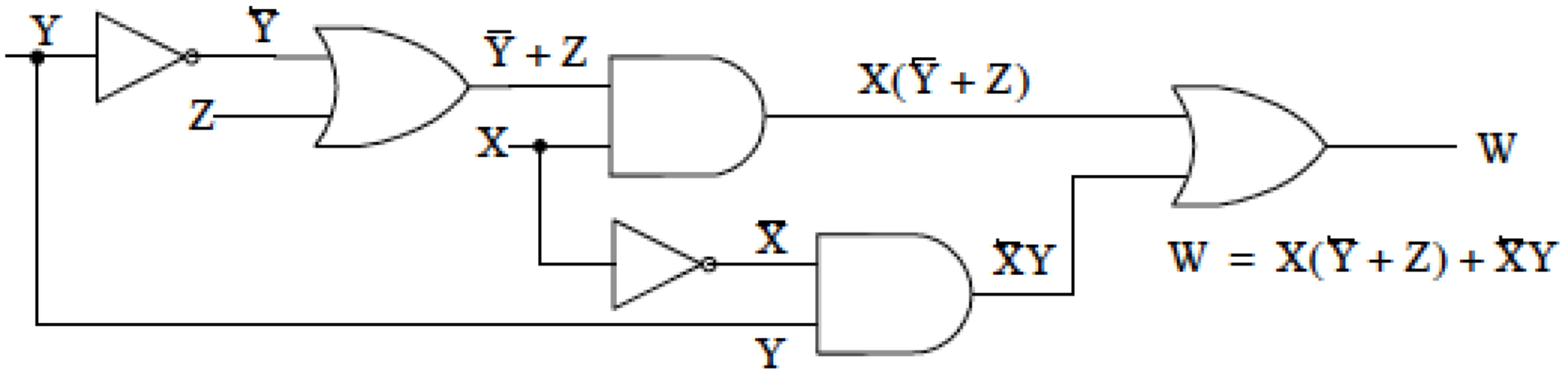




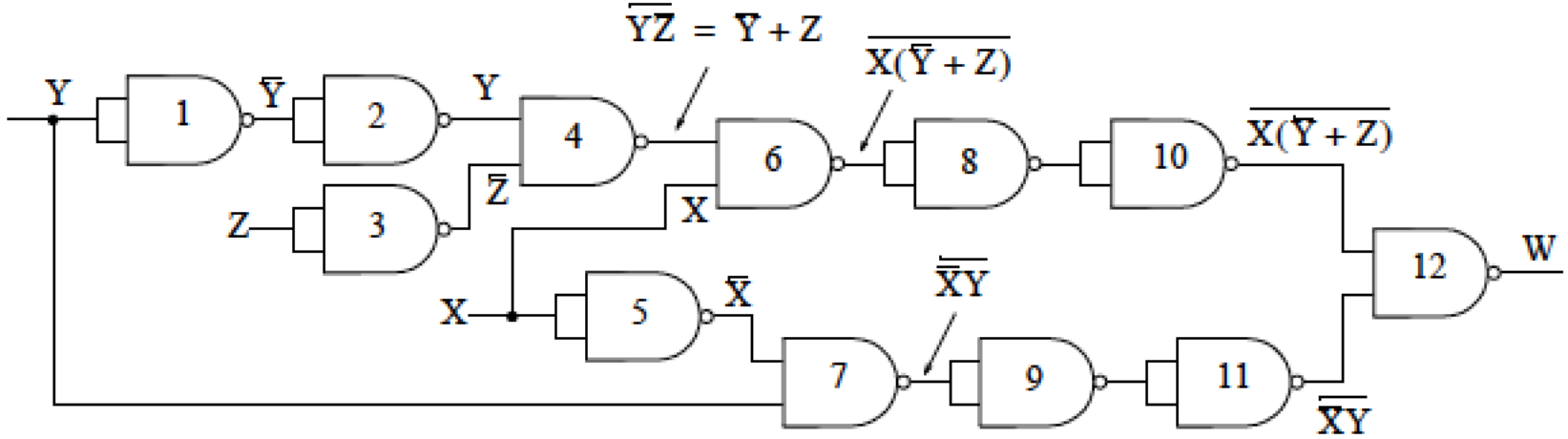
Implementation of the OR & NOR



Implementation of the AND OR & Inverters

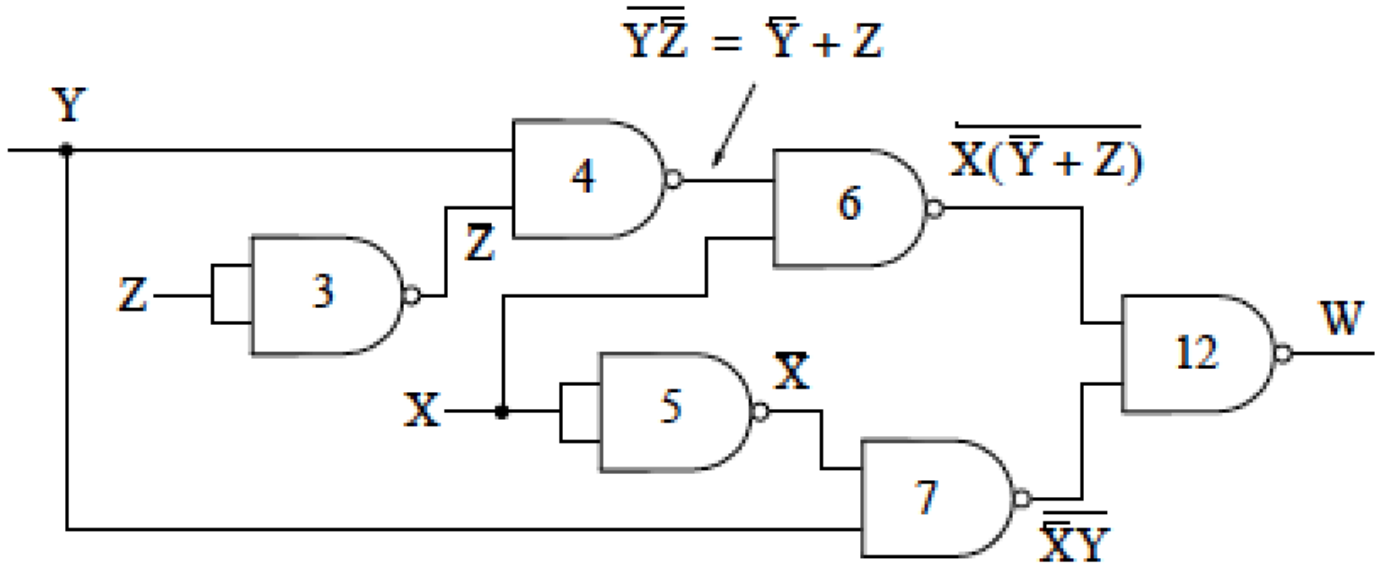


Implementation of the NAND gates



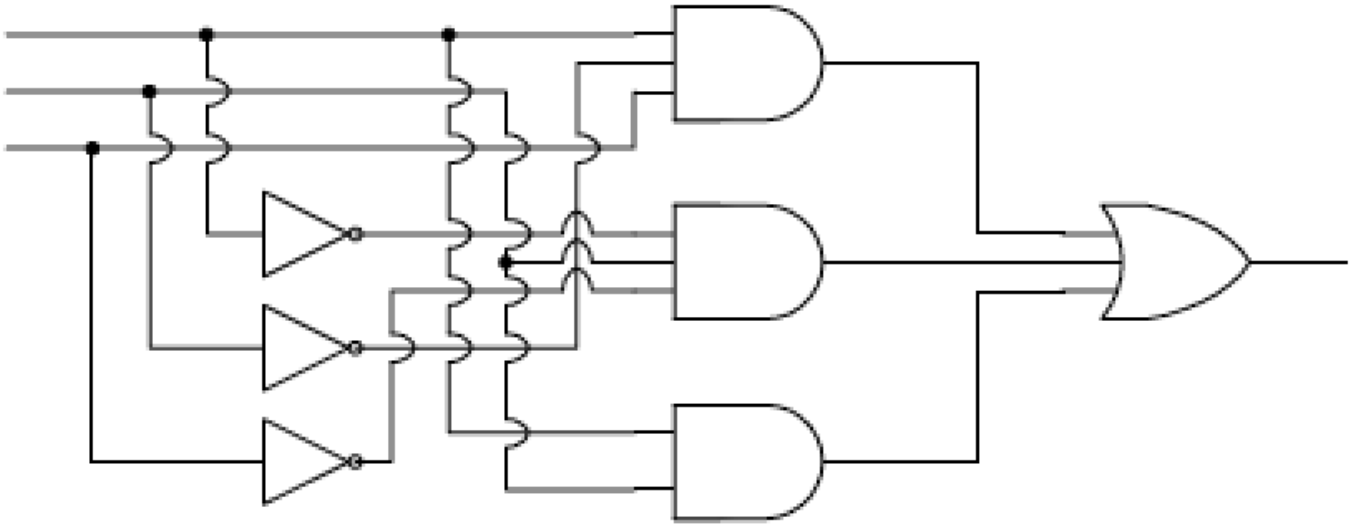
$$W = \overline{\overline{X(\bar{Y} + Z)} \cdot \overline{\bar{X}Y}} = X(\bar{Y} + Z) + \bar{X}Y$$

Implementation of the NAND

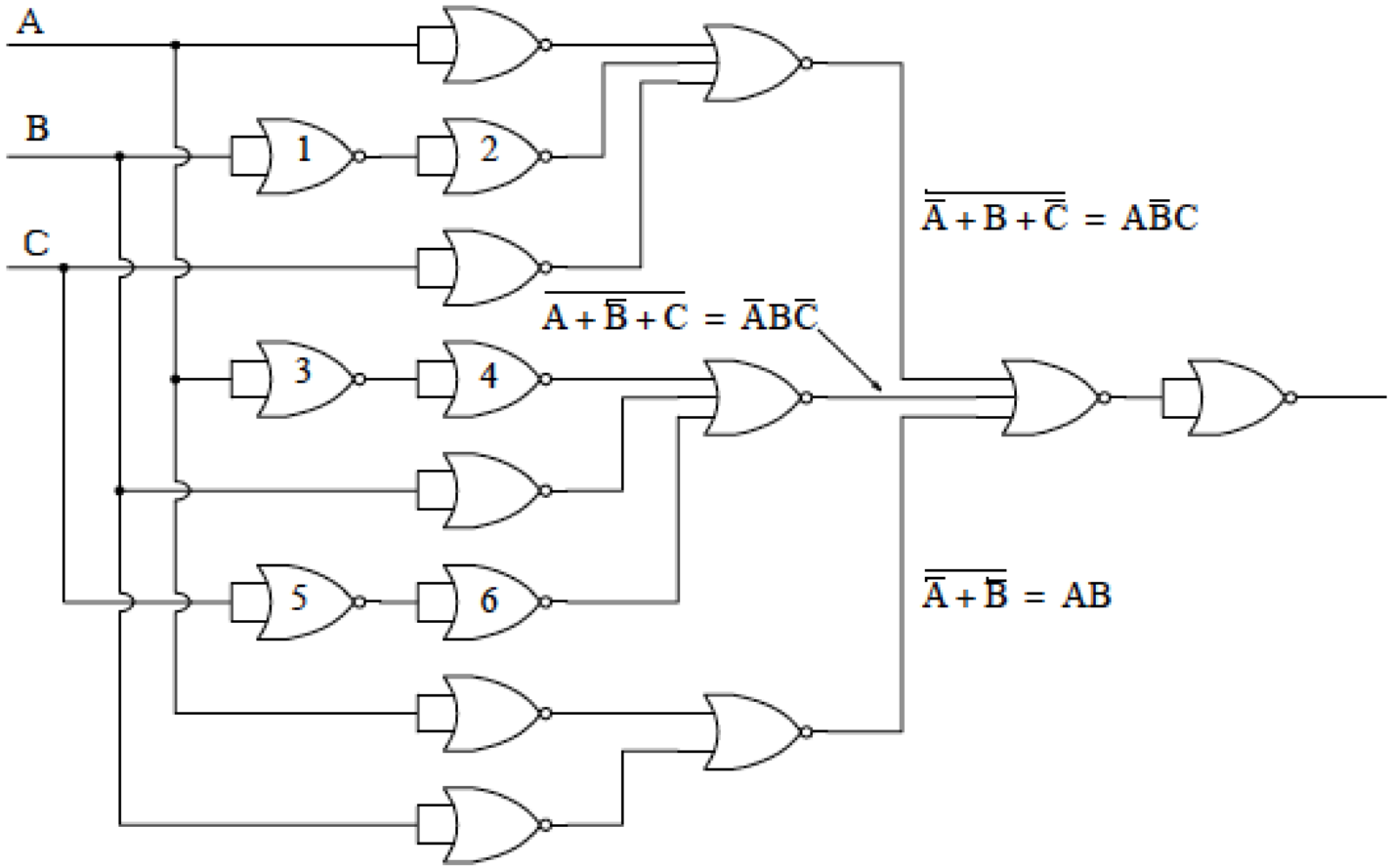


$$W = \overline{\overline{X(\bar{Y} + Z)} \cdot \overline{\bar{X}Y}} = X(\bar{Y} + Z) + \bar{X}Y$$

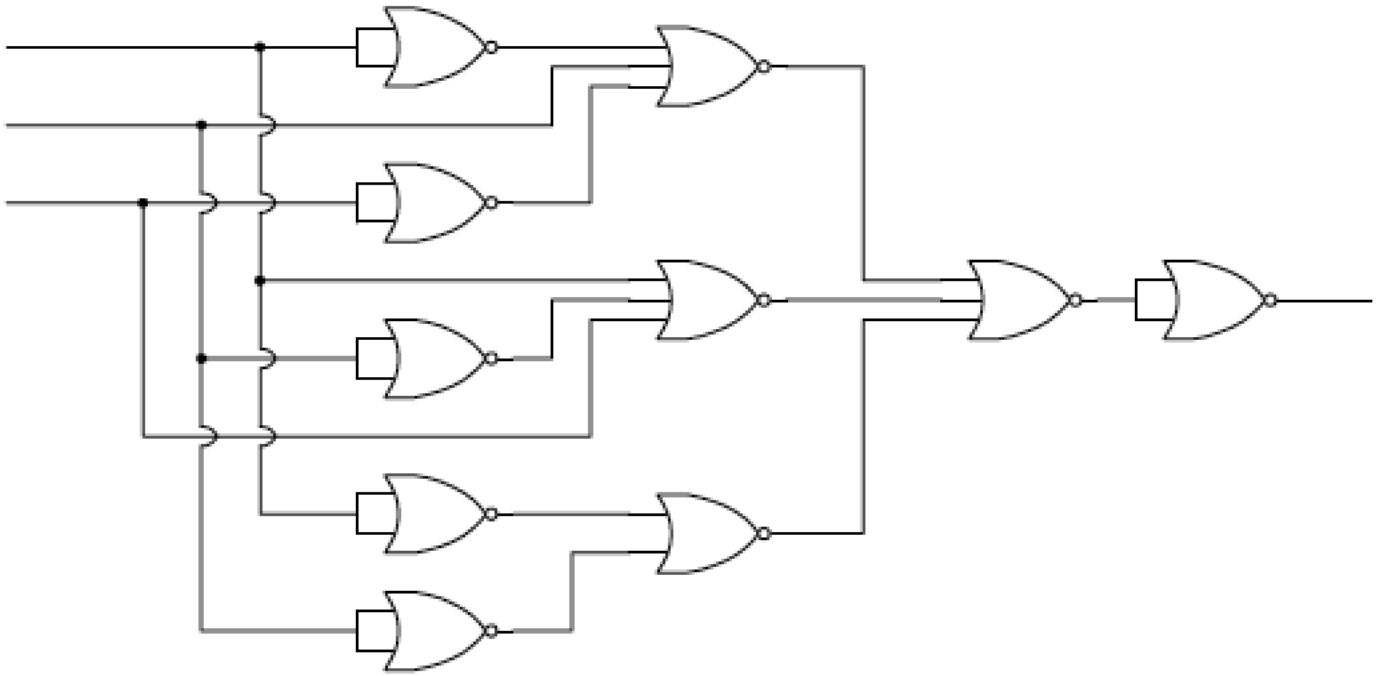
Implementation of the AND OR & Inverters



Implementation of NOR - unsimplified



Implementation of NOR - simplified

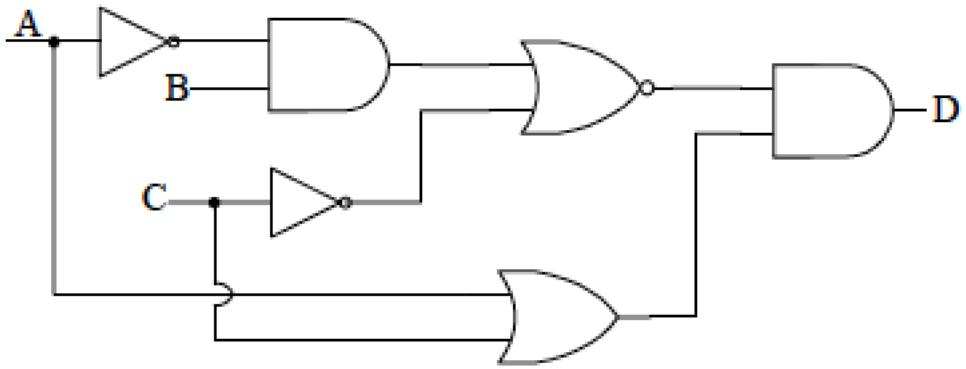


Ex.

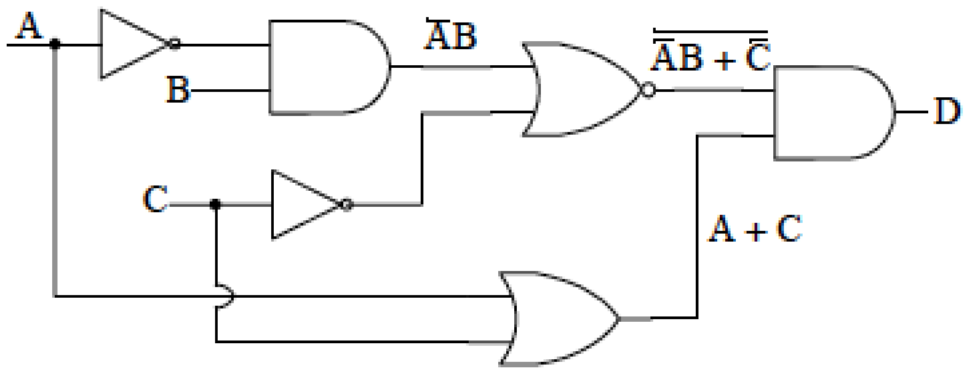
$$D = \bar{A}BC + A\bar{B}C + ABC + B\bar{C}.$$

$$\begin{aligned} D &= \bar{A}BC + ABC + A\bar{B}C + ABC + B\bar{C} \\ &= BC(A + \bar{A}) + AC(B + \bar{B}) + B\bar{C} \\ &= BC + AC + B\bar{C} \\ &= B(C + \bar{C}) + AC \\ &= B + AC \end{aligned}$$

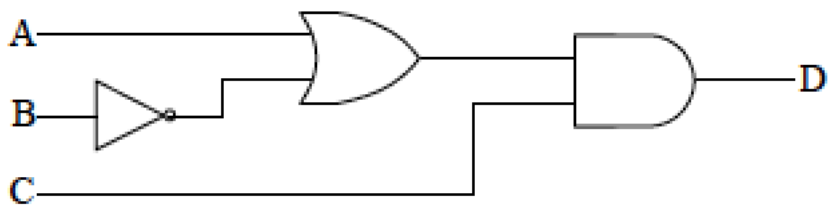
Output of the gates of logic



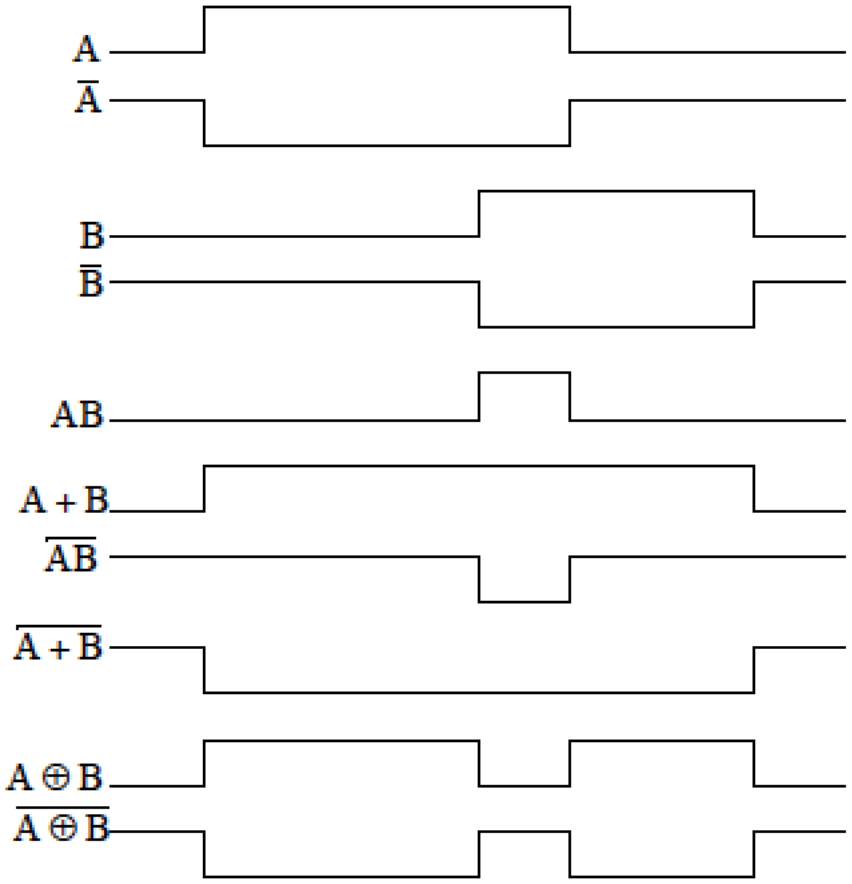
Ex.



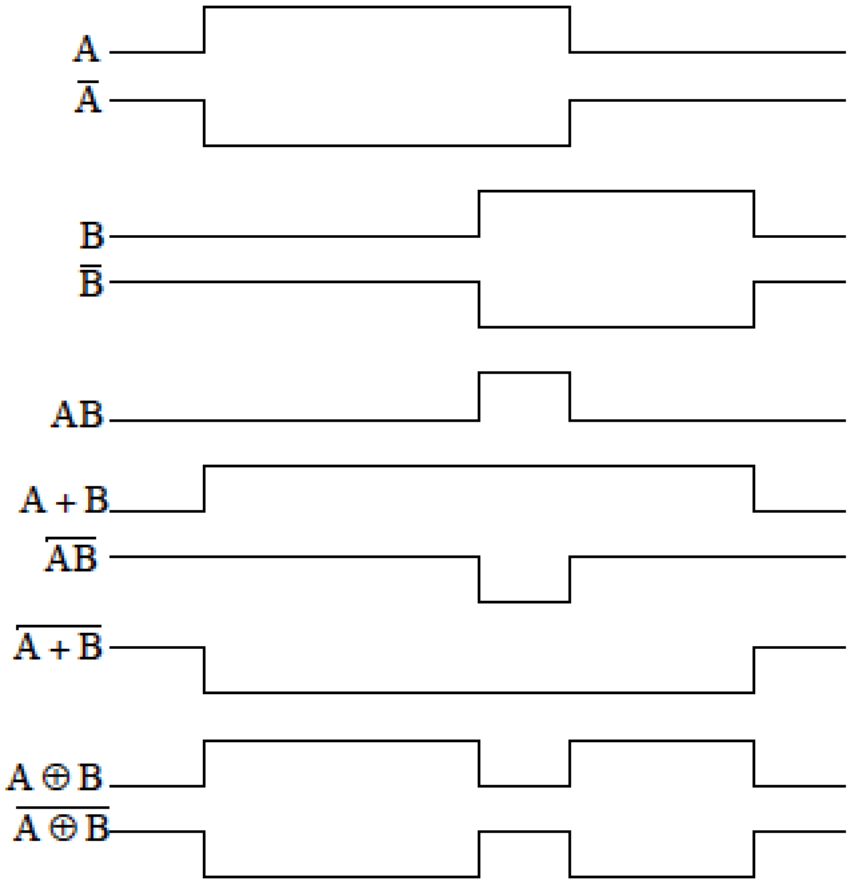
$$D = (\overline{\bar{A}B + \bar{C}})(A + C) = (\bar{A}\bar{B}C)(A + C) = [(A + \bar{B})C](A + C)$$
$$= (A + \bar{B})(AC + CC) = (A + \bar{B})(AC + C) = AAC + AC + A\bar{B}C + \bar{B}C$$
$$= AC + AC + \bar{B}C(A + 1) = AC + \bar{B}C(1) = AC + \bar{B}C$$
$$= (A + \bar{B})C$$



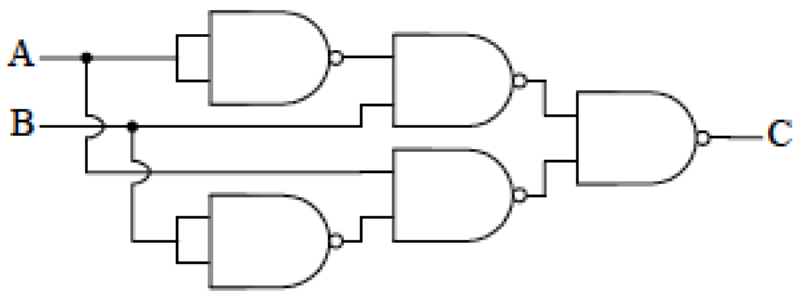
Input/Output Waveforms



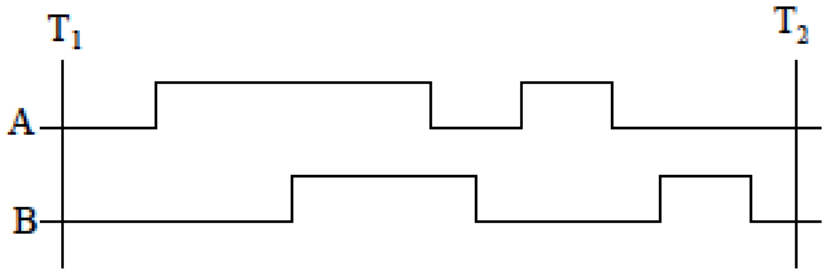
Input/Output Waveforms



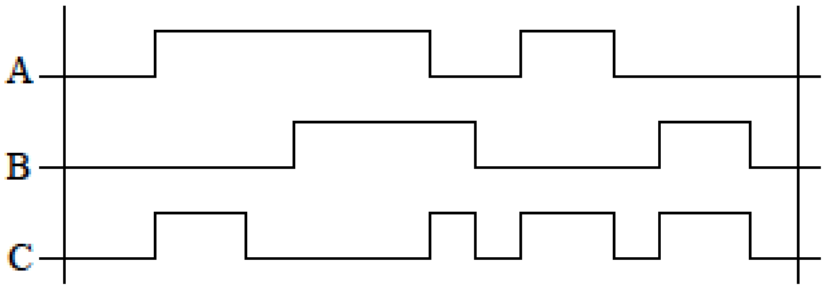
Ex.



(a)



(b)



Ref.
(Required Text)

- Steven T. Karris .(2005). Digital Circuit Analysis and Design with an Introduction to CPLDs and FPGAs: Orchard Publications.