Logic Lab – Exp #6

Combinational Circuit Synthesis

Y-0016/001D and Y-0016/005D board (given in next page)

1) The half adder adds two single binary digits A and B. It has two outputs, sum (**S**) and carry (**C**). The carry signal represents an overflow into the next digit of a multi-digit addition. Fill in the truth table for a half adder and design the circuit. Then use modular half adder circuit (with EXOR gate) and verify results with your circuit.

2) A full adder adds binary numbers and accounts for values carried in as well as out. **A** one-bit full-adder adds three one-bit numbers, often written as **A, B**, and $\mathbf{C_{in}}$; **A** and **B** are the operands, and $\mathbf{C_{in}}$ is a bit carried in from the previous less-significant stage.
The circuit produces a two-bit output, carry and sum typically represented by the signals $\mathbf{C_{out}}$ and **S**.
First formulate the truth table with **A, B**, $\mathbf{C_{in}}$ as inputs, and $\mathbf{C_{out}}$, **S** as outputs.
Then design the circuit with logic gates. Then use modular full adder circuit (with EXOR gate) and verify your results.

3) The half subtractor is a circuit which is used to perform subtraction of two bits. It has two inputs, **X** and **Y**; and two outputs the difference **D = X - Y** and borrow out **Bout**.
The borrow out signal is set when the subtractor needs to borrow from the next digit in a multi-digit subtraction. That is, when X < Y. Since X and Y are bits, if and only if X = 0 and Y = 1.
Fill in the truth table for a half subtractor and design the circuit.

Then implement the circuit using modular full adder circuit.

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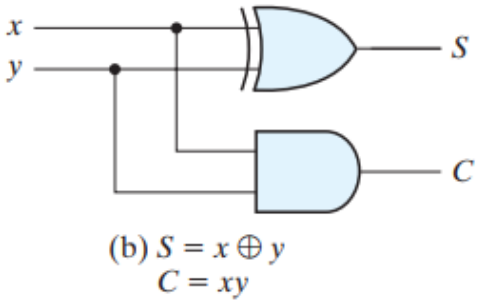
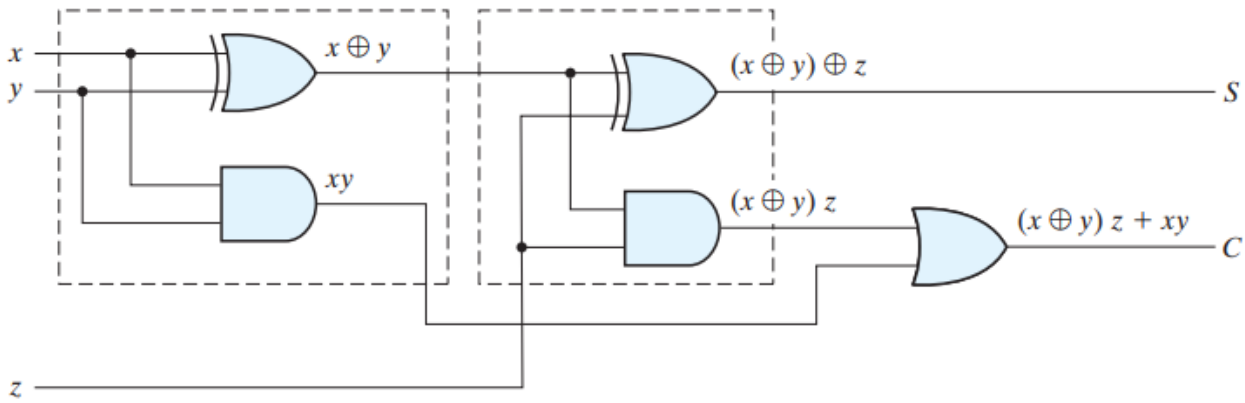
Modular Half Adder Circuit



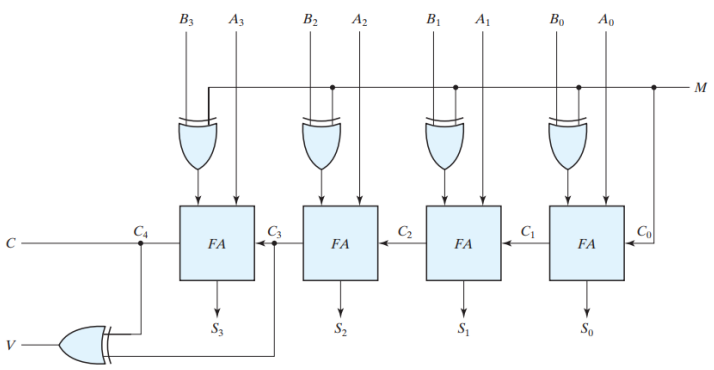
(b) $S = x \oplus y$
$C = xy$

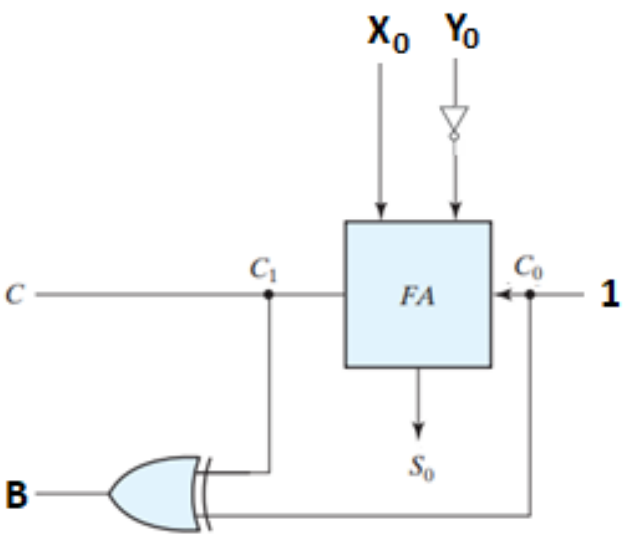
Modular Full Adder Circuit



S = x ⊕ y⊕z = (x ⊕ y) ⊕ z ***C = (x ⊕ y)z + xy***

Subtractor Using Full Adder Circuit





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