Grading

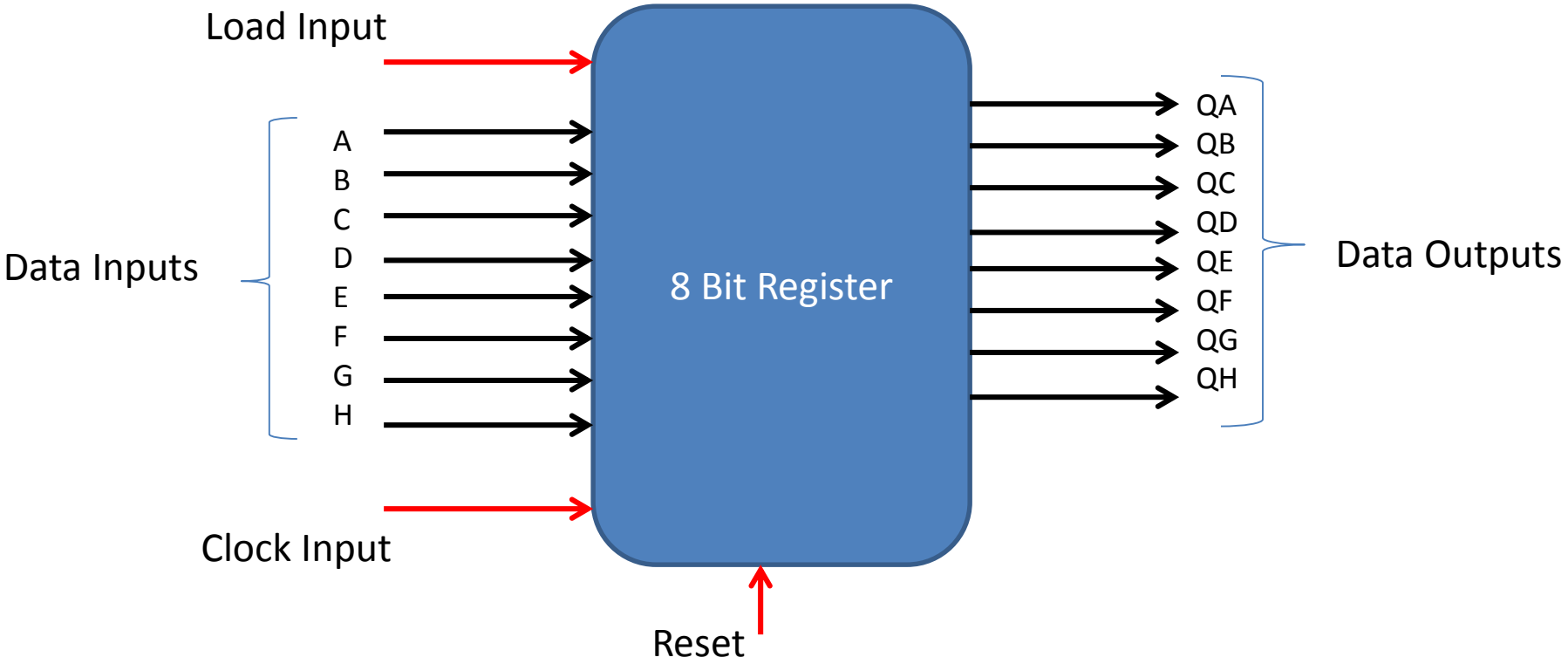
	Implementation	Report	Final Grade	Remark
Lab 1	7.5%	7.5%	**15%**	
Lab 2- Display Ckt	7.5%	7.5%	**15%**	
Lab 3- 4 Bit Adder	7.5%	7.5%	**15%**	
Lab 4 -4 Bit Substractor	7.5%	7.5%	**15%**	
Lab 5 – 4 Bit Multiplier	7.5%	7.5%	**15%**	
Test 1			**15%**	
Final Project & Presentation			**10%**	
Total			100%	

Lab 5 B: A 4 Bit Multiplier

- i. Modify the 8 bit register with reset pin.
- ii. 4 Bit Multiplier
  - Design a 4 Bit Multiplier using the add and shift algorithm.

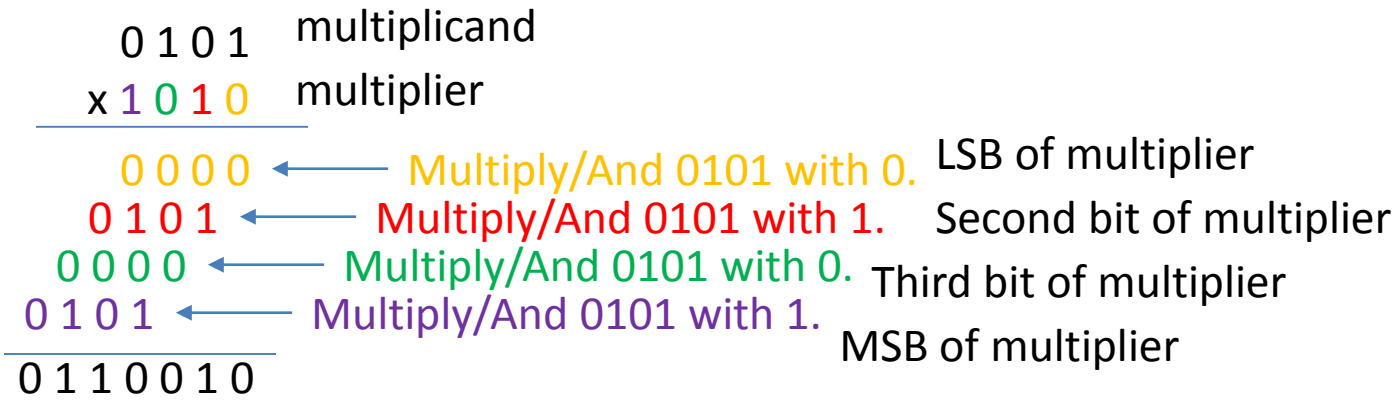
Modify the 8 bit Register with Reset Pin

- In Lab 5 A, we connect PRN and CLRN pin to Vcc.
- Add the Reset input to your 8 bit register and connect the Reset input to all the CLRN pin of DFF.



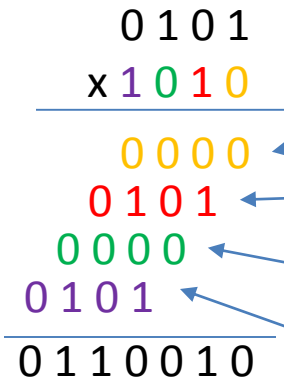
Multiplication in Binary

- Z = X*Y where X = 0101, Y = 1010.



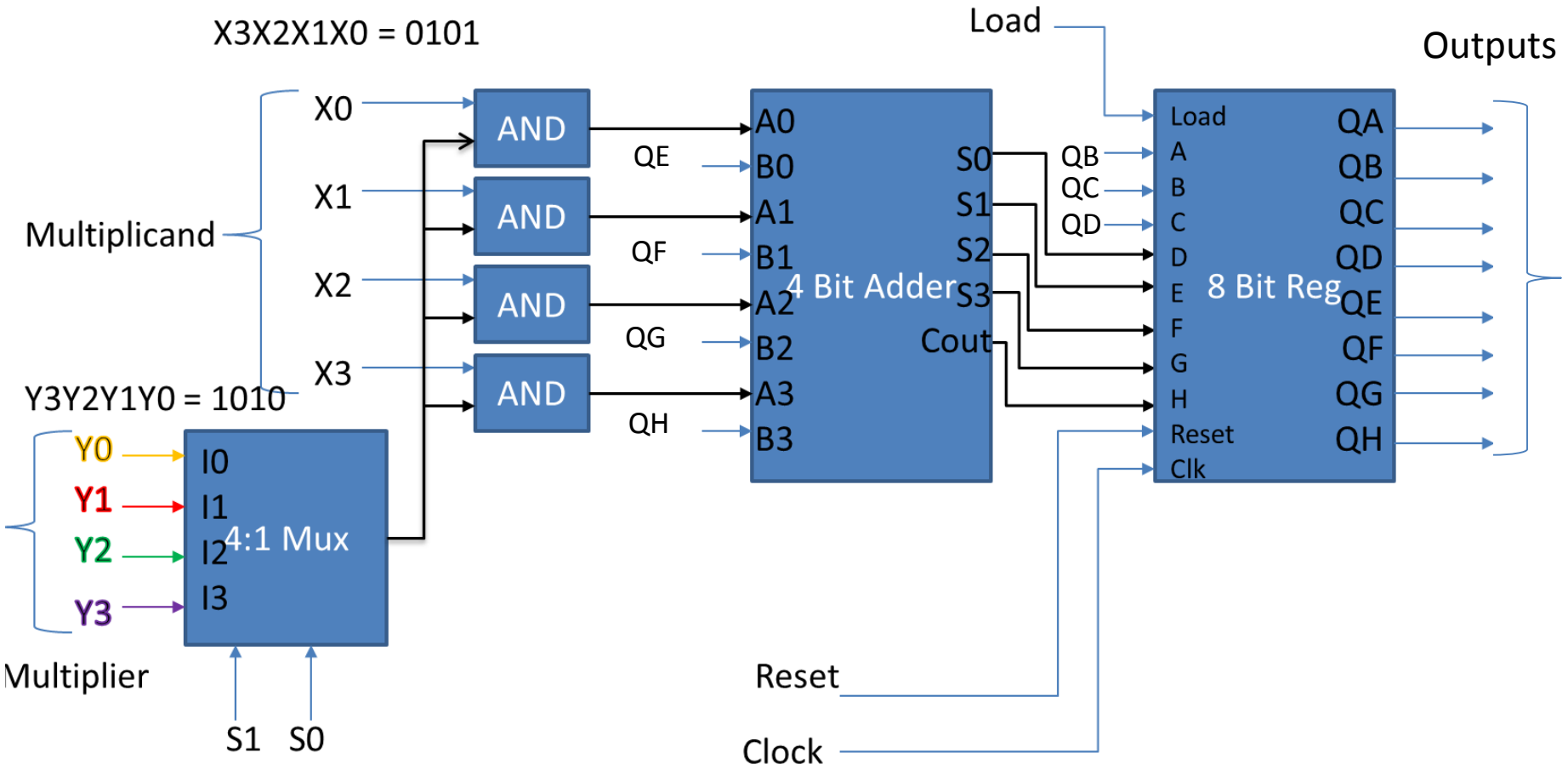
Add and Shift Algorithm

- For multiplication of two 4 bit binary the result is represented in 8 bit.
- Z = X*Y. (X is the multiplicand and Y is the multiplier).
- X and Y are 4 bit each and Z is 8 bit.

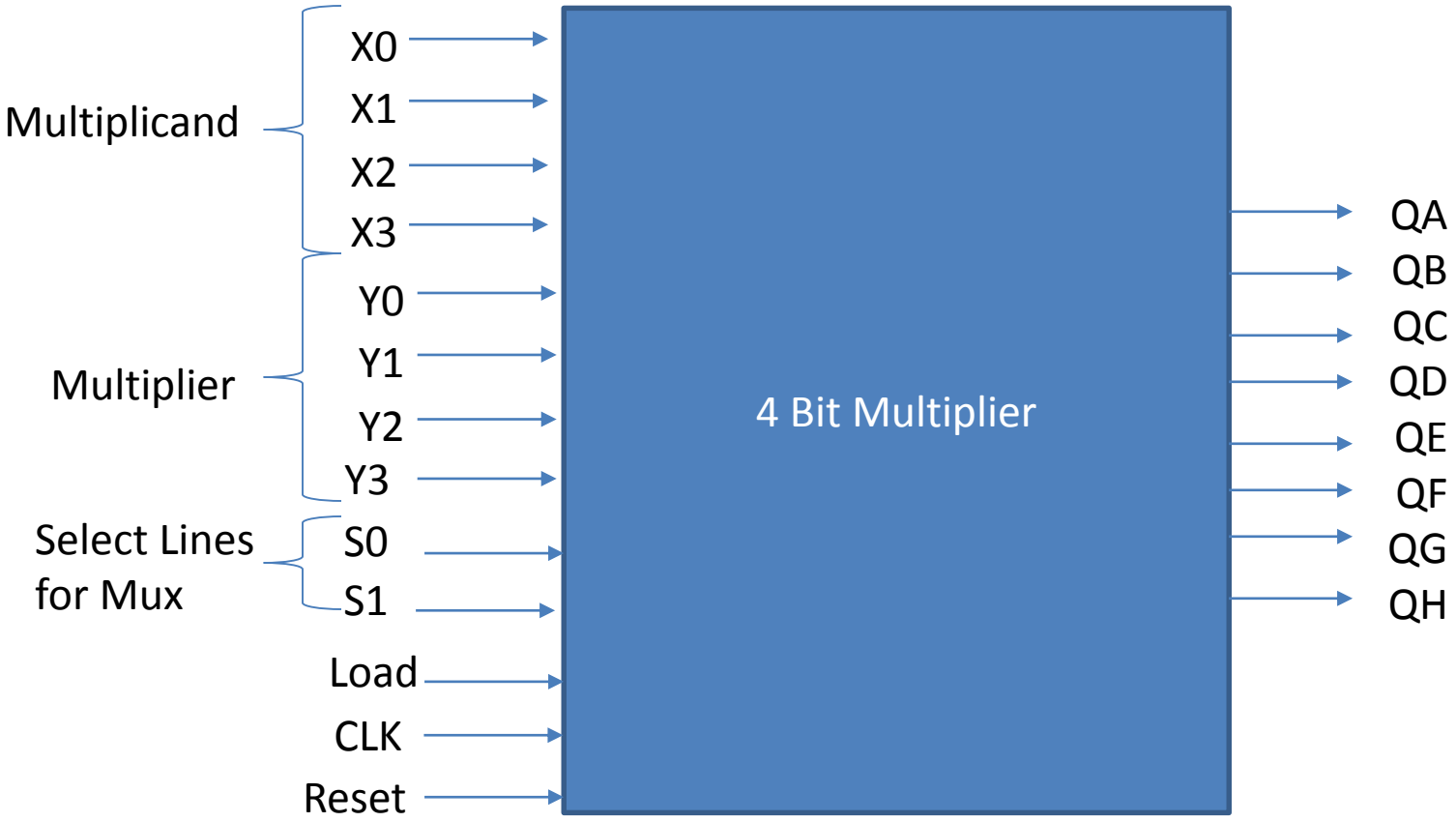


	H	G	F	E	D	C	B	A
Initialize Z	0	0	0	0	0	0	0	0
X and Y0	0	0	0	0				
Z + (X and Y0)	0	0	0	0	0	0	0	0
Shift >>	0	0	0	0	0	0	0	0
X and Y1	0	1	0	1				
Z + (X and Y1)	0	1	0	1	0	0	0	0
Shift >>	0	0	1	0	1	0	0	0
X and Y2	0	0	0	0				
Z + (X and Y2)	0	0	1	0	1	0	0	0
Shift >>	0	0	0	1	0	1	0	0
X and Y3	0	1	0	1				
Z + (X and Y3)	0	1	1	0	0	1	0	0
Shift >>	0	0	1	1	0	0	1	0

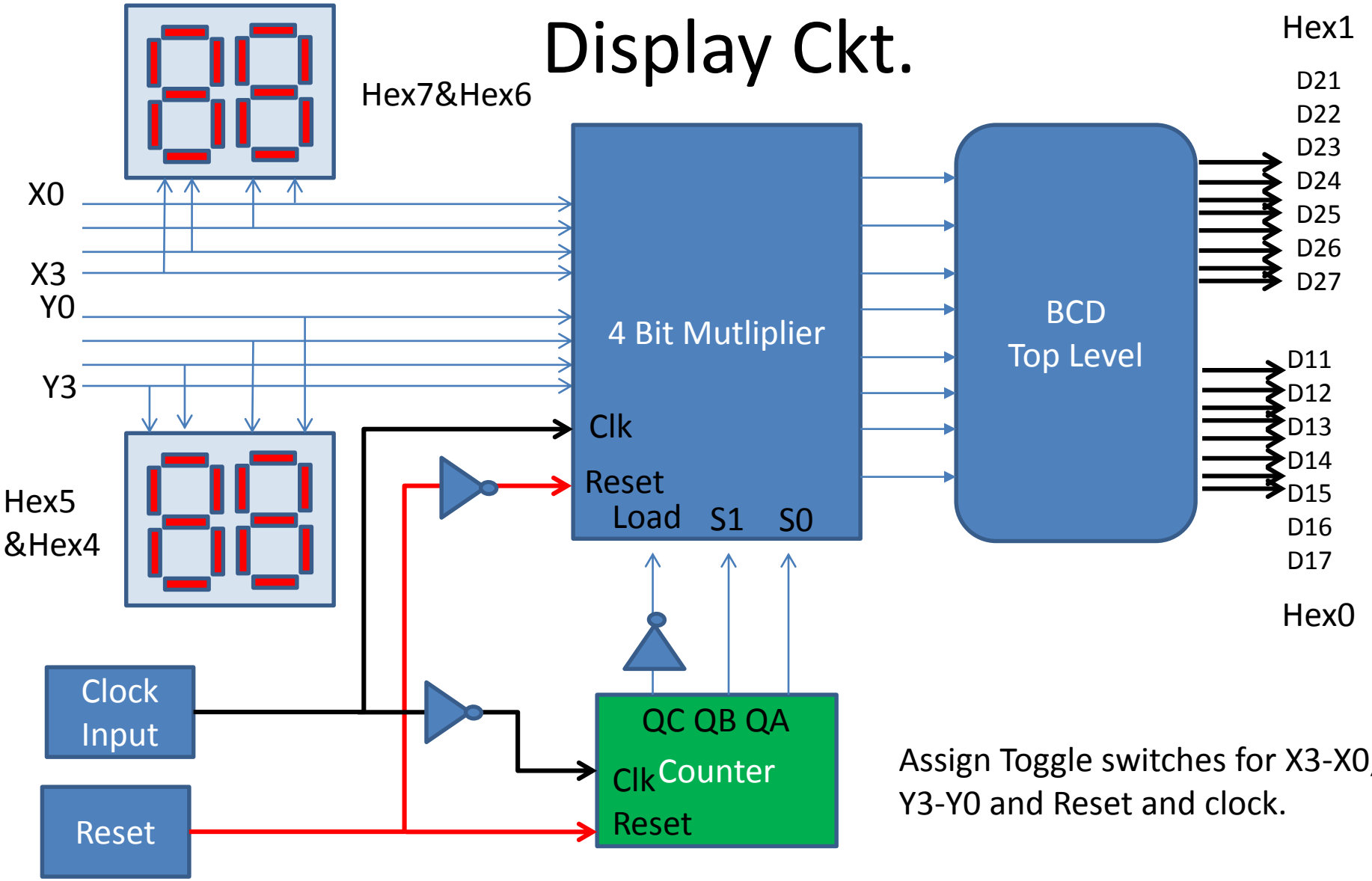
Block Diagram for A 4 bit Multiplier



4 Bit Multiplier



Top Level Ckt for 4 Bit Multiplier and Display Ckt.



Assign Toggle switches for X3-X0, Y3-Y0 and Reset and clock.

Question to be answered in Report…

- Q1. Give a clear explanation on the purpose of a 3 bit up counter in Lab 5? (10 points).

Simulation and Downloading

- Simulation result for a 4 bit multiplier.
- Download the top level 4 bit multiplier to DE2 board.

Final Calculator Project

- Final Project counts 10% of the final grade.
- Project Goals:
  - A fully functional calculator on DE2 board that allows addition, subtraction and multiplication upon user selection. (30 Points)
  - Display the calculation result using 7 segments display and also using LEDS (15 points)
    - -15 to +30 for Addition and Subtraction
    - 0 to 99 for multiplication.
  - Presentation (5 Points).