Project 1 COMBINATIONAL CIRCUITS

PROJECT LIST

1. Design a combinational circuit which realizes **y = sin(x)** function. **x input** is going to be 9-bits wide, and it is going to take value of degrees in the interval [0,360). **y output** is going to be 6-bits, and it is going to be represented in 2's complement representation and it will be fixed-point with 2 digits decimal and 4 digits fractional. Y output is going to be in the interval [-1,1].
2. Design a combinational circuit which realizes **y = cos(x)** function. **x input** is going to be 9-bits wide, and it is going to take value of degrees in the interval [0,360). **y output** is going to be 6-bits, and it is going to be represented in 2's complement representation and it will be fixed-point with 2 digits decimal and 4 digits fractional. Y output is going to be in the interval [-1,1].
3. Design a combinational circuit which realizes **y = tan(x)** function. **x input** is going to be 7-bits wide, and it is going to take value of degrees in the interval [-64,64). **y output** is going to be 6-bits, and it is going to be represented in 2's complement representation and it will be fixed-point with 2 digits decimal and 4 digits fractional. Y output is going to be in the interval [-2,2).
4. Design a combinational circuit which realizes **y = sinh(x)** function. **x input** is going to be 7-bits wide, and it is going to take value of degrees in the interval [-4,4) and it will be fixed-point with 3 digits decimal and 4 digits fractional. **y output** is going to be 10-bits, and it is going to be represented in 2's complement representation and it will be fixed-point with 6 digits decimal and 4 digits fractional. Y output is going to be in the interval [-32,32).
5. Design a combinational circuit which realizes **y = cosh(x)** function. **x input** is going to be 7-bits wide, and it is going to take value of degrees in the interval [-4,4) and it will be fixed-point with 3 digits decimal and 4 digits fractional. **y output** is going to be 10-bits, and it is going to be represented in 2's complement representation and it will be fixed-point with 5 digits decimal and 5 digits fractional. Y output is going to be in the interval [0,32).
6. Design a combinational circuit which realizes **y = tanh(x)** function. **x input** is going to be 7-bits wide, and it is going to take value of degrees in the interval [-1,1) and it will be fixed-point with 1 digit decimal and 6 digits fractional. **y output** is going to be 8-bits, and it is going to be represented in 2's complement representation and it will be fixed-point with 1 digit decimal and 7 digits fractional. Y output is going to be in the interval [-1,1).
7. Design a combinational circuit which realizes **y = 3^x** function. **x input** is going to be 6-bits wide, and it is going to take values in the interval [0,8) and it will be fixed-point with 3 digits decimal and 3 digits fractional. **y output** is going to be 13-bits positive integers, and it is going to be in the interval [0,8192).
8. Design a combinational circuit which realizes **y = 2.5^x** function. **x input** is going to be 6-bits wide, and it is going to take values in the interval [0,8) and it will be fixed-point with 3 digits decimal and 3 digits fractional. **y output** is going to be 11-bits positive integers, and it is going to be in the interval [0,2048).
9. Design a combinational circuit which realizes **y = ln(x)** function. **x input** is going to be 10-bits wide, and it is going to take values in the interval [1,1024). **y output** is going to be 8-bits, and it will be fixed-point with 3 digits decimal and 5 digits fractional. Y output is going to be in the interval [0,8).
10. Design a combinational circuit which realizes **y = log(x)** function. **x input** is going to be 10-bits wide, and it is going to take values in the interval [1,1024). **y output** is going to be 8-bits, and it will be fixed-point with 3 digits decimal and 5 digits fractional. Y output is going to be in the interval [0,8).
11. Design a combinational circuit which is a **6x64 multiplexer**. **X input** is going to be 64-bits, **C input** is going to be 6-bits, and **y output** is going to be 1 bit.
12. Design a combinational circuit which is a **demultiplexer**. **X input** is 1-bit, **C input** is 6-bits, and **Y output** is 64-bits. Outputs which are not selected is going to be **high impedance(z)**.
13. Design a combinational circuit which is a **comparator.** Comparator is going to have 10-bits **x input** and 1-bit **y output.** Y output is going to be 1 when x has **three ones** or x has **three zeros.**
14. Design a combinational circuit which is a **comparator.** Comparator is going to have 10-bits **x input** and 1-bit **y output.** Y output is going to be 1 when x has **four ones** or x has **two zeros.**

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15. Design a combinational circuit which is a **comparator.** Comparator is going to have 10-bits **x input** and 1-bit **y output.** Y output is going to be 1 when x has **five ones** or x has **a zero.**
16. Design a combinational circuit which is a **comparator.** Comparator is going to have 10-bits **x input** and 1-bit **y output.** Y output is going to be 1 when x has **consecutive two ones** or x has **consecutive five zeros.**
17. Design a combinational circuit which is an **encoder**. Encoder is going to have 15-bits **x input** and 4-bits **y output.** Number of ones in x input is going to be displayed on the y output.
18. Design a combinational circuit which is an **encoder**. Encoder is going to have 14-bits **x input** and 4-bits **y output.** Number of 1 couples which are separated by zero or zeroes is going to be displayed on the y output. (such as 101, 10001, 110011)
19. Design a combinational circuit which is a **comparator.** Comparator is going to have 32-bits **a input**, 32-bits **b input**, and 1-bit **e output**. e output is going to be 1 when a input is greater than b input, and is going to be 0 otherwise. Operators **(<,>,==)** are not allowed. You will design a 1-bit comparator module, 32-bit comparator will be realized using this 1-bit comparator module.
20. Design a combinational circuit which is **gray encoder.** Gray encoder is going to have 8-bits **x input**, and 8-bits **y output**.

DIRECTIVES FOR ALL PROJECTS

1. Input values for testbenches are going to be read from a text file, and output values are going to be written into another text file. You can prepare your input text by using MATLAB, C etc.
2. Project report is going to be 2 pages at most.
3. You must explain how your circuit works in your project report.