Digital Circuit & Logic Design

Lab 1: *Logic Gates*

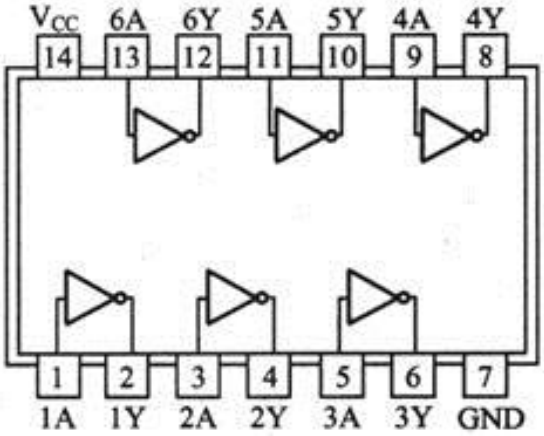
Equipments: Equipmental Box, 74LS00 (NAND Gate), 74LS04 (NOT Gate), 74LS86 (XOR Gate)

Requirements:

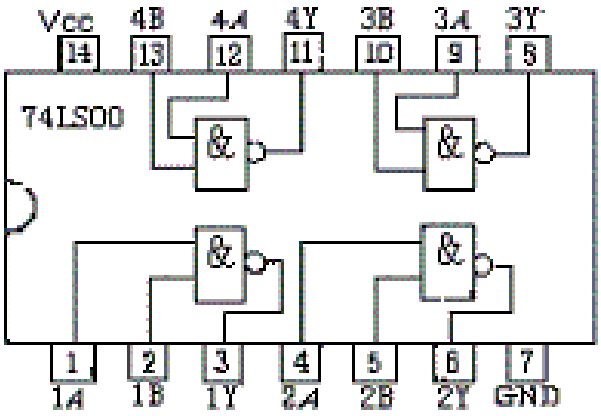
1. Get familiar with the structure, function, and usage of the equipmental box.
2. Learn the logic functions of NOT gate and NAND gates, as well as their usage and test methods.
3. Use the minimal number of 74LS00s and 74LS04s to build an XOR gate.

Chip Data:

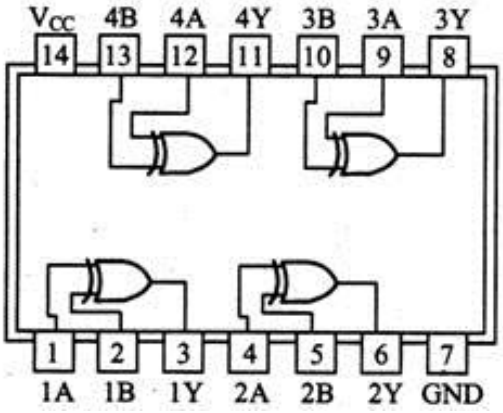
74LS04: Inverter



74LS00: NAND Gate



74LS86: XOR Gate



Lab 2: *Combinational Logic Design*

Equipments: Equipmental Box

Requirements:

1. Design an alarm for a dam. Use 4 bits to represent the water level. When the level reaches 8 meters, the green light is on; when it reaches 10 meters, the yellow light is on; and when it reaches 12 meters, the red light is on. The water level would never reach 14 meters, and only one light is on at one time. Design the control circuit of the alarm and implement it.
2. Design an adder/subtractor, which performs addition/subtraction under the control of a signal M. When M = 0, the adder works; and when M = 1, the subtractor works.

Lab 3: *Combinational Logic Design Practices I*

Equipments: Multisim

Requirements:

1. Use two 74LS138s and appropriate logic gates to implement the conversion from 2421 code to 8421 code.
2. Use one Multiplexer (74LS151 or 74LS152) to implement a 1-bit full adder.

Lab 4: *Combinational Logic Design Practices II*

Equipments: Multisim

Requirements:

1. Use two 4-bit full adders (74LS283) and appropriate logic gates to implement F = (X + Y) * Z, where X = $X_2X_1X_0$, Y = $Y_2Y_1Y_0$, and Z = Z_1Z_0.
2. Use only two 74LS283s to implement a convertor that converts 2-digit decimal 8421 codes to binary codes. For example:

   56: 0101 0110 (8421)→ 0011 1000

Lab 5: *Flip-Flops Practices*

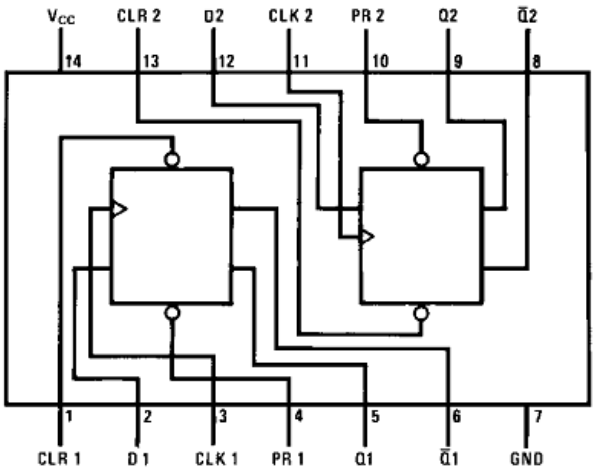
Equipments: Multisim

Requirements:

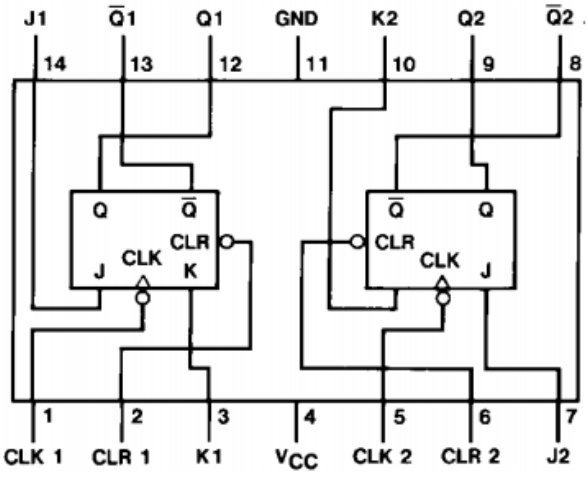
1. Use a J-K FF to design a ¼ frequency divider (the output frequency is ¼ of the input frequency)
2. Use D flip-flop(s) to build a responder(抢答器). Four persons participate in a contest, and each one has a button. The first to press the button, the corresponding lamp lights on; and the other buttons would not work anymore.

Chip Data:

74LS74 (D FF)



74LS73(J-K FF)



Lab 6: *Sequential Logic Design*

Equipments: Multisim

Requirements:

1. Build a mod-4 invertible counter.
2. Design a 0011 sequence detector (0 is detected first).

Lab 7: *Sequential Logic Design Practices*

Equipments: Multisim

Requirements:

1. Use 74LS163(s) to build a mod-100 counter.
2. Use counter and decoder or multiplexer to build a 00011101 sequence generator (1 is generated first).

Lab 8: *Comprehensive Lab*

Equipments: Multisim

Requirements: (Choose either of the followings:)

1. Design a serial 8421BCD detector. The output is Z=0 if the input lies between 0000~1001; and is Z=1 if the input is between 1010~1111. The detector takes 4-bit input and works repeatedly.
2. Design a circuit for a vending machine of drinks. The slot accepts 50-cent coins and 1-dollar coins. The drink costs 1.5 dollars. The vending machine should be able to give changes.