Logic Design Laboratory
Final Examination

Topic : Control of Free-run binary counter
Design a 4-bit free-run binary/modular counter that has the following functions

- ✓ Frequency Divider and Binary Counter
    1. Generate a 1-second-period clock using frequency divider.
    2. Design a 4-bit free-run binary counter that is triggered by the 1-second-period clock.
    3. You can use an LED to show 1-second-period clock.
- ✓ Buttons / DIP switch
    1. The counter is set to be 0000 when pressing a reset button (BUTTON 1)
    2. When a DIP switch is on, initially, the counter operates as a **free-run binary up counter**. Then, it can operate as a **free-run binary down counter** and then as a **BCD counter** when you press the same button (BUTTON 2) in rotation.
    3. When the DIP switch is off, the counter is paused. You can press a button (BUTTON 2) to increase the counter value or press another button (BUTTON 3) to decrease the counter value. When the DIP switch is on again, it operates as in 2.
- ✓ 7-Segment Display
    1. The 7-segment DISPLAY shows the corresponding number 0,1,2,…,9,A,B,C,D,E,F of the free-run counter counter
- ✓ Keyboard
    1. When you press the keyboard on the key 0,1,2,..,9,A,B,C,D,E,F, the 4-bit free-run binary counter jumps to the number of the pressed key.
    2. When you press the keyboard on the key 0,1,2,..,9, the 4-bit free-run BCD counter jumps to the number of the pressed key. When you press the keypad on the key A, B, C, D, E, F, the 4-bit free-run BCD counter jumps to 0.
- ✓ 16xLED
    1. 16 LED shows one-hot code of the 4-bit counter, for examples,

    4-bit counter >> 16-bit LED
    0000(0)   >> 0000_0000_0000_0001
    0001(1)   >> 0000_0000_0000_0010
    ….
    1111(F)   >> 1000_0000_0000_0000

Demo
TA should sign each item to get your score.
TA:_____   Frequency divider and binary counter (20%)
TA:_____   Buttons and DIP switch (20%)
TA:_____   Keyboard (20%)
TA:_____   7-segment DISPLAY (20%)
TA:_____   16 x LED (20%)

Total: _____