Class	CS47, Sec 01
Homework	II
Due Date	Apr 25, 2018 11:59 PM PST
Instructions	1. There are 7 questions with total 100 points. 2. Please create electronic document with your answer. 3. There is no need to include the question itself. However, you **MUST** include question number and sub-part index if any. Example: 5(b) 4. Please create a PDF document **hw2.pdf** and ***upload that in Canvas*** assignment page by the due date. 5. **Please re-check you submission for any logistic errors (empty file, corrupted PDF, and many more) and re-submit if needed. Once grading is started, any file with logistics errors will be given 0 point.** 6. **NO** handwritten document is accepted. 7. **NO LATE SUBMISSION.** 8. **Please explain your answer clearly – just writing the final answer in a word or two is not sufficient in most of the cases.**

1. Prove the following equation by basic identity rules (mention which rule you have applied; e.g. identity 5).
   a. F(a, b, c, d) = (a + b)(a + b + c + d) = a + b [**10pts.**]
   b. F(a, b) = ab + a'b' = (a $\oplus$ b)' [**10pts.**]

2. Establish equivalency of Q1 expressions (Q1a & Q1b) by constructing truth table of LHS and RHS. [**10 pts.**]

3. Write Boolean functions Q1a and Q1b in most compact SOP and POS form. [**10pts**]

4. Simplify F(w,x,y,z) = ∑m(0,2,5,7,8,10,13,15) using K-map and list all the prime-implicants and essential prime implicants (use compact SOP form). [**10pts.**]

5. A Boolean function f(w,x,y,z) = ΠM(1,3,9,11,14) + d(4,5,8,10,12,13). List all the prime implicants and essential prime implicants in compact SOP form. [**20pts.**]

6. Design a rock-paper-scissor digital game. There are four inputs I3, I2, I1, I0 and 3 outputs N, P1, P2. The input pair (I3, I2) encodes selection of player 2 (related to output P2) and input pair (I1, I0) encodes selection of player 1 (related to output P1). The encoding of selection is as following. If any player's setting is '00' output N is 0, P1 is 0 and P2 is 0. For any other setting N is 1, and P1, P2 are 0 or 1 depending on who is winning. If it is a draw, then both P1 and P2 are 1. Show all

the design steps. You should use multi input basic logic gates (e.g. 3-input OR) only (no decoder or multiplexer) [**20pts.**]

Encoding	Selection
00	None
01	Rock
10	Paper
11	Scissor

[Review of rules - paper beats rock, rock beats scissor, scissor beats paper]

7. Design a digital circuit to which value will be input using 5-bit 2's complement form (B4-B0 as input bits). It has following two outputs. [**10pts**]

- DIV3: It will be 1 If input value is completely divisible by 3, 0 otherwise.
- SQR: It will be 1 if absolute of input value is square value, 0 otherwise.