CS221: Digital Design

Examination 4 **Full Marks: 50**

Date: 16th October 2020

Exam starts at 9:00AM

Submission Deadline: 9:50AM in MS Teams

Instructions:

1. Marks distributions: **[Q1: 25 + Q:15 + Q3:10 = 50].**
2. Submission **deadline is hard.** If you miss it, you cannot submit your answer. So, keep ample time to upload your file. Submission of multiple file are allowed within deadline. However, if you submit the answer of same question multiple times, none of them will be evaluated.
3. You need to write your answers in your copy and submit the scan copy in MS teams.
4. In each page of your submission, writing your name and roll number is must on top of the page (preferably in different color**)** is mandatory. A page without your name or roll number will not be evaluated.
5. Submission file format <RollNo_E4>.pdf. If you are submitting multiple files, add _i (<RollNo_E4_i>.pdf) to index them. Scan all pages and create a single file for submission.
6. Only writing the final answer without any explanation attracts 100% penalty.
7. **Please give me your word that you will not use any unfair means. You can use Kohavi's and Mano's book and my video lectures and course lecture slides to solve the assignment. You have all the options and had all the time and opportunities communicate answers to one another, or discuss with other, or copy the solution from Internet and from your friend. But, I trust you and your conscience to follow these guidelines. Hope you will repay my trust.**

Questions:

1. Consider the following Boolean expressions. Identify the kernel intersections of the expressions cube–literal incidence matrix and kernel–cube incidence matrix. Rewrite the expression after the kernel intersection extraction. Solution using any other method is not acceptable. **(25)**

   f1 = ace + bce + de + g

   f2 = ad + bd + cde + ge

   f3 = abc

2. Draw the transistor level design for the following function using minimum number of PMOS and NMOS. You assume that a variable p is available in both normal and complemented form (i.e, p and p'). **(15)**

   $$f(w, x, y, z) = \sum(1, 3, 5, 7, 8, 11, 13, 15).$$

3. Consider the function again and draw the 2-level circuit representation of the function with minimum number of NOR gates. **(10)**

   $$f(w, x, y, z) = \sum(1, 3, 5, 7, 8, 11, 13, 15).$$