Indian Institute of Technology, Kharagpur

Date. February 22, 2021   Time: 45 mins   Full Marks: 10

Second Class Test (Spring) Semester 2020-21   Subject Name: Discrete Mathematics

Instruction: Notations used are as explained in the class.

1. [**2 mark**] Prove or disprove:
   Cantor's Ternary Set $\mathcal{T}$ where $\mathcal{T}$ is the set of real numbers of the form

   $$\frac{a_1}{3} + \frac{a_2}{3^2} + \frac{a_3}{3^3} + \cdots + \frac{a_n}{3^n} + \cdots$$

   where each a_n is either 0 or 2, is not a countable set.

2. [**2 mark**] Implement the following function with two-input NAND gates. Assume that both the normal and complement inputs are available.

   $$(AB + \overline{A}\,\overline{B})(C\overline{D} + \overline{C}D)$$

3. [**2 mark**] Use the Quine-McCluskey method to simplify the *sum-of-products* expression for

   $$f(x, y, z) = xy\overline{z} + x\overline{y}z + x\overline{y}\,\overline{z} + \overline{x}yz + \overline{x}\,\overline{y}z$$

4. [**2 mark**] With the use of maps, find the simplest form in sum of products of the function $F = fg$, where f and g are given by:

   $$f = wx\overline{y} + \overline{y}z + \overline{w}y\overline{z} + \overline{x}y\overline{z}$$

   $$g = (w + x + \overline{y} + \overline{z})(\overline{x} + \overline{y} + z)(\overline{w} + y + \overline{z})$$

5. [**2 mark**] The following Boolean expression:

   $$BE + \overline{B}D\overline{E}$$

   is simplified version of expression:

   $$\overline{A}BE + BCDE + B\overline{C}\,\overline{D}E + \overline{B}\,\overline{C}D\overline{E}$$

   Are there any don't care conditions? If so, what are they?

   ——-The End———