



**School of Electrical Engineering and Computer Science**  
**National University of Sciences & Technology (NUST)**

**Home Assignment No-3[CLO1]**

Subject: **Digital Logic Design**

Marks: **50**

Course: **BEE-12CD**

Issue: **03 Nov 2021**

Teacher: **Engr. Arshad Nazir**

Due: **10 Nov 2021**

**Note:**

**(12:00 Hrs)**

- ✓ Attempt the given problem set in a sequential order. Show all the design steps.
- ✓ Make an index showing summary of the problems solved with page numbers and also specify the missing ones.
- ✓ No late submissions will be accepted unless a prior approval from the teacher is obtained with extremely genuine reasons. The assignments submitted after the due date/time will be graded **zero**.
- ✓ University has zero tolerance for plagiarism and serious penalties apply. All assignments found mutually copied will be marked **zero**.
- ✓ The students will submit a certificate with the assignment work stating the originality of their efforts and no copying from others.
- ✓ **Five** marks are reserved for neat and clean work, table of contents, and certificate to be attached with the assignment work.

**Problem No-1**

Optimize the following Boolean functions together with the don't care conditions  $d$  in the forms indicated using map method by finding all the prime implicants and essential prime implicants and apply the selection rule:

- a.  $F(W,X,Y,Z) = \pi_M(0,1,6,8,11,12) \cdot \pi_D(3,7,14,15)$  **SOP**
- b.  $g(a,b,c,d,e) = (a' + c + d)(a' + b + e)(a + c' + e')(c + d + e')(b + c + d' + e)(a' + b' + c + e')$  **SOP**
- c.  $h(a,b,c,d,e) = \sum_m(1,5,12,13,14,16,17,21,23,24,30,31) + \sum_d(0,2,3,4)$  **POS**
- d.  $f(w,x,y,z) = \sum_m(0,1,3,7,8,11,12,13,15)$  **SOP & POS**

**Problem No-2**

A chemical plant needs a micro-processor-driven alarm system to warn of critical conditions in one of its chemical tanks. The tank has four HIGH/LOW (1/0) switches that monitor temperature (T), pressure (P), fluid level (L), and weight (W). Design a system that will notify the micro-processor to activate an alarm when any of the following conditions arise:

- a. High fluid level with high temperature and high pressure
- b. Low fluid level with high temperature and high weight
- c. Low fluid level with low temperature and high pressure
- d. Low fluid level with low weight and high temperature

Use map method to derive simplified Boolean equation for the conditions that will activate the alarm.

Implement the chemical tank alarm system with two-level (a) NAND-AND, (b) OR-NAND forms

**Problem No-3**

Implement the following two-level function using multi-level NOR gates:

$$f(x_1, x_2, x_3, x_4, x_5, x_6, x_7) = x_1 x_4 x_5 + x_1 x_4 x_6 + x_1 x_7 + x_2 x_3 x_4 x_5 + x_2 x_3 x_4 x_6 + x_2 x_3 x_7$$

Assume that logic gates have a maximum fan in of 2 and the input variables are available in uncomplemented form only.

**Problem No-4**

Consider the following functions

$$F(A, B, C, D) = \sum_m (1, 3, 4, 5, 9, 10, 11, 12, 13, 14, 15)$$

$$G(A, B, C, D) = \sum_m (0, 2, 3, 4, 5, 7, 8, 10, 11, 12, 13, 15)$$

Use map method to obtain minimum sum-of-product (SOP) expressions for F, G and F+G.

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**“Good Luck”**