Dec. 23, 2010

COMPUTER ENGINEERING DEPARTMENT

COE 561

Digital System Design and Synthesis

MAJOR EXAM II

(Open Book Exam)

First Semester (101)

Time: 1:00-4:00 PM

Student Name : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Student ID. : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| --- | --- | --- |
| **Question** | **Max Points** | **Score** |
| **Q1** | **15** |  |
| **Q2** | **20** |  |
| **Q3** | **15** |  |
| **Q4** | **14** |  |
| **Q5** | **18** |  |
| **Q6** | **18** |  |
| **Total** | **100** |  |

# 

# **[15 Points]**

# **(Q1)** Consider the function F(A, B, C, D) with **ON-SET=Σm(0, 5, 7, 13, 15)** and **OFF-SET=Σm(8, 10, 11, 12)**. Note that you do not need to use the positional-cube notation in your solution.

## **Expand** the minterm **A’B’C'D’** using ESPRESSO heuristics.

## A cover of the function is given by F = A’ + BD. **Reduce** the cube **A’** using Theorem 7.4.1.

## Use Corollary 7.4.1 to check if the implicant **BD** is an **essential** prime implicant.

# 

# **[20 Points]**

# **(Q2)** Consider the following cover of a function F*(A,B,C,D)*

# 

# With *FDC*= ∑m(5, 11, 12)

## Determine the relatively essential set of cubes, Er.

## Determine the totally redundant, Rt, and partially redundant, Rp, sets of cubes.

## Find a subset of Rp that, together with Er, covers the function by solving a covering problem.

# **[15 Points]**

# **(Q3)** Consider the logic network defined by the following expression:

# *x = a c d + a e + a' b' f + a' b' g + b c d + b e*

## Using the recursive procedure **KERNELS**, compute all the kernels and co-kernels of *x*. Show all the steps of the algorithm. Assume the following lexicographic order: {a, a’, b, b’, c, d, e, f, g}.

## 

# 

# **[14 Points]**

# **(Q4)** Consider the logic network defined by the following expression:

# *x = a b d + a b e + a b' d' e' + a' c d + a' c e + a' c' d' e'*

# Compute the weight of the double cube divisors *d1 = a b + a' c* and *d2 = d + e*. Extract the double cube divisor with the highest weight and show the resulting network after extraction and the number of literals saved.

# 

# **[18 Points]**

# **(Q5)** Consider the logic network defined by the following expressions with inputs *{a, b, c}* and output {*z}*:

# 

# *x = a + b*

# *y = x' c + a x'*

# *z = y + c'*

# 

## Compute the CDC set for the cut at the inputs of circuit Y.

## Compute the ODC set for node Y.

## Simplify the function of Y using both its ODC and CDC.

## Based on perturbation analysis starting with the original network, determine if it is possible to change the implementation of *y* to *y= x'.*

**[18 Points]**

# **(Q6)** Consider the logic network below with inputs *{a, b, c, d, e, f, g, h}* and output *{X}*:

# 

# Assume that the delay of a gate is related to the number of its inputs i.e. the delay of a 2-input AND gate is 2. Also, assume that the input data-ready times are zero for all inputs.

## Compute the data ready times and slacks for all vertices in the network.

## Determine the topological critical path.

## Suggest an implementation of the function *X* to reduce the delay of the circuit to the minimum possible and determine the maximum propagation delay in the optimized circuit. Has the area been affected?