Dec. 12, 2011

COMPUTER ENGINEERING DEPARTMENT

COE 561

Digital System Design and Synthesis

MAJOR EXAM II

(Open Book Exam)

First Semester (111)

Time: 8:00-10:30 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, 8, 12)** and **OFF-SET=Σm(2, 10, 11, 13, 14, 15)**. 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’B + C’D’. **Reduce** the cube **A’B** using Theorem 7.4.1.

## Use Corollary 7.4.1 to check if the implicant **A’B** is an **essential** prime implicant.

#  **[20 Points]**

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

#

#  With *FDC*= ∑m(6, 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 e + a c' e' + a d + b c e + b c' e' + b d*

## 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, b, c, c’, d, e, e’}.

##

#

#  **[14 Points]**

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

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

# Compute the weight of the double cube divisors *d1 = a b + a' b’* and *d2 = c + d*. 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’ + a’ b*

# *y = a’ c’ x' + b x*

# *z = y + a b'*

#

## Compute the SDC set for nodes *x* and *y*.

## Use the SDC computed in (i) to simplify *z*.

## Compute the CDC and ODC of Y based on the simplified network in (ii) and simplify its function.

**[18 Points]**

# **(Q6)** Consider the logic network below with inputs *{a, b, c, d, e, f}* 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 except input *a,* which has a data-ready time of 2.

## 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?