Nov. 2, 2006

COMPUTER ENGINEERING DEPARTMENT

COE 561

Digital System Design and Synthesis

MAJOR EXAM I

(Open Book Exam)

First Semester (061)

Time: 3:30-5:30 PM

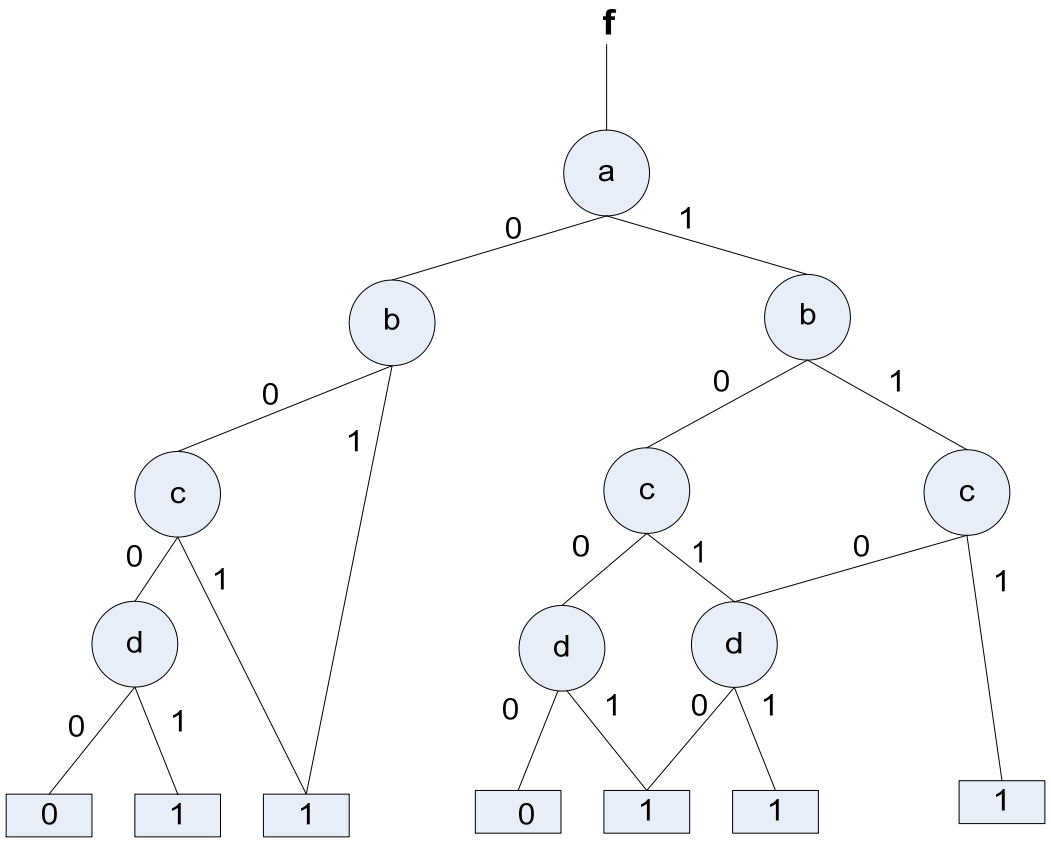
Student Name : _____

Student ID. : _____

Question	Max Points	Score
Q1	10	
Q2	16	
Q3	26	
Q4	28	
Q5	20	
Total	100	

[10 Points]

(Q1) Consider the following OBDD with the variable ordering {a, b, c, d}. Reduce it based on **Reduce** function to obtain the **ROBDD**. Show the details of applying the algorithm step by step.



[16 Points]

(Q2) Consider the function $F(A,B,C) = \overline{A}\overline{B} + AC + AB$.

(i) Represent the function using **positional cube notation**.

(ii) Using positional cube notation, compute the **cofactor** F_A.

(iii) Using positional cube notation, compute the **consensus** between the two cubes $\overline{A}\overline{B}$ and AC.

(iv) Using positional cube notation, compute the **sharp** operation $AC \# AB$.

(v) Using positional cube notation, determine if the cube $\overline{B}C$ is **covered** by the function $F = \overline{A}\overline{B} + AC + AB$.

[26 Points]

(Q3) Consider the two Boolean functions F_1 and F_2 given below:

$$F_1(A,B,C,D) = ABC + \overline{A}\overline{B}C + A\overline{B}\overline{C} + A\overline{B}\overline{D}$$

$$F_2(A,B,C,D) = ABC + A\overline{D} + \overline{B}\overline{C}$$

(i) Compute the expansion of F_1 and F_2 using the **Orthonormal Basis** {$\varnothing_1$=A'B', $\varnothing_2$=A'B, $\varnothing_3$=AB', $\varnothing_4$=AB}.

(ii) Compute the **complement** of function F_1**, *i.e.,*** $\overline{F_1}$.

(iii) Compute the function $F_1 \oplus F_2$.

(iv) Draw the **ROBDD** for the function F_1 using the variable order {A , B, C, D}.

(v) Draw the **ITE DAG** for the function $F_1 \cdot \overline{F_2}$ using the variable order {A, B, C, D}. Use the given functions as is and do not start with the minimized result of $F_1 \cdot \overline{F_2}$. Show all the details of your solution using ITE procedure.

[28 Points]

(Q4) Consider the function $F(A,B,C,D) = \overline{A}B\overline{D} + \overline{B}C\overline{D} + \overline{A}CD + B\overline{C}\overline{D} + BCD + AB\overline{C} + AC\overline{D}$

(i) Compute the **complement** of the function using the recursive complementation procedure outlined in section 7.3.4.

(ii) Compute all the **prime implicants** of the function using the method outlined in section 7.3.4.

[20 Points]

(Q5) Consider the following given matrix representing a covering problem:

$$\begin{bmatrix} \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{0} & \mathbf{1} & \mathbf{1} & \mathbf{0} & \mathbf{0} \\ \mathbf{1} & \mathbf{1} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{1} & \mathbf{0} \\ \mathbf{1} & \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{0} \\ \mathbf{1} & \mathbf{0} & \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{1} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{1} & \mathbf{1} \\ \mathbf{0} & \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{1} & \mathbf{1} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{1} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{1} & \mathbf{1} & \mathbf{1} & \mathbf{0} \end{bmatrix}$$

Find a **minimum cover** using **EXACT_COVER** procedure. Show all the details of the algorithm. Assume the following order in branching selection when needed: C_1, C_2, C_3, C_4, C_5, C_6, C_7, C_8.