Set – I :: 2017504001 - 2017504036

Problem 1

For each of the following functions, find all of the prime implicants, using the Quine-McCluskey method.

(a) $f(a, b, c, d) = \Sigma\, m(1, 5, 7, 9, 11, 12, 14, 15)$

(b) $f(a, b, c, d) = \Sigma\, m(0, 1, 3, 5, 6, 7, 8, 10, 14, 15)$

Problem 2

A sequential circuit has three D flip-flops, A, B, and C, and one input, x. It is described by the following flip-flop input functions:

$$DA = (BC' + B'C)x + (BC + B'C')x'$$

$$DB = A$$

$$DC = B$$

(a) Derive the state table for the circuit.

(b) Draw two state diagrams: one for $x = 0$ and the other for $x = 1$.

Problem 3

An asynchronous sequential circuit has two internal states and one output. The excitation and output functions describing the circuit are as follows:

$$Y_1 = x_1x_2 + x_1y_2' + x_2'y_1$$

$$Y_2 = x_2 + x_1y_1'y_2 + x_1'y_1$$

$$z = x_2 + y_1$$

(a) Draw the logic diagram of the circuit.

(b) Derive the transition table and output map.

(c) Obtain a flow table for the circuit.

Problem 4

Design a combinational circuit with three inputs and one output. The output is equal to logic-1 when the binary value of the input is less than 3. The output is logic-0 otherwise.

Set – II :: 2017504037 - 2017504072

Problem 1

For this function, find a minimum sum-of-products solution, using the Quine-McCluskey method.

$f(a, b, c, d) = \Sigma\, m(1, 3, 4, 5, 6, 7, 10, 12, 13) + \Sigma\, d(2, 9, 15)$

Problem 2

A sequential circuit has one flip-flop, Q; two inputs, x and y; and one output, S. It consists of a full-adder circuit connected to a D flip-flop, as shown in Fig. P6-8. Derive the state table and state diagram of the sequential circuit.

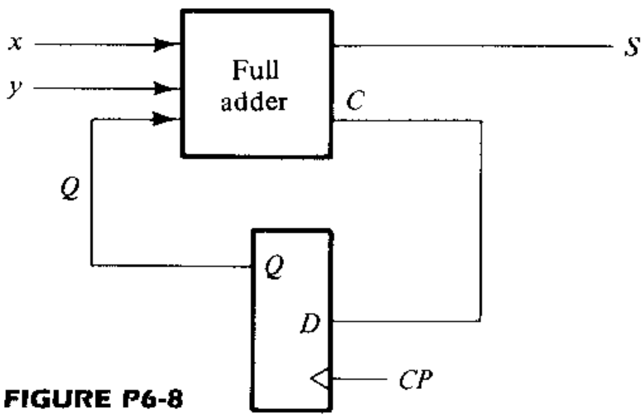

FIGURE P6-8

Problem 3

Convert the flow table of Fig. P9-5 into a transition table by assigning the following binary values to the states: $a = 00$, $b = 11$, and $c = 01$.

(a) Assign values to the extra fourth state to avoid critical races.
(b) Assign outputs to the don't-care states to avoid momentary false outputs.
(c) Derive the logic diagram of the circuit.

	x_1x_2 = 00	01	11	10
a	a, 0	b, –	c, –	a, 1
b	a, –	b, 0	b, 0	c, –
c	a, –	b, –	c, 1	c, 0

FIGURE P9-5

Problem 4

Design a combinational circuit with three inputs, x, y, and z, and three outputs, A, B, and C. When the binary input is 0, 1, 2, or 3, the binary output is one greater than the input. When the binary input is 4, 5, 6, or 7, the binary output is one less than the input.

Digital Assignment – Last Date 30.10.18 Tuesday

Set – III :: 2017504073 - 2017504534

Problem 1

For each of the following functions, find all of the prime implicants using the Quine-McCluskey method.

(a) $f(a, b, c, d) = \Sigma\, m(0, 3, 4, 5, 7, 9, 11, 13)$

(b) $f(a, b, c, d) = \Sigma\, m(2, 4, 5, 6, 9, 10, 11, 12, 13, 15)$

Problem 2

A sequential circuit has one flip-flop, Q; two inputs, x and y; and one output, S. It consists of a full-adder circuit connected to a D flip-flop, as shown in Fig. P6-8. Derive the state table and state diagram of the sequential circuit.

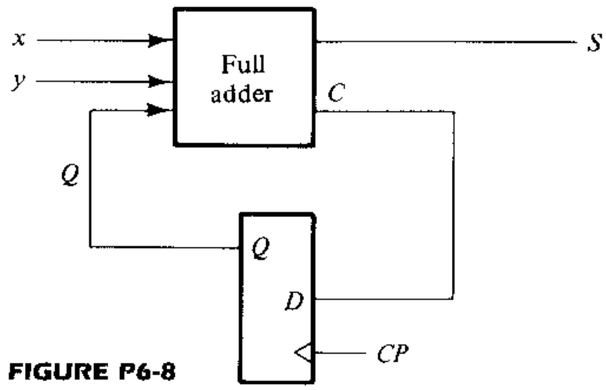

FIGURE P6-8

Problem 3

For the asynchronous sequential circuit shown in Fig. P9-9:

(a) Derive the Boolean functions for the outputs of the two SR latches Y_1 and Y_2. Note that the S input of the second latch is $x_1' y_1'$.

(b) Derive the transition table and output map of the circuit.

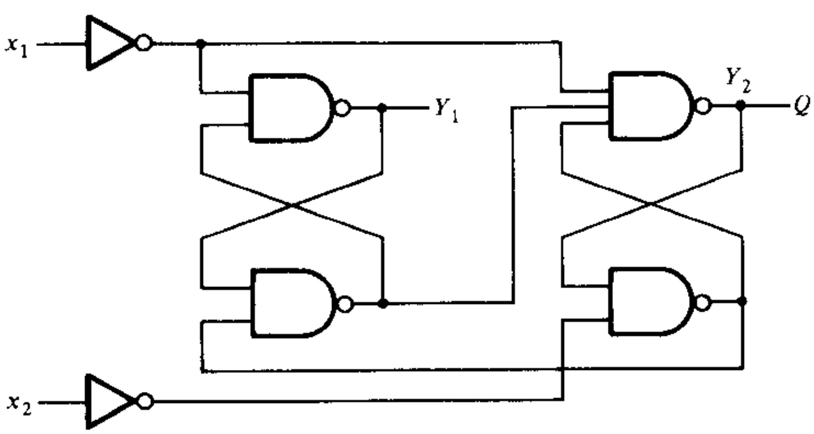

FIGURE P9-9

Problem 4

Design a combinational circuit that adds one to a 4-bit binary number, $A_3A_2A_1A_0$. For example, if the input of the circuit is $A_3A_2A_1A_0 = 1101$, the output is 1110. The circuit can be designed using four half-adders.

Set – IV :: 2017504535 - 2017504553

Problem 1

For each function, find a minimum sum-of-products solution using the Quine-McCluskey method.

(a) $f(a, b, c, d) = \Sigma m(2, 3, 4, 7, 9, 11, 12, 13, 14) + \Sigma d(1, 10, 15)$

(b) $f(a, b, c, d) = \Sigma m(0, 1, 5, 6, 8, 9, 11, 13) + \Sigma d(7, 10, 12)$

Problem 2

Reduce the number of states in the following state table and tabulate the reduced state table.

Present State	Next state $x = 0$	Next state $x = 1$	Output $x = 0$	Output $x = 1$
a	f	b	0	0
b	d	c	0	0
c	f	e	0	0
d	g	a	1	0
e	d	c	0	0
f	f	b	1	1
g	g	h	0	1
h	g	a	1	0

Problem 3

Obtain a primitive flow table for a circuit with two inputs, x_1 and x_2, and two outputs, z_1 and z_2, that satisfy the following four conditions:

(a) When $x_1x_2 = 00$, the output is $z_1z_2 = 00$.

(b) When $x_1 = 1$ and x_2 changes from 0 to 1, the output is $z_1z_2 = 01$.

(c) When $x_2 = 1$ and x_1 changes from 0 to 1, the output is $z_1z_2 = 10$.

(d) Otherwise, the output does not change.

Problem 4

Design a combinational circuit with four inputs that represent a decimal digit in BCD and four outputs that produce the 9's complement of the input digit. The six unused combinations can be treated as don't-care conditions.

Set – V :: 2017504562 - 2017504590

Problem 1

Using the Quine-McCluskey method, find all minimum sum-of-products expressions for

(a) $f(A, B, C, D, E) = \Sigma\, m(0, 1, 2, 3, 4, 8, 9, 10, 11, 19, 21, 22, 23, 27, 28, 29, 30)$

(b) $f(A, B, C, D, E) = \Sigma\, m(0, 1, 2, 4, 8, 11, 13, 14, 15, 17, 18, 20, 21, 26, 27, 30, 31)$

Problem 2

Analyze the circuit of Fig. P6-18 and prove that it is equivalent to a T flip-flop.

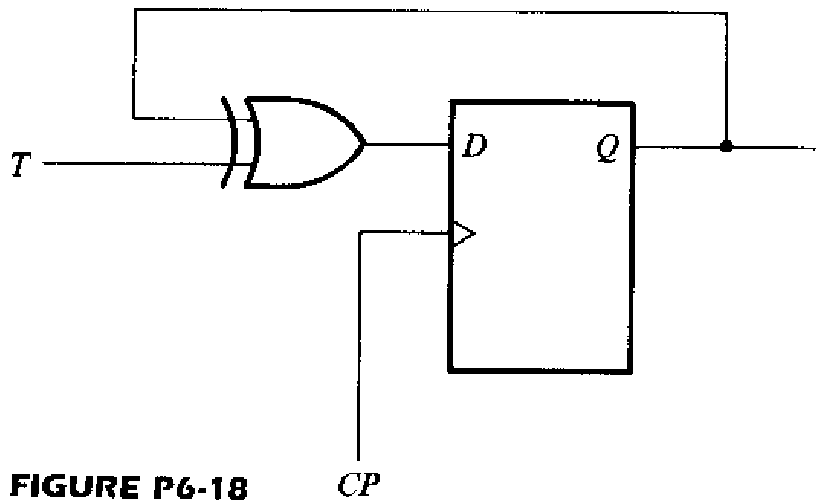

FIGURE P6-18

Problem 3

The Boolean functions for the inputs of an SR latch are as follows. Obtain the circuit diagram using a minimum number of NAND gates.

$$S = x_1' x_2' x_3 + x_1 x_2 x_3$$

$$R = x_1 x_2' + x_2 x_3'$$

Problem 4

Design a combinational circuit that detects an error in the representation of a decimal digit in BCD. The output of the circuit must be equal to logic-1 when the inputs contain any one of the six unused bit combinations in the BCD code.

Set – VI :: 2017504591 - 2017504621

Problem 1

(a) Use the Quine-McCluskey method to find all prime implicants of $f(a, b, c, d, e) = \Sigma\, m(1, 2, 4, 5, 6, 7, 9, 12, 13, 15, 17, 20, 22, 25, 28, 30)$. Find all essential prime implicants, and find all minimum sum-of-products expressions.

(b) Repeat part (a) for f'.

Problem 2

Design a sequential circuit with two *JK* flip-flops, A and B, and two inputs, E and x. If $E = 0$, the circuit remains in the same state regardless of the value of x. When $E = 1$ and $x = 1$, the circuit goes through the state transitions from 00 to 01 to 10 to 11 back to 00, and repeats. When $E = 1$ and $x = 0$, the circuit goes through the state transitions from 00 to 11 to 10 to 01 back to 00, and repeats.

Problem 3

(a) Obtain a binary state assignment for the reduced flow table shown in Fig. P9-19. Avoid critical race conditions.

(b) Obtain the logic diagram of the circuit using NAND latches and gates.

	x_1x_2 = 00	01	11	10
a	a, 0	a, 1	b, −	d, −
b	a, −	b, 0	b, 0	c, −
c	a, −	−, −	d, −	c, 0
d	a, −	a, −	d, 1	d, 1

FIGURE P9-19

Problem 4

Design a combinational circuit that converts a binary number of four bits to a decimal number in BCD. Note that the BCD number is the same as the binary number as long as the input is less than or equal to 9. The binary number from 1010 to 1111 converts into BCD numbers from 1 0000 to 1 0101.