Q.1) Max Marks: 1

A value given in a 16 bit register is 11101000100101. The value in register using 4 digit 3321 system will be ________

Correct Answer

Solution: (3524)

Solution: 3524

The grouping of bits will be:

3321 3321 3321 3321

0011 1010 0010 0101

| | | |

3 5 2 4

Q.2) Max Marks: 1

Given the function F(W, X, Y, Z) = X'(W + Y' + Z') and don't care, D(W, X, Y, Z) = WXY + WX'Z'. Which of the following statements are correct?

I. F(W, X, Y, Z) = π(0, 1, 2, 9, 11) + d(8, 10, 13, 15)
II. F(W, X, Y, Z) = Σ(0, 1, 2, 9, 11) + d(8, 10, 13, 15)
III. F(W, X, Y, Z) = π(3, 4, 5, 6, 7, 12, 14) + d(8, 10, 13, 15)
IV. F(W, X, Y, Z) = Σ(3, 4, 5, 6, 7, 12, 14) + d(8, 10, 13, 15)

A. I and II are correct

B. I and IV are correct

C. II and IV are correct

D. II and III are correct — Correct Option

Solution: (D)

Solution: (iii)

The simplification of the expression X'(W + Y' + Z') will be: (after removing all redundant terms)

=> W'X'Y'Z (M_1) + W'X'Y'Z' (M_0) + WX'YZ (M_{11}) + WX'Y'Z (M_9) + W'X'YZ' (M_2)

Hence, F(W, X, Y, Z) = Σ(0, 1, 2, 9, 11) and the rest of the terms will be maxterms i.e. F(W, X, Y, Z) = π(3, 4, 5, 6, 7, 12, 14)

Simplification of WXY + WX'Z will be:

=> WXYZ (M_{15}) + WXYZ' (M_{13}) + WX'YZ' (M_{10}) + WX'Y'Z' (M_8)

Hence, it will be d(8, 10, 13, 15)

(Since, don't care terms are the same, therefore no need to simplify them.)

Q.3) Max Marks: 1

Which of the following statements are correct about signed numbers?

I. The range of numbers for signed magnitude representation and signed 1's complement representation differs by 1.
II. The range of signed 2's complement number are from $-2^{(n-1)}$ to $2^{(n-1)}-1$

A. Only I

B. Only II — Correct Option

Solution: (B)

Solution: (ii)

I. The range of signed magnitude number representation and signed 1's complement representation is same which is $(-2^{(n-1)} - 1)$ to $(2^{(n-1)} - 1)$
II. The range of signed 2's complement number are from $-2^{(n-1)}$ to $2^{(n-1)}-1$
For example, for 4-bits the representation of signed magnitude, signed 1's complement and signed 2's complement representation will be:

W	X	Y	Z	Signed magnitude number	Signed 1's complement number	Signed 2's complement number
0	0	0	0	0	0	0

0	0	0	1	1	1	1
0	0	1	0	2	2	2
0	0	1	1	3	3	3
0	1	0	0	4	4	4
0	1	0	1	5	5	5
0	1	1	0	6	6	6
0	1	1	1	7	7	7
1	0	0	0	0	-7	-8
1	0	0	1	-1	-6	-7
1	0	1	0	-2	-5	-6
1	0	1	1	-3	-4	-5
1	1	0	0	-4	-3	-4
1	1	0	1	-5	-2	-3
1	1	1	0	-6	-1	-2
1	1	1	1	-7	0	-1

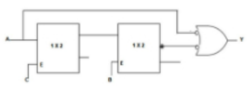
C Both I and II

D Neither I nor II

Q.4)

Max Marks: 1

Consider the following combinational circuit of the decoder:



Which of the following is correct for Y.

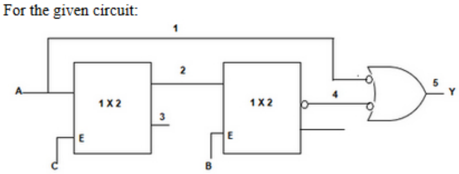
A A + C'

B A' + B

Correct Option

Solution: (B)

For the given circuit:



Expression at 1 will be: A
Expression at 2 will be: A'C
Expression at 3 will be: AC
Expression at 4 will be: (A'C)' B = (A + C')B = AB + BC'
Expression at 5 will be: A' + AB + BC'
On expanding expression at 5 we will get:
=> A' + AB + BC'
=> (A' + A) (A' + B) + BC'
=> A' + B + BC'
=> A' + B (1 + C')
=> A' + B
Hence, the correct option is (ii)

C A' + BC'

D None of the above

Q.5)

Max Marks: 1

The minimum number of NAND gates required to represent the function F(A, B, C) = A'B'C + BC + AC are _______

Correct Answer | Attempted

Solution: ()

Solution: 0

First we try to minimize the expression in order to get the minimum number of gates for its implementation.

=> A'B'C + BC + AC

=> A'B'C + BC + AC
=> A'B'C + AC + BC (A + A')
=> A'B'C + AC + ABC + A'BC
=> A'C (B + B') + AC (1 + B)
=> A'C + AC
=>C (A' + A)
=> C
Hence, 0 NAND gates are required to implement the given expression.

Q.6)

Max Marks: 1

What is the minimum number so digits required to represent a 32 digit number base 8 into a hexadecimal number?

A 96

B 24 Correct Option

Solution: (B)

Solution: (ii)
For a n digit number with base b, the largest number in decimal could be given as $b^n - 1$.
If it is to be converted in some other base x with k digits (the largest number will be $x^k - 1$
then:
=> $x^k - 1 >= b^n - 1$
=> $x^k >= b^n$
=> $k = n \log_x b$
Since here we have, n = 32, b = 8. First lets convert it into binary (for ease of calculation) so x = 2
Then, $k = 32 * \log_2 8 = 32 * 3 = 96$
Hence, 96 digits are required in binary to represent 32 digit number with base 8. Since for hexadecimal, each number is represented by 4 digit/bits of binary number. Therefore, 96/4 = 24
Hence, the minimum number of digits required to represent a 32 digit number with base 8 in hexadecimal are 24.

C 64

D None of the above

Q.7)

Max Marks: 1

The minimum amount of memory unit required in order to store the result of 16 X 16 bit multiplier in the form of truth table is

A 2^{32}

B 2^{30}

C 2^{35}

D 2^{37} Correct Option

Solution: (D)

Solution: (iv)
A two 4-bit digit will result in 2 * 16 = 32 bits
Total number of multiplications possible = 2^{16} X 2^{16} = 2^{32}
Therefore, the size of the memory will be: 2^{32} X 32 = 2^{32} X 2^5 = 2^{37}
Hence, the correct option is (iv)

Q.8)

Max Marks: 1

Which of the following is the correct matching for List I and List II for the below given canonical sop form of functions:

F1(A, B, C, D) = Σ(0, 1, 2, 5, 9, 15)
F2 (A, B, C, D) = Σ(3, 5, 7, 8, 9, 11, 14)

List I	List II
a) F1. F2	I. Σ(0, 1, 2, 3, 5, 7, 8, 9, 11, 14 ,15)
b) F1' . F2	II. Σ(4, 6, 10, 12, 13)
c) F1 + F2	III. Σ(3, 8, 11, 14)
d) F1' . F2'	IV. Σ(5, 9)

A a - I, b - II, c - III, d - IV

B a - III, b - IV, c - II, d - I

C a - IV, b - III, c - II, d - I

D a - IV, b - III, c - I, d - II — Correct Option

Solution: (D)

Solution: (iv)

For the given functions F1 and F2, for AND operation we perform "intersection" of the minterms while for OR operation we perform "union of the minterms"

Therefore,

$F1 . F2 = \Sigma(5, 9)$

$F1' . F2 = \Sigma(3, 8, 11, 14)$

$F1 + F2 = \Sigma(0, 1, 2, 3, 5, 7, 8, 9, 11, 14, 15)$

$F1' . F2' = \Sigma(4, 6, 10, 12, 13)$

Here F1' will be : $\Sigma(3, 4, 6, 7, 8, 10, 11, 12, 13, 14)$

and F2' will be: $\Sigma(0, 1, 2, 4, 6, 10, 12, 13, 15)$

Q.9) Max Marks: 1

Which of the following statements is not true?

I. The expression $W \odot X \odot Y \odot Z = \Sigma(0, 3, 5, 6, 9, 10, 12, 15)$

II. The boolean function $F = WX'YZ' + W'XYZ' + WX'Y'Z + W'XY'Z$ is equivalent to $(W \oplus X)(Y \oplus Z)$

A Only I

B Only II

C Both I and II

D Neither I nor II — Correct Option

Solution: (D)

Solution: (iv)

I. The truth table for this expression could be given as:

W	X	Y	Z	$W\odot X\odot Y\odot Z$
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

Since $W \odot X \odot Y \odot Z = 1$ for an even number of 1's and 0 for odd number of 1's. The minterms will be: 0, 3, 5, 6, 9, 10, 12, 15

Hence, this statement is true.

II. Since simplification of $(W \oplus X)(Y \oplus Z)$ will be:

$\Rightarrow (WX' + W'X)(YZ' + Y'Z)$

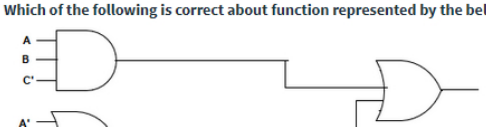
$\Rightarrow WX'YZ' + WX'Y'Z + W'XYZ' + W'XY'Z$

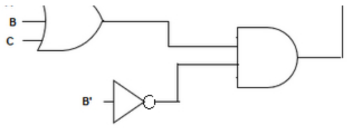
Hence, this statement is also true.

Therefore, the correct option is (iv)

Q.10) Max Marks: 1

Which of the following is correct about function represented by the below given circuit?



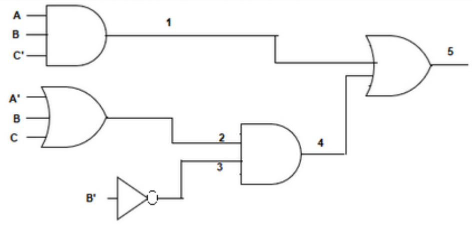


A (A'B + B + BC) + ABC'

B B

C Both (i) and (ii) — Correct Option

Solution: (c)
Solution: (iii)
The simplification of the following circuit will be:



Expression at 1 will be: ABC'
Expression at 2 will be: A' + B + C
Expression at 3 will be: B
Expression at 4 will be: (A' + B + C) . B => (A'B + B + BC) => B
Expression at 5 will be: ABC' + B => B (1 + AC') = **B**

Since there is an option for both option (i) and (ii) to be correct, therefore, we will check for (i) by simplifying it.
On simplifying (A'B + B + BC) + ABC':
=> (B (1 + A') + BC) + ABC'
=> (B + BC) + ABC'
=> B + ABC'
=> B (1 + AC')
=> B
Since both (i) and (ii) and the same, therefore, the correct option is (iii)

D Neither (i) nor (ii)

Q.11) Max Marks: 1

For the given equation $(1xy0)_r + (x3)_r = (1313)_r$. Which of the following option is correct about the values of x, y, and r?

A x = 2, y = 4, r = 3

B x = 3, y = 2, r = 4

C x = 2, y = 3, r = 4 — Correct Option

Solution: (c)

Solution: (iii)
Here, conditions are: r > x, r > y, r > 3
Option (i) is not possible because r should be greater than 3. Since it is given that r = 3, hence, this is not correct.
For Option (ii), since it satisfies all the conditions, therefore, substitute the value of x, y, and r in the given equation, we will get:
$(1320)_4 + (33)_4 = 2213$
Since final outputs are not the same, therefore, option (ii) is not correct.
For option (iii), since all conditions are satisfied, therefore we will substitute the values:
$(1230)_4 + (23)_4 = 1313$.
Hence, the correct option is (iii)

D None of the above

Q.12) Max Marks: 1

Which of the following statement is true about minimal SOP and POS canonical forms?
I. Every Minimal SOP and POS expression depends on the same number of variables.
II. In the absence of don't cares, the minimal SOP and POS are free of same number of variables.

A Only I

B Only II — Correct Option

Solution: (B)
Solution: (ii)

I. In the presence of don't cares, the number of free variables in minimal expression of POS and SOP may or may not be the same.
II. It is true that in the absence of don't cares, the minimal SOP and POS are free of same number of variables and therefore, depends on the same number of variables.

C — **Both I and II**

D — **Neither I nor II**

Q.13)

Max Marks: 1

Which of the following is the correct match for the given lists?

List I	List II
a) $(12121)_3$	I. $(260)_{10}$
b) $(198)_{12}$	II. $(151)_{10}$
c) $(4310)_5$	III. $(580)_{10}$

A — **a - I, b - II, c - III**

B — **a - II, b - III, c - I**

C — **a - III, b - I, c - II**

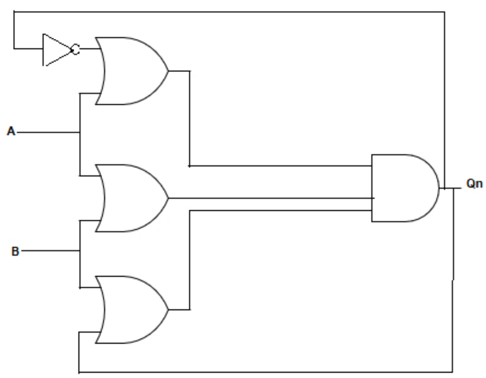
D — **a - II, b - I, c - III** — Correct Option

Solution: (D)

Solution: (iv)
$(12121)_3 = (151)_{10}$
$(198)_{12} = (260)_{10}$
$(4310)_5 = (580)_{10}$
Hence, the correct option is a - II, b - I, c - III

Q.14)

Max Marks: 1



The minimal expression for the given sequential circuit of AB-FF is?

A — **AQ + BQ'** — Correct Option

Solution: (A)
Solution: (i)
The expression for the given sequential circuit will be:
=> (A + B) (B + Q) (A + Q')
=> (AQ + B) (A + Q')
=> AQ + AB + BQ'
This expression could be the minimum but to make sure, we will draw its k-map by deriving its function and characteristic table.
The function table will be:

A	B	Q_n
0	0	0
0	1	Q'
1	0	Q
1	1	1

The characteristic table will be:

A	B	Q	Q_n

0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

The k-map will be:

A\BQ	00	01	11	10
0	0	0	0	1
1	0	1	1	1

Here, pair AB is redundant. Hence the minimal expression will be AQ + BQ'.

B AQ + AB + BQ'

C AQ + AB

D None of the above

Q.15)

Max Marks: 1

What is the number of maxterms presents for the boolean expression F(P, Q, R, S, T) = QST + Q'R'S + RST + P'Q'RT + P'Q'R + Q'R'S'T'

A 20

B 12

C 10

D 17

Correct Option

Solution: (D)

On expanding the expression QST + Q'R'S + RST + P'Q'RT + P'Q'R + Q'R'S'T' we will get:
=> PQRST + PQR'ST + P'QRST + P'QR'ST + PQ'R'ST + PQ'R'ST' + P'Q'R'ST +P'Q'R'ST' + PQRST + PQ'RST + P'QRST + P'Q'RST + P'Q'RST + P'Q'RS'T + P'Q'RST + P'Q'RST' + P'Q'RS'T + P'Q'RST' + PQ'R'S'T' + P'Q'R'S'T'

Out of these many minterms, 4 minterms are repeated which are : P'Q'RS'T, twice PQRST, and twice P'Q'RST
Therefore, the total number of minterms remained are 20 - 5 =15
Since, total number of terms/functions possible with 5 variable are = 2^5 = 32
Hence, the remaining terms are maxterm i.e 32 - # minterms = 32 - 15 = 17.

Q.16)

Max Marks: 2

A sequential circuit consists of 4 FF P, Q ,R, S and an input a = 1. The state equations of each FF is given as:

P(n + 1) = (RS + R'S')a
Q(n + 1) = P(n)
R(n + 1) = Q(n)
S(n + 1) = R(n)

The sequence of the states are generated based on the above state equations. What will the state of sequence after 6th step if the starting state is 0000.

A 8

B 13

Correct Option

Solution: (B)

Solution: (ii)
Starting state is 0000 and a = 1
Step 1:
P(1) = (RS + R'S')a = (0.0 + 1.1).1 = 1.1 = 1
Q(1) = P(0) = 0
R(1) = Q(0) = 0
S(1) = R(0) = 0
State: 1000 => 8

Step2:
P(2) = (RS + R'S')a = (0.0 + 1.1).1 = 1.1 = 1
Q(2) = P(1) = 1
R(2) = Q(1) = 0

S(2) = R(1) = 0
State: 1100 => 12

Step 3:
P(3) = (RS + R'S')a = (0.0 + 1.1).1 = 1.1 = 1
Q(3) = P(2) = 1
R(3) = Q(2) = 1
S(3) = R(2) = 0
State: 1110 => 14

Step 4:
P(4) = (RS + R'S')a = (1.0 + 1.0).1 = 0.1 = 0
Q(4) = P(3) = 1
R(4) = Q(3) = 1
S(4) = R(3) = 1
State: 0111 => 7

Step 5:
P(5) = (RS + R'S')a = (1.1 + 0.0).1 = 1.1 = 1
Q(5) = P(4) = 0
R(5) = Q(4) =1
S(5) = R(4) = 1
State: 1011 => 11

Step 6:
P(6) = (RS + R'S')a = (1.1 + 0.0).1 = 1.1 = 1
Q(6) = P(5) = 1
R(6) = Q(5) = 0
S(6) = R(5) = 1
State: 1101 => 13
Hence, the correct option is (ii)

C 1

D None of the above

Q.17)

Max Marks: 2

Let G be a function of 2 ternary variables, G(a,b) having 4 minterms. The number of functions covering G are ______
NOTE: Given 2 functions F and G, we can say function F covers function G iff all the minterms of function G are covered by function F ie F should be superset of G

Correct Answer

Solution: (32)

Solution: 32

Any function F can cover G iff it covers all of its minterms.
Since for 2 ternary variable, total number of minterms possible are = $3^2 = 9$
Since there are a total of 9 minterms out of which 4 are covered by function G. Therefore, number of minterms remaining to be covered in order to be super set are = 9 - 4 = 5
With 5 minterms, total number of functions possible are = $2^5 = 32$
Hence, 32 functions are possible which can cover G.

Another intuition:

Consider an example of function F and G for 2 variables (having four minterms), where F covers G:

Minterms	G	F
0	1	1
1	0	either 0 or 1 → 2 possibilities
2	0	either 0 or 1 → 2 possibilities
3	0	either 0 or 1 → 2 possibilities

Hence, total functions possible are 2 * 2 * 2 = 8
It could be generalised to $2^{(2^{\wedge}n - k)}$, where k is the number of minterms already present in the given function G.

Q.18)

Max Marks: 2

Given 8 Flip Flops, the ring counter can count upto A states, the twisted ring counters can count upto B states, and the ripple counter can count upto C states. The value of A + B + C will be____________

Correct Answer

Solution: (280)

Solution: 280

Given a mod-n counter, the number of states each type of counter can count are:

1) Ring Counter can count upto n states only
2) Twister ring counter (johnson counter) can count upto 2n states
3) The ripple counter can count upto 2^n states.

Therefore, the value of A, B and C for mod-8 counter will be:

1) A = 8
2) B = 2 * 8 = 16
3) $C = 2^8 = 256$

Hence, A + B + C = 8 + 16 + 256 = 280 states.

Q.19)

Max Marks: 2

For a n-bit ripple carry adder which is implemented using only AND, OR and NOT gates. The sum (EX-OR gate) is realized using 3 level NOT, AND, OR gates while carry is realized using 2 level AND, OR gates. Which of the following is correct about the total propagation delay in n-bit ripple carry adder. Assuming that all gates are having same gate delay 'G' and inputs are not available in both complemented form.

A (2n + 1) * G — Correct Option

Solution: (A)

Solution: (i)

For single adder:
When a EX-OR gate is realized using 3-level gates (AND, OR and NOT gate), the sum will be computed after 3 gate delays i.e 3 * G
While carry is computed using 2-level gates (AND, OR), the delay in computing carry will be after 2 gate delays i.e 2 * G.
For n adders:
Since, the carry will propagate through all n adders and sum will be computed in every stage by consuming the carry generated in previous stage. Thus the expression will be given as:
=> (n-1) * single carry delay + Single sum delay
=> (n-1) * 2 * G + 3 * G
=> (2n - 2 + 3) * G
=> (2n + 1) * G
Hence, the correct option is (i)

B (n + 2) * G

C (2n + 3) * G

D None of the above

Q.20)

Max Marks: 2

Which of the following statements is true about the RAM of size 64 words X 16 bits constructed using a decoder and a multiplexer.
I. The number of data lines and address lines are 6 and 16 respectively.
II. The number of connections and links are 80 and 1024 respectively.

A Only I

B Only II — Correct Option

Solution: (B)

Solution: (ii)

I. In a memory circuit constructed using a decoder and a multiplexer, the input lines to the decoder are referred as the address bus (for example, 2 X 4 decoder need 2 bits address in order to point the 4 different addresses, thus the size of address bus is 2 bits). While Data bus corresponds to the vertical lines of the memory matrix where each vertical line is considered as a bit. (For example, for 2 X 1 mux the number of functions it can represent is $2^2 = 4$, thus data bus is of 4 bits.)
In the given case size of memory is given as 64words X 16bits which is implemented using a decoder. To represent 64 words we need 6 bits (6 X 2^6 decoder) and 16 bits/functions could be represented by a 4 X 1 multiplexer. Thus, the size of the address bus/lines is 6 bits and size of data bus/lines is 16 bits. Hence, this statement is wrong.

II. In a memory circuit, connections = # of output lines of decoder + # of functions implemented by MUX = 64 + 16 = 80. While links = intersection of output lines of decoder and all function lines of mux = 64 * 16 = 1024. Hence, this statement is correct.

C Both I and II

D Neither I nor II

close