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Internal Assessment Test 1 – December 2022

Sub:	Analog and Digital Electronics					Sub Code:	21CS33	Branch:	ISE	
Date:	02/12/2022	Duration:	90 min's	Max Marks:	50	Sem/Sec:	III / A,B and C		OBE	
Answer any FIVE FULL Questions								MARKS	CO	RBT
1	With the help of flow chart explain how to determine Minimum Sum of Products using a Karnaugh Map with an Example.							10	CO3	L3
2	What are the disadvantages of K map? Find the minimum SOP expression using QM method for the following function f (a, b, c, d) = Σ m (0,1,2,3,10,11,12,13,14,15)							10	CO3	L3
3	Minimize the following function for SOP using K map and realize it by using basic gates f (a,b,c,d) = π M (5,7,13,14,15) +d(1,2,3,9)							10	CO3	L3
4	Realize basic gates and Ex-Or using NAND and NOR gates only.							10	CO4	L3
5	What is Hazard? Explain Static 0 and Static 1 hazard with an example and its elimination method.							10	CO4	L2
6	Implement the following Boolean function using 8:1 Mux f(a, b, c, d) = Σ m (0,1,2,4,6,9,12,14)							10	CO3	L3

Faculty Signature CCI Signature HOD Signature

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Answer any FIVE FULL Questions

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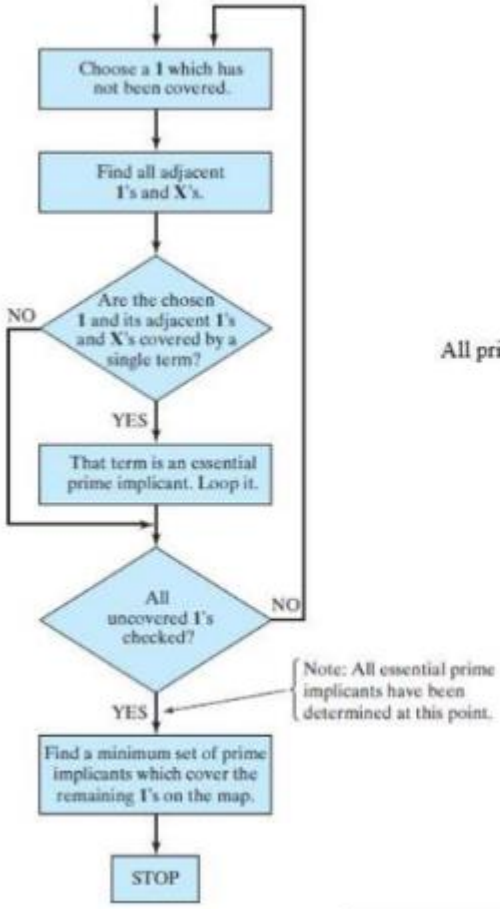
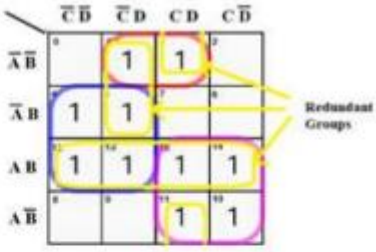
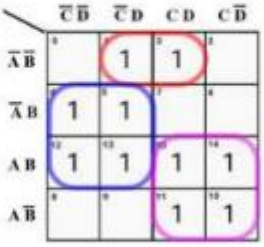
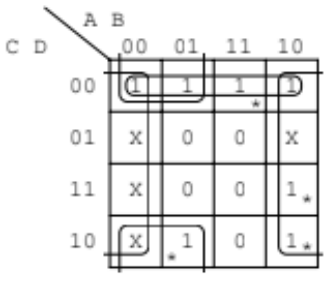
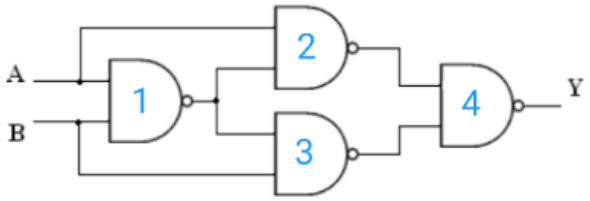
1	With the help of flow chart explain how to determine Minimum Sum of Products using a Karnaugh Map with an Example. **Solution:**   All prime implicants: $A'B'D, BC', AC, A'C'D, AB, B'CD$  Minimum solution: $F = A'B'D + BC' + AC$	10	CO3	L3
2	What are the disadvantages of K map? Find the minimum SOP expression using QM method for the following function f (a, b, c, d) = Σ m (0,1,2,3,10,11,12,13,14,15) **Solution:** Disadvantages of K map: The Karnaugh map method is an effective way to simplify switching functions which have a small number of variables. When the number of variables is large or if several functions must be simplified, the use of a digital computer is desirable. Determination of PI:	10	CO3	L3

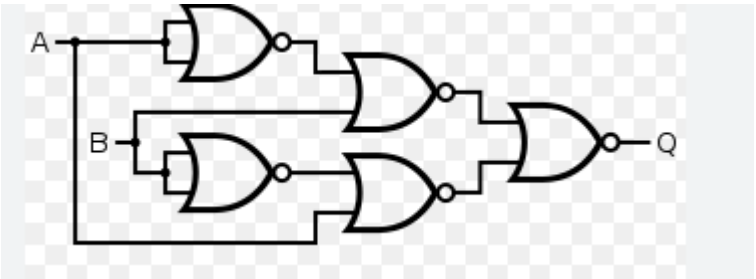
	<table><tr><th colspan="2">Stage 1</th><th colspan="2">Stage 2</th><th colspan="2">Stage 3</th></tr><tr><th>ABCD</th><th>minterms</th><th>ABCD</th><th>minterms</th><th>ABCD</th><th>minterms</th></tr><tr><td>0000</td><td>(0)√</td><td>000-</td><td>(0,1)√</td><td>00--</td><td>(0,1,2,3)</td></tr><tr><td></td><td></td><td>00-0</td><td>(0,2)√</td><td>00--</td><td>(0,2,1,3)</td></tr><tr><td>0001</td><td>(1)√</td><td></td><td></td><td></td><td></td></tr><tr><td>0010</td><td>(2)√</td><td>00-1</td><td>(1,3)√</td><td>-01-</td><td>(2,10,3,11)</td></tr><tr><td></td><td></td><td>001-</td><td>(2,3)√</td><td></td><td></td></tr><tr><td>0011</td><td>(3)√</td><td>-010</td><td>(2,10)√</td><td>1-1-</td><td>(10,11,14,15)</td></tr><tr><td>1010</td><td>(10)√</td><td>-011</td><td>(3,11)√</td><td>1-1-</td><td>(10,14,11,15)</td></tr><tr><td>1100</td><td>(12)√</td><td>101-</td><td>(10,11)√</td><td>11--</td><td>(12,13,14,15)</td></tr><tr><td></td><td></td><td>1-10</td><td>(10,14)√</td><td>11--</td><td>(12,14,13,15)</td></tr><tr><td>1011</td><td>(11)√</td><td>110-</td><td>(12,13)√</td><td></td><td></td></tr><tr><td>1101</td><td>(13)√</td><td>11-0</td><td>(12,14)√</td><td></td><td></td></tr><tr><td>1110</td><td>(14)√</td><td>1-11</td><td>(11,15)√</td><td></td><td></td></tr><tr><td></td><td></td><td>11-1</td><td>(13,15)√</td><td></td><td></td></tr><tr><td>1111</td><td>(15)√</td><td>111-</td><td>(14,15)√</td><td></td><td></td></tr></table> Prime implicant charts: <table><tr><th></th><th>0</th><th>1</th><th>2</th><th>3</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th></tr><tr><td>A′B′ (0,1,2,3)</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>B′C (2,3,10,11)</td><td></td><td></td><td>√</td><td>√</td><td>√</td><td>√</td><td></td><td></td><td></td><td></td></tr><tr><td>AC (10,11,14,15)</td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td></td><td></td><td>√</td><td>√</td></tr><tr><td>AB (12,13,14,15)</td><td></td><td></td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td><td>√</td></tr></table> $Y = A'B' + B'C + AB$ or $Y = A'B' + AC + AB$			
3	Minimize the following function for SOP using K map and realize it by using basic gates f (a,b,c,d) = π M (5,7,13,14,15) +d(1,2,3,9). **Solution:**  F = A'D' + B' + C'D' (*) Indicates a minterm that makes the corresponding prime implicant essential. C'D'→m_{12}; A'D'→m_6; B'→m_{10} or m_{11}	6	CO3	L3
4	Realize basic gates and Ex-Or using NAND and NOR gates only. **Solution:** Ex-Or using NAND	10	CO4	L3

(e) Ex-OR gate: $Y = A \oplus B$

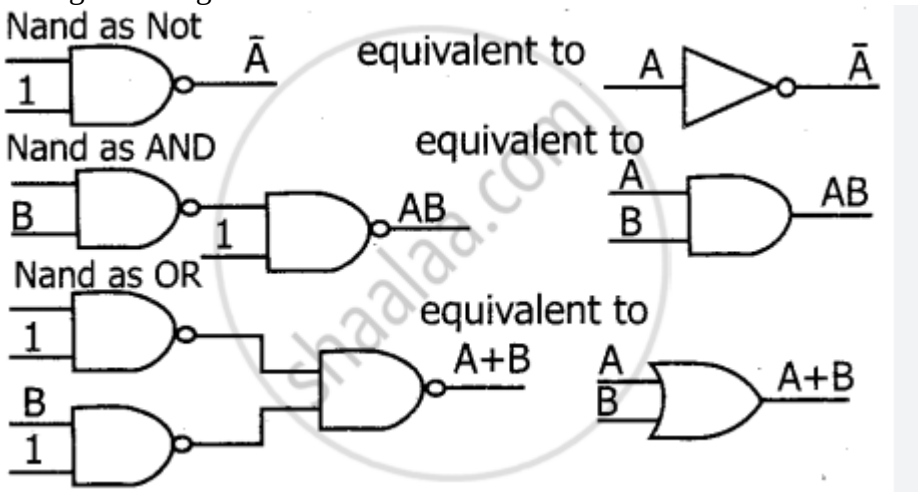


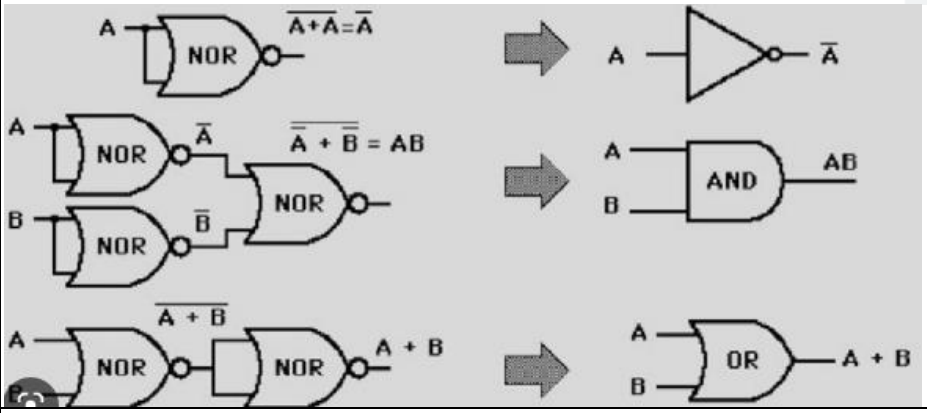
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

Ex-Or using NOR



Basic gates using NAND

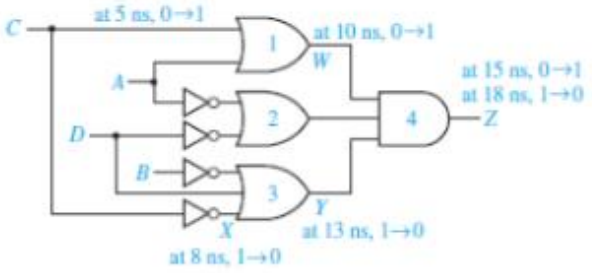




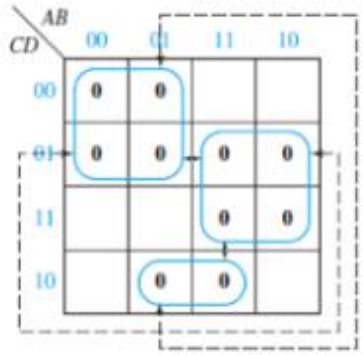
5	What is Hazard? Explain Static 0 and Static 1 hazard with an example and its elimination method. **Solution:**	10	CO4	L2

When the input to a combinational circuit changes, unwanted switching transients may appear in the output. These transients occur when different paths from input to output have different propagation delays.

- If, in response to any single input change and for some combination of propagation delays, a circuit output may momentarily go to 0 when it should remain a constant 1, we say that the circuit has a ***static 1-hazard***.
- Similarly, if the output may momentarily go to 1 when it should remain a 0, we say that the circuit has a ***static 0-hazard***.
- If, when the output is supposed to change from 0 to 1 (or 1 to 0), the output may change three or more times, we say that the circuit has a ***dynamic hazard***.



(a) Circuit with a static 0-hazard



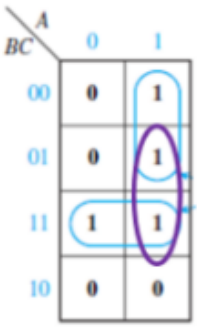
(b) Karnaugh map for circuit of (a)

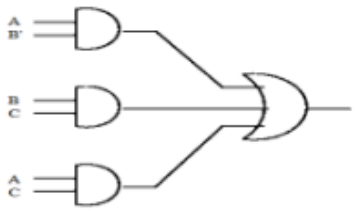
Detection of Static 1 Hazard: Hazards can be detected using a Karnaugh map (see above Figure). As seen on the map, no loop covers both minterms ABC and ABC'. So if A = C = 1 and B changes, both terms can momentarily go to 0, resulting in a glitch in F.

We can detect hazards in a two-level AND-OR circuit, using the following procedure:

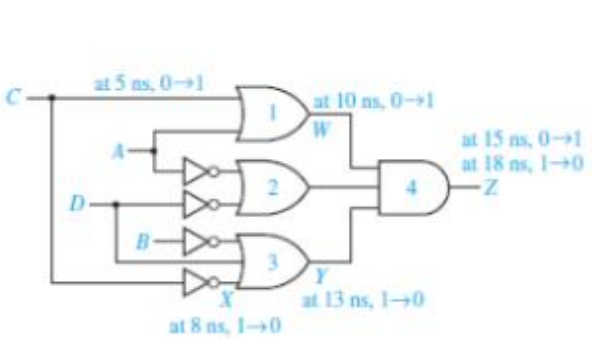
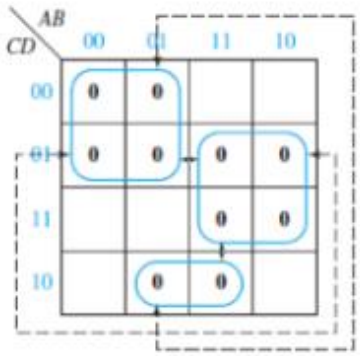
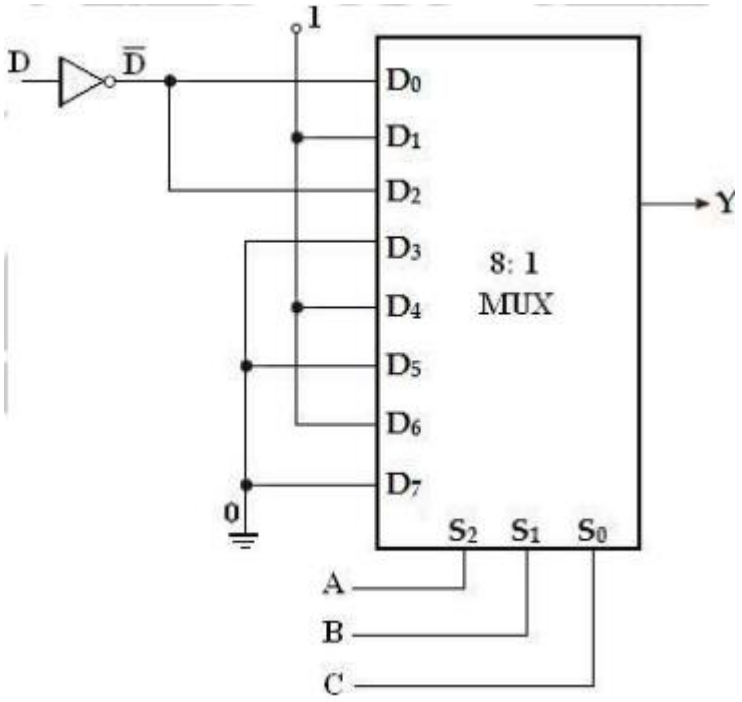
1. Write down the sum-of-products expression for the circuit.
2. Plot each term on the map and loop it.
3. If any two adjacent 1's are not covered by the same loop, a 1-hazard exists for the transition between the two 1's. For an n-variable map, this transition occurs when one variable changes and the other $n - 1$ variables are held constant.

To Eliminate Static 1 Hazard: If we add a loop to the map of above Figure and, then, add the corresponding gate to the circuit (as shown in the following Figure), this eliminates the hazard. The term AC remains *1* while B is changing, so no glitch can appear in the output. Note that F is no longer a minimum sum of products.





Detection of Static 0 Hazard: The following Figure shows a circuit with several 0-hazards. The product-of-sums representation for the circuit output is $F = (A + C)(A' + D')(B' + C' + D)$

	 (a) Circuit with a static 0-hazard  (b) Karnaugh map for circuit of (a)			
6	Implement the following Boolean function using 8:1 Mux f(a, b, c, d) = Σ m (0,1,2,4,6,9,12,14) **Solution:** 	10	CO3	L3