EE 2720 Fall 2010,

Homework # 5 solution

in this HW ~~Problem~~ Here I will denote minterm i by m_i and ~~maxterm~~ maxterm i by M_i

Problem 1

(a) We have: $F = \Sigma_{A,B,C,D}(0, 2, 4, 6, 9, 11, 13, 14, 15)$

$$= m_0 + m_2 + m_4 + m_6 + m_9 + m_{11} + m_{13} + m_{14} + m_{15}$$

$$= (m_0' \cdot m_2' \cdot m_4' \cdot m_6' \cdot m_9' \cdot m_{11}' \cdot m_{13}' \cdot m_{14}' \cdot m_{15}')'$$

$$= (M_0 \cdot M_2 \cdot M_4 \cdot M_6 \cdot M_9 \cdot M_{11} \cdot M_{13} \cdot M_{14} \cdot M_{15})'$$

From the above we get the figure shown on the next page

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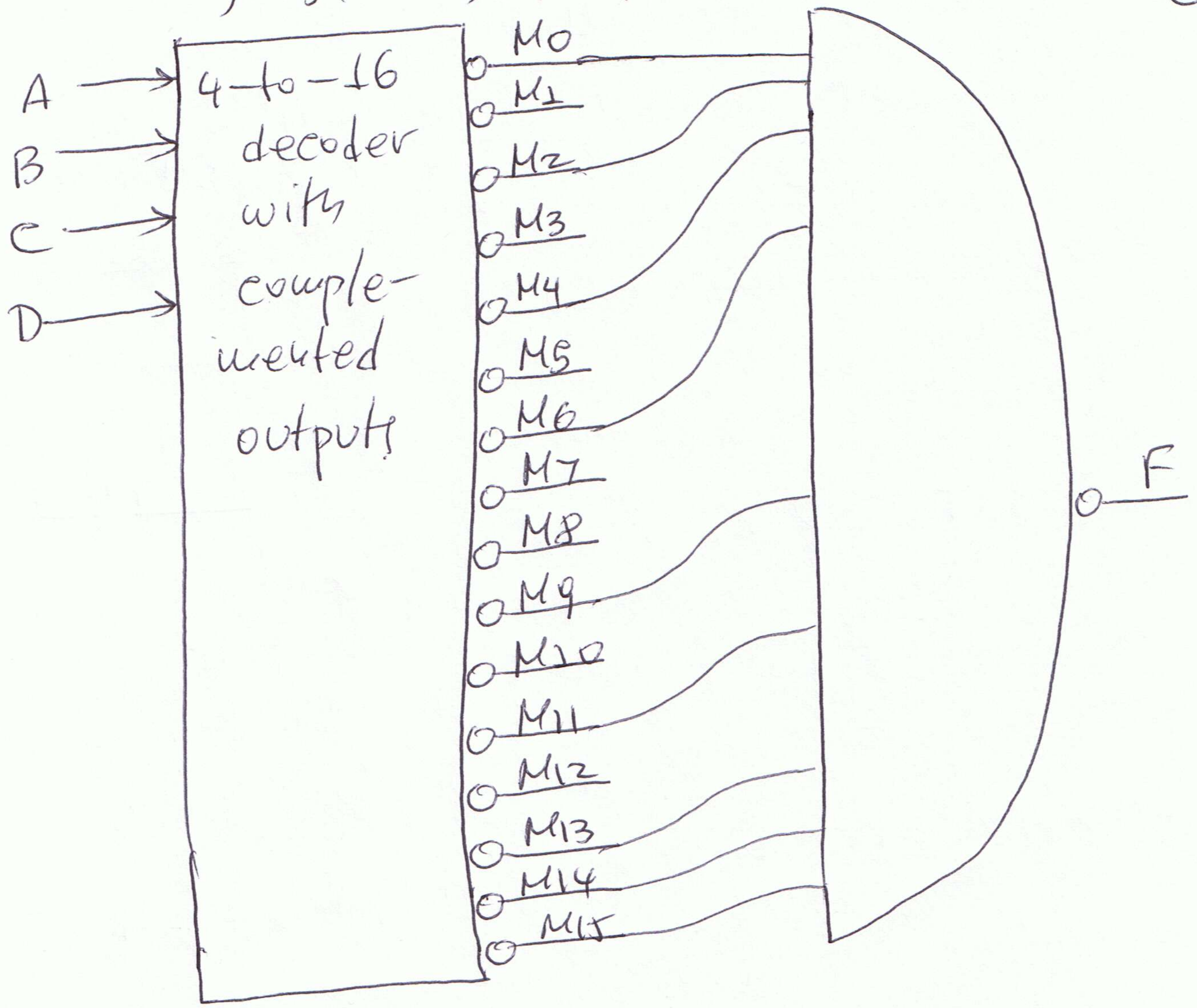

(b) We have:

$$F = \Sigma_{A,B,C,D}(0, 2, 4, 6, 9, 11, 13, 14, 15)$$

$$= \Pi_{A,B,C,D}(1, 3, 5, 7, 8, 10, 12)$$

From the above we get the figure shown on the next page.

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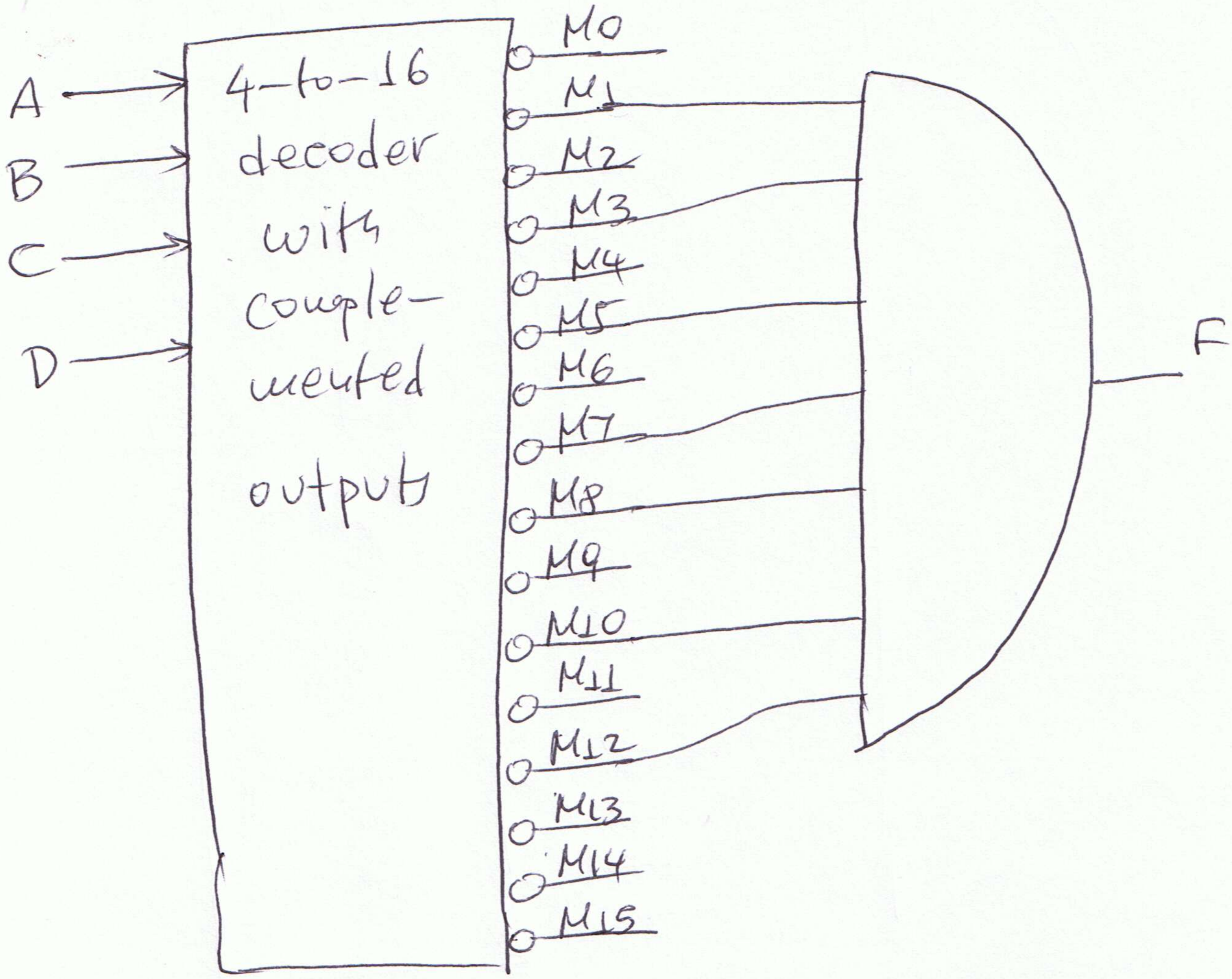

(c) we have

$$F = \sum_{A,B,C,D}(0, 2, 4, 6, 9, 11, 13, 14, 15)$$

From the above we get the figure shown on the next page.

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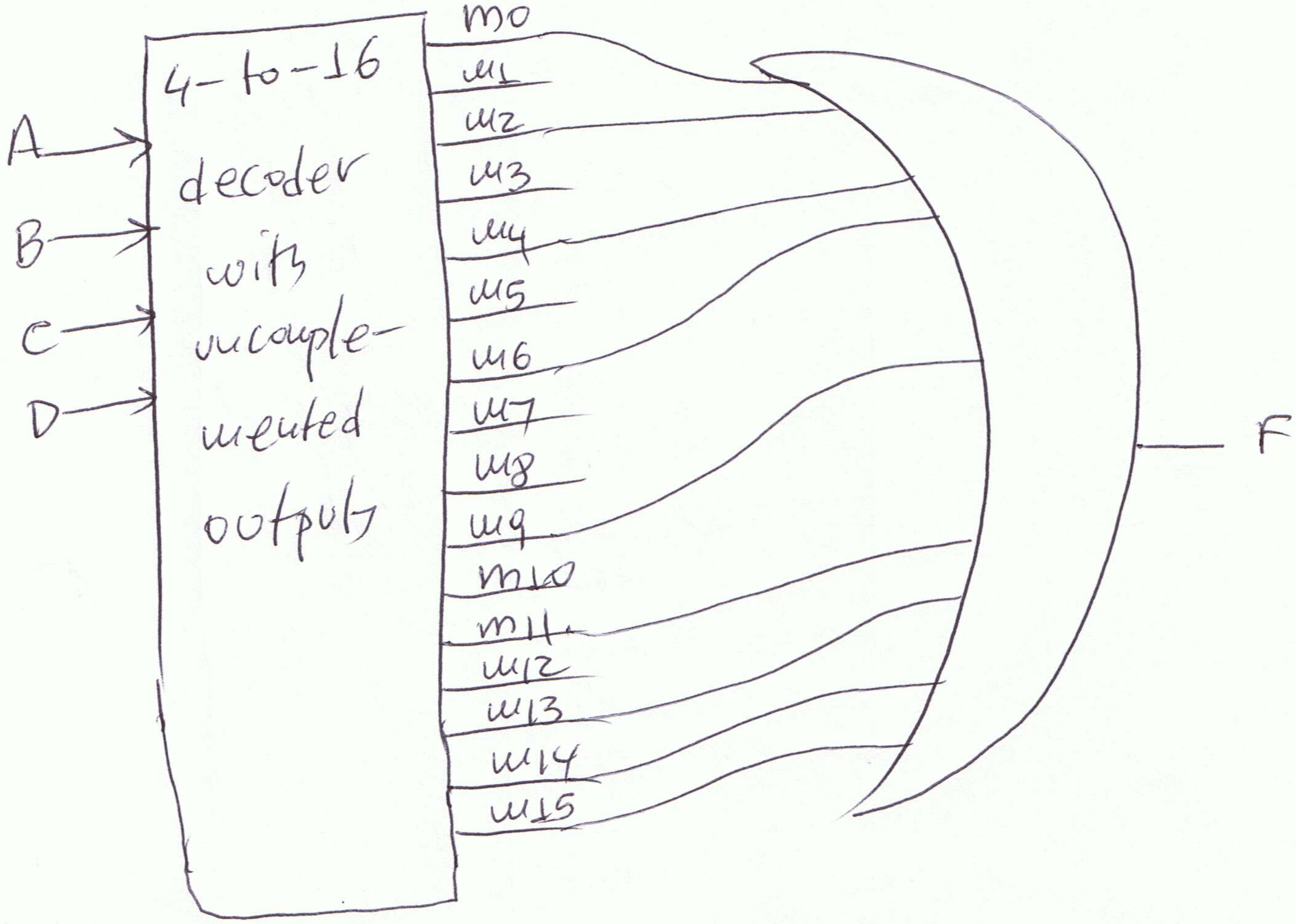

(d) we have:

$$F = \prod_{A,B,C,D}(1, 3, 5, 7, 8, 10, 12)$$

$$= M_1 \cdot M_3 \cdot M_5 \cdot M_7 \cdot M_8 \cdot M_{10} \cdot M_{12}$$

$$= (M_1' + M_3' + M_5' + M_7' + M_8' + M_{10}' + M_{12}')'$$

$$= (m_1 + m_3 + m_5 + m_7 + m_8 + m_{10} + m_{12})'$$

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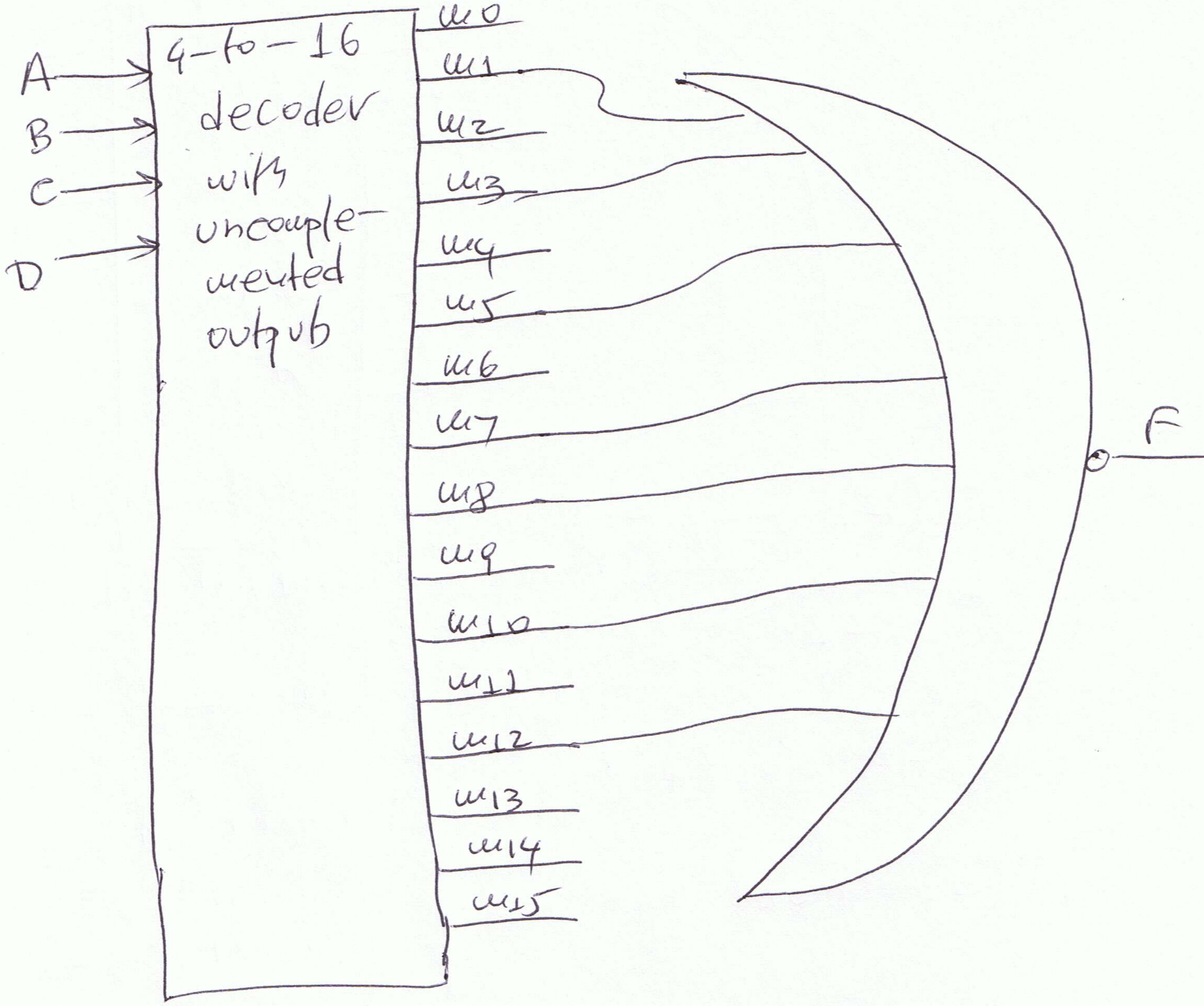


<u>Problem 2:</u> Since a decoder with uncomplemented outputs generates the minterms, we have to express F as a canonical sum. Since F is given as a product-of-sums expression, it is easier to obtain the canonical product from which we can easily get the canonical sum. We have

$$F=(A'+B+C')\cdot(B+C'+D)\cdot(A+C'+D')$$

$$\cancel{(A'+B+C'+D\cdot D')\cdot(A+B+C'}$$

$$=(A'+B+C'+D\cdot D')\cdot(B+C'+D+A\cdot A')\cdot(A+C'+D'+B\cdot B')$$

$$=(A'+B+C'+D)\cdot(A'+B+C'+D')\cdot$$
$$(B+C'+D+A)\cdot(B+C'+D+A')$$
$$(A+C'+D'+B)\cdot(A+C'+D'+B')$$

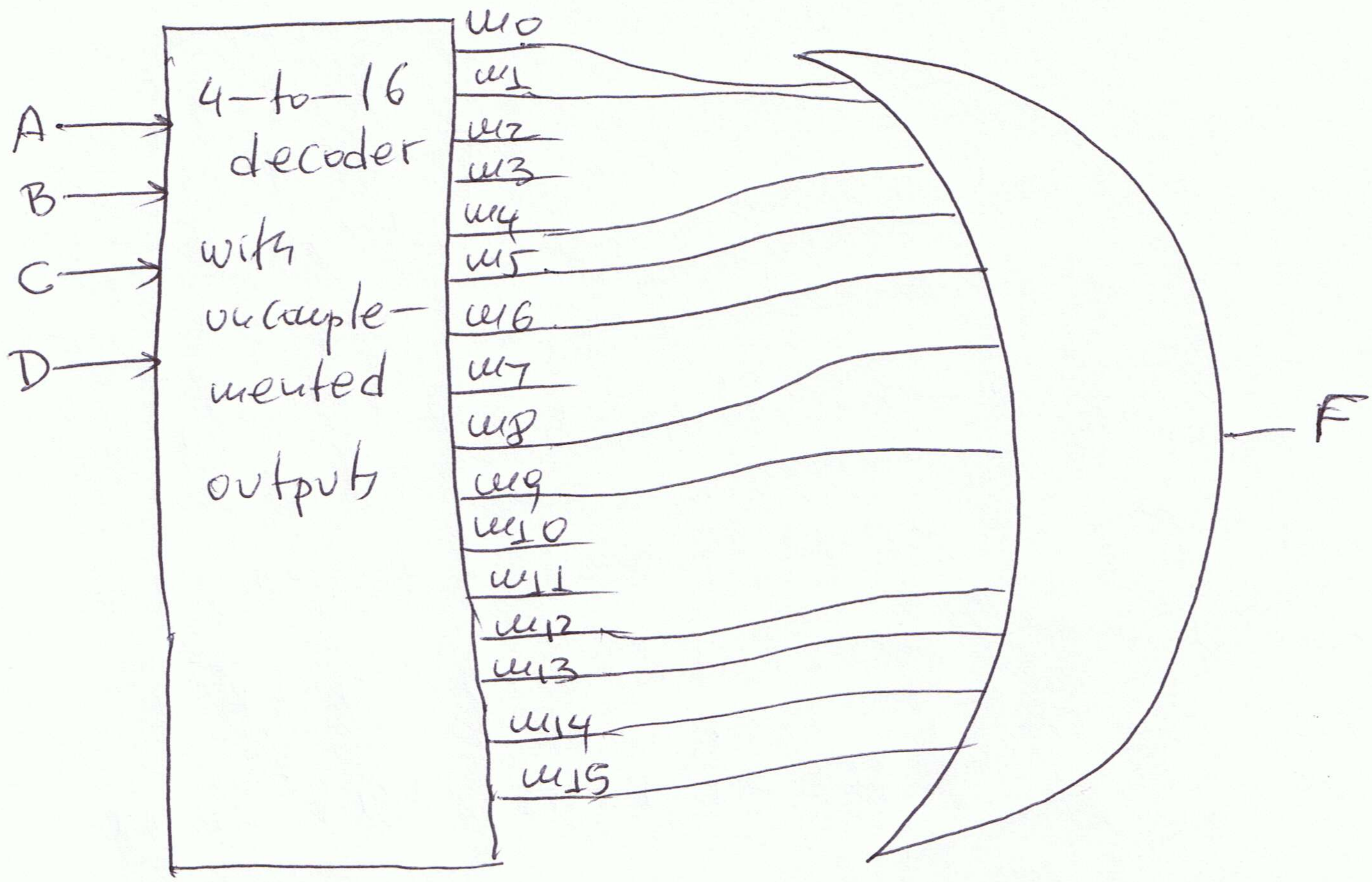
$$=(\underset{1}{A'}+\underset{0}{B}+\underset{1}{C'}+\underset{0}{D})\cdot(\underset{1}{A'}+\underset{0}{B}+\underset{1}{C'}+\underset{1}{D'})\cdot(\underset{0}{A}+\underset{0}{B}+\underset{1}{C'}+\underset{0}{D})$$
$$\cancel{(\underset{1}{A'}+\underset{0}{B}+\underset{1}{C'}+\underset{0}{D})}\cdot(\underset{0}{A}+\underset{0}{B}+\underset{1}{C'}+\underset{1}{D'})\cdot(\underset{0}{A}+\underset{1}{B'}+\underset{1}{C'}+\underset{1}{D'})$$

$$=\prod_{A,B,C,D}(2,3,7,10,11)$$ $\Longrightarrow$ next page

Pr. 2 cont:

$= \sum_{A,B,C,D}(0,1,4,5,6,8,9,12,13,14,15)$

we now have:



Pr. 3: From problem 2 we found out

that $F = \prod_{A,B,C,D}(2,3,7,10,11)$

We thus have the figure of next page

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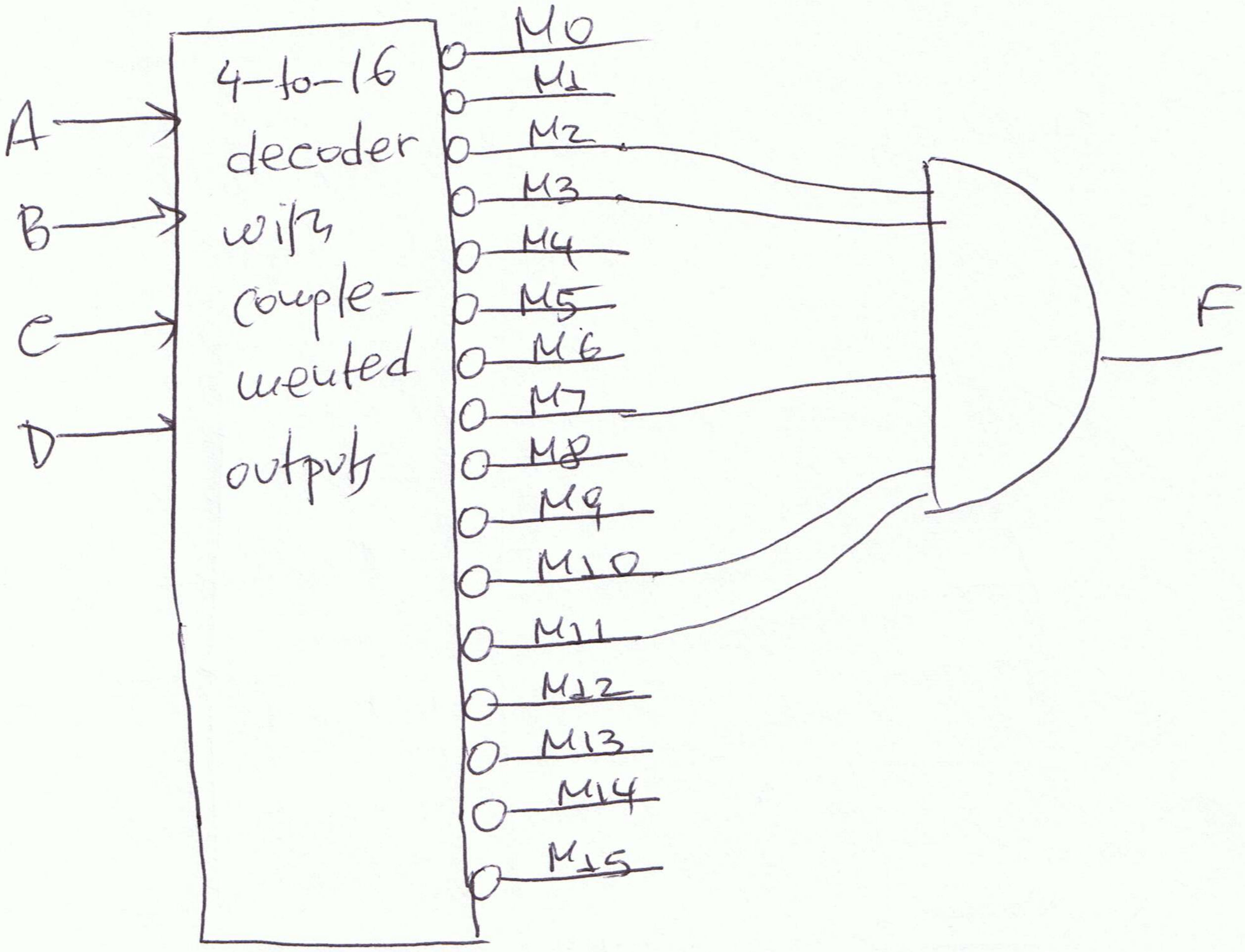

Problem 4 : Since a decoder with complemented outputs generates the maxterms, we have to express F as a canonical product. Since F is given as sum-of-products, it is easier to obtain ~~the~~ ~~canonical~~ the canonical sum from which we can easily get the canonical product. We have:

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Pr. 4 cont:

$$F = A' \cdot B \cdot C' + B \cdot C' \cdot D + A \cdot C' \cdot D'$$

$$= A' \cdot B \cdot C' \cdot (D + D') + B \cdot C' \cdot D\,(A + A')$$

$$+ A \cdot C' \cdot D' \cdot (B + B')$$

$$= \underset{0}{A'} \cdot \underset{1}{B} \cdot \underset{0}{C'} \cdot \underset{1}{D} + \underset{0}{A'} \cdot \underset{1}{B} \cdot \underset{0}{C'} \cdot \underset{0}{D'} + \underset{1}{A} \cdot \underset{1}{B} \cdot \underset{0}{C'} \cdot \underset{1}{D}$$

$$+ \cancel{\underset{0}{A'} \cdot \underset{1}{B} \cdot \underset{0}{C'} \cdot \underset{1}{D}} + \underset{1}{A} \cdot \underset{1}{B} \cdot \underset{0}{C'} \cdot \underset{0}{D'} + \underset{1}{A} \cdot \underset{0}{B'} \cdot \underset{0}{C'} \cdot \underset{0}{D'}$$

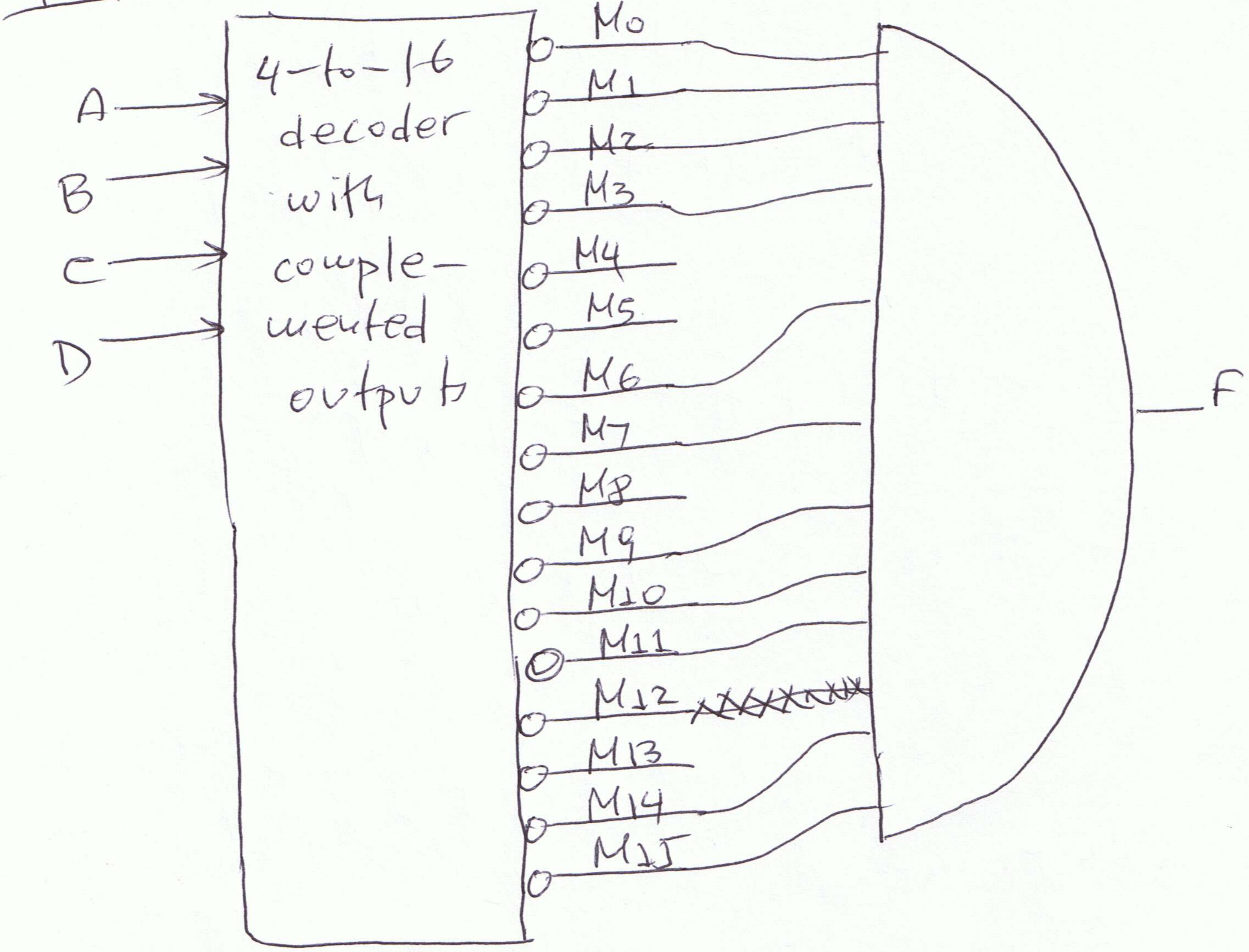
$$= \sum_{A,B,C,D} (4, 5, 8, 12, 13)$$

$$= \prod_{A,B,C,D} (0, 1, 2, 3, 6, 7, 9, 10, 11, 14, 15)$$

From the above we get the figure

shown on next page

Pr. 4 cont:



Problem 5: From problem 4 we found out that $F = \sum_{A,B,C,D}(4, 5, 8, 12, 13)$

we thus have the figure shown on next page

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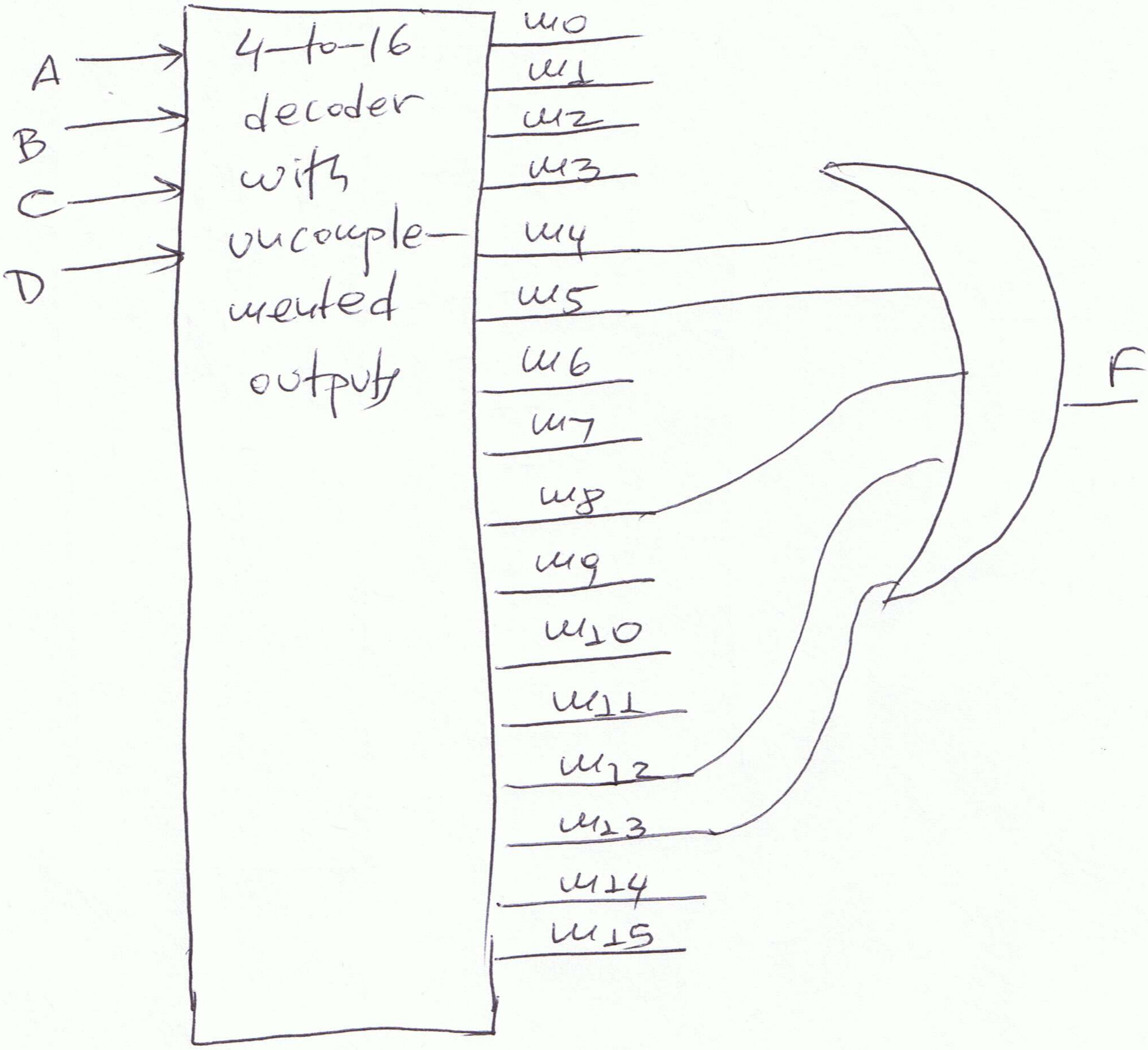
Pr. 5 cont.:


A
B
C
D
4-to-16 decoder with uncomplemented outputs
m0
m1
m2
m3
m4
m5
m6
m7
m8
m9
m10
m11
m12
m13
m14
m15
F