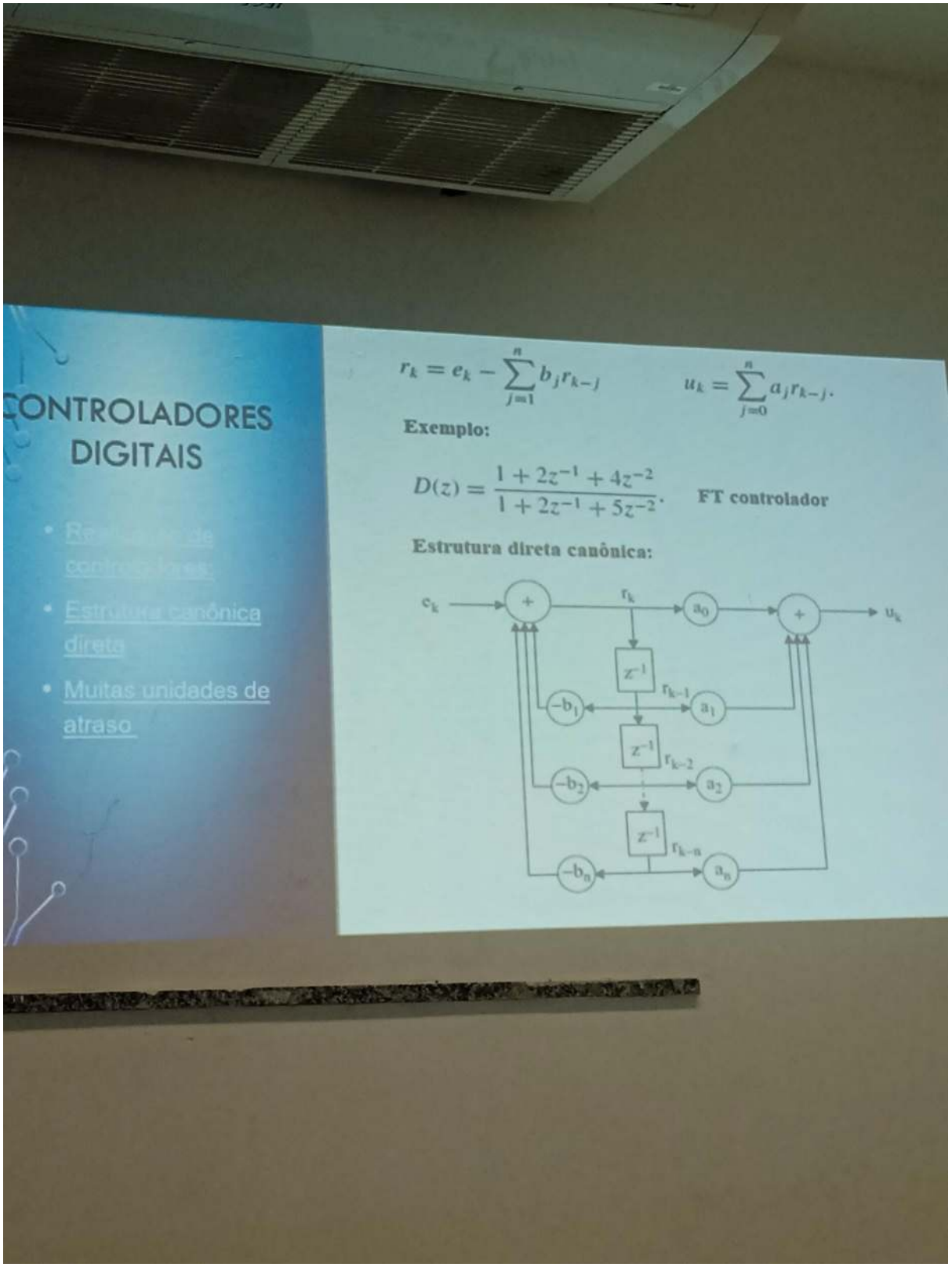
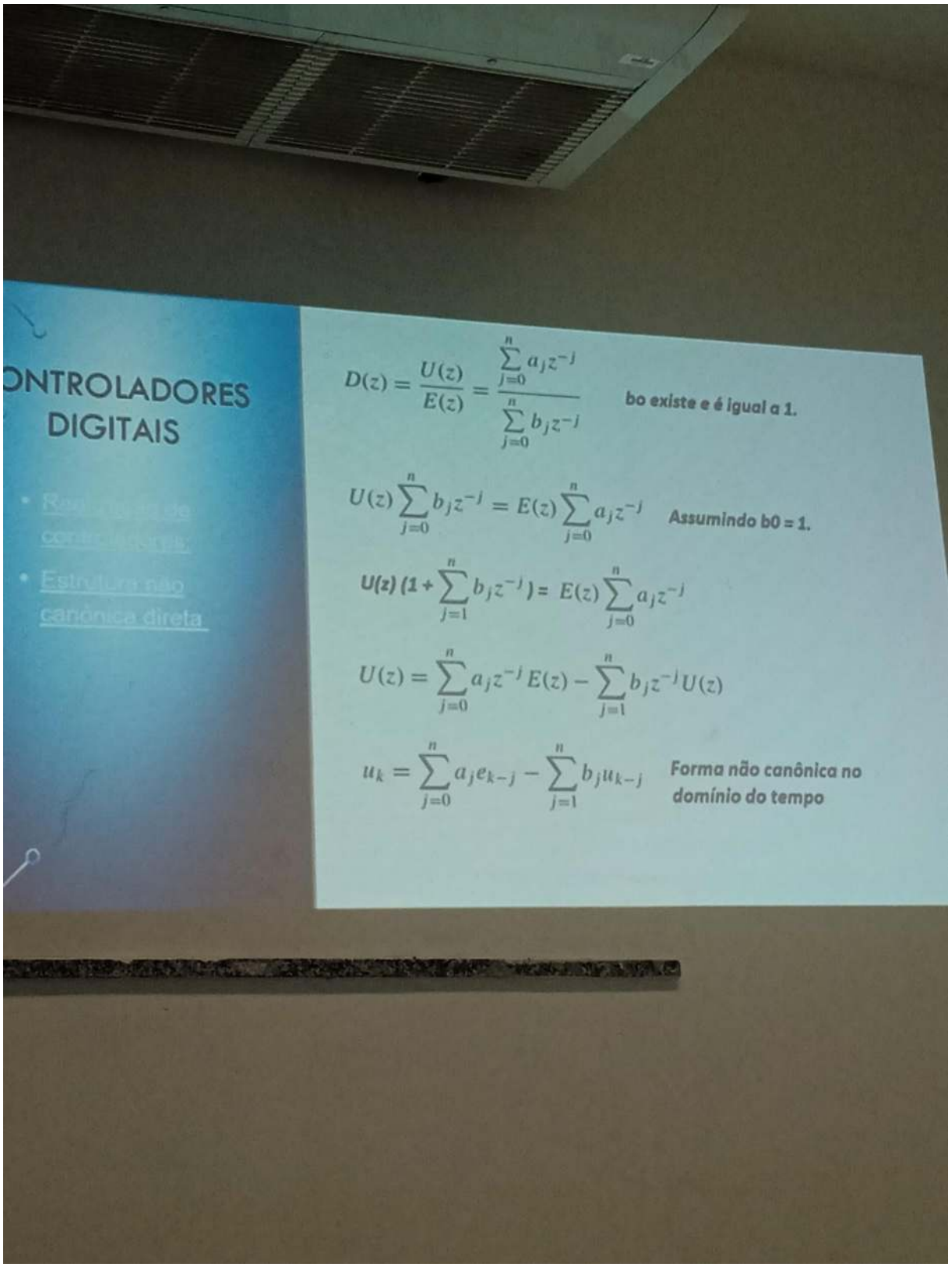
Cristiano Coutinho Costa
Aula 08-11-22

Estruturas de programação

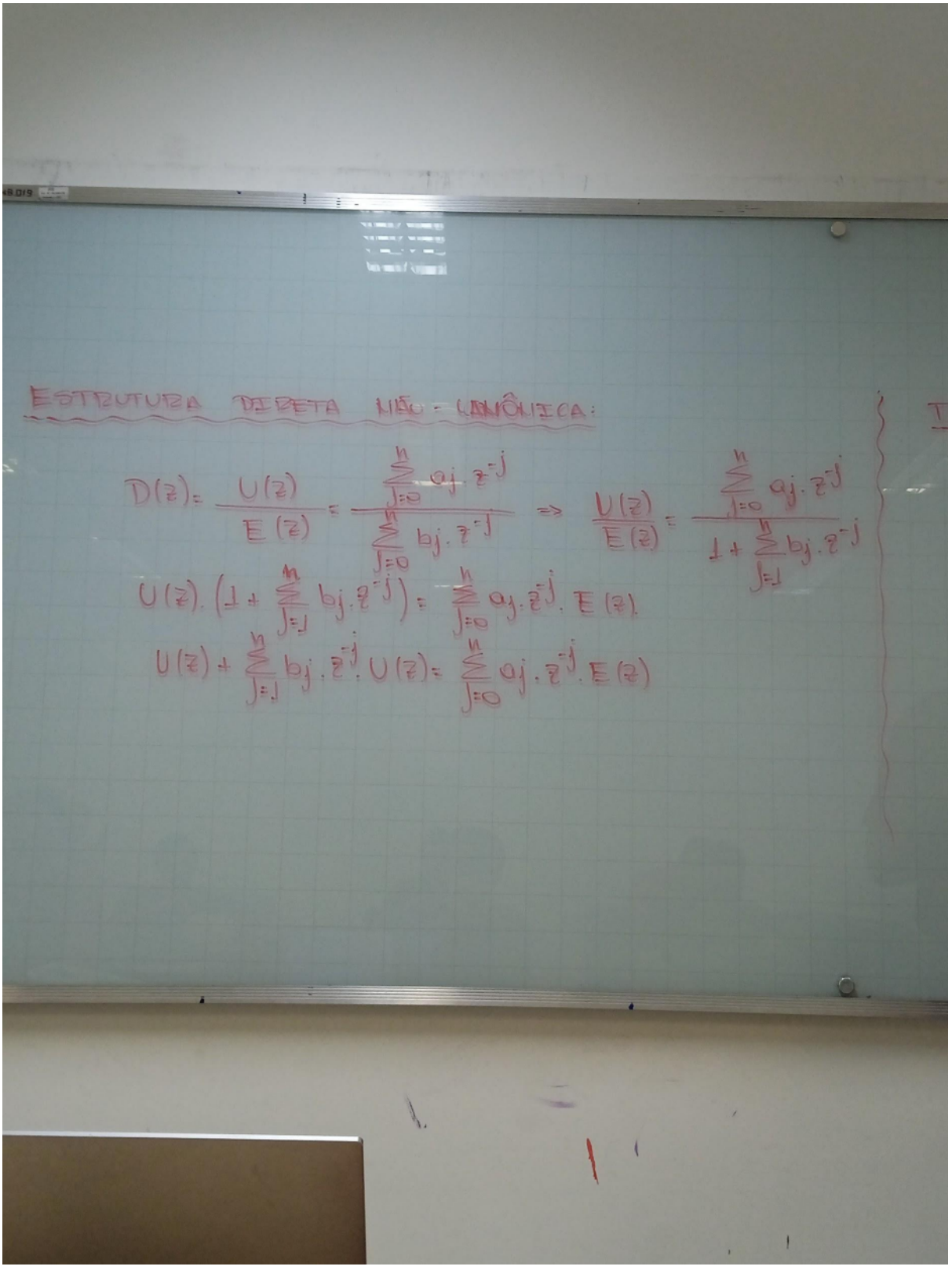
- Estrutura direta canônica



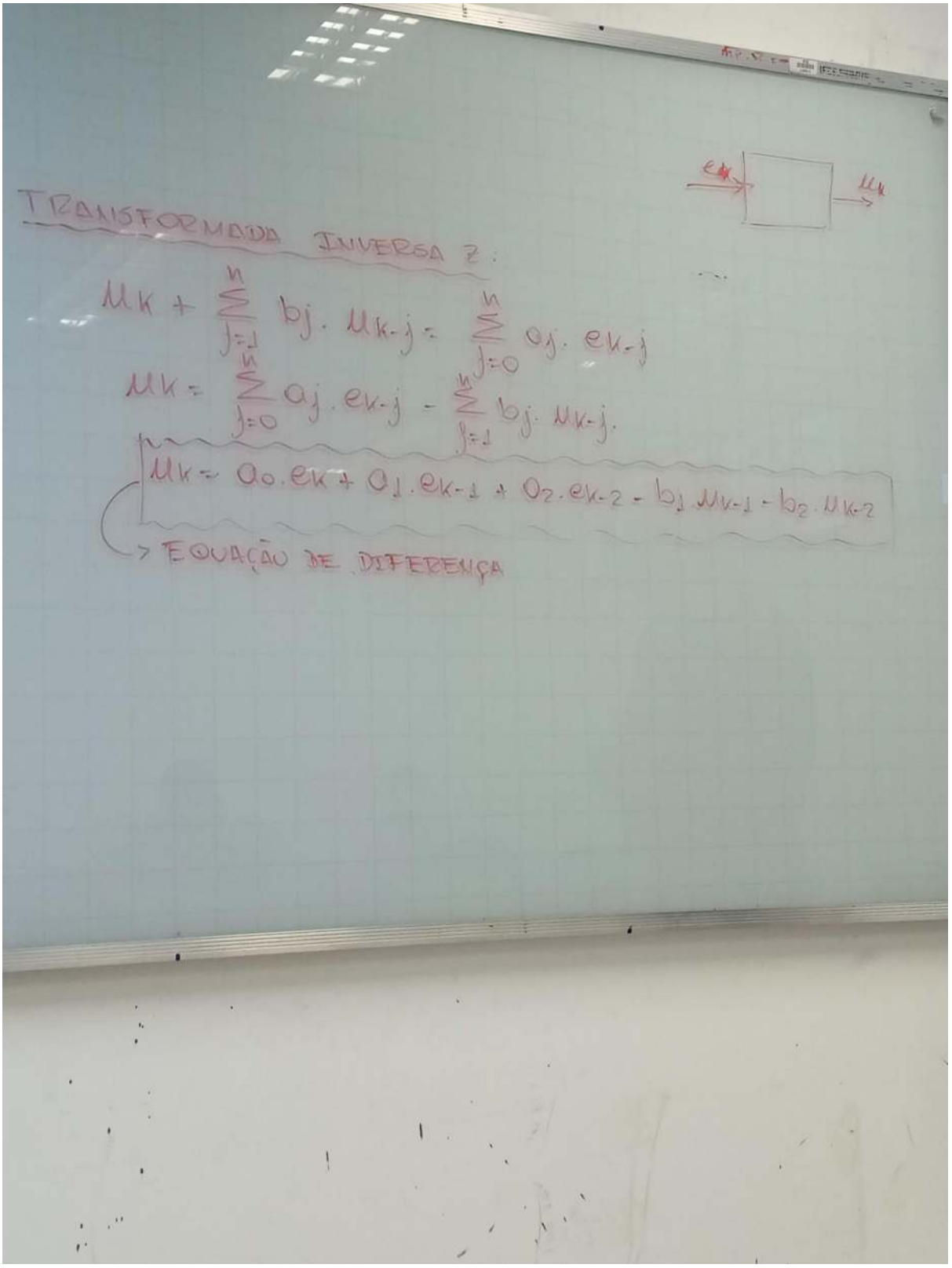
Estrutura direta não-canônica



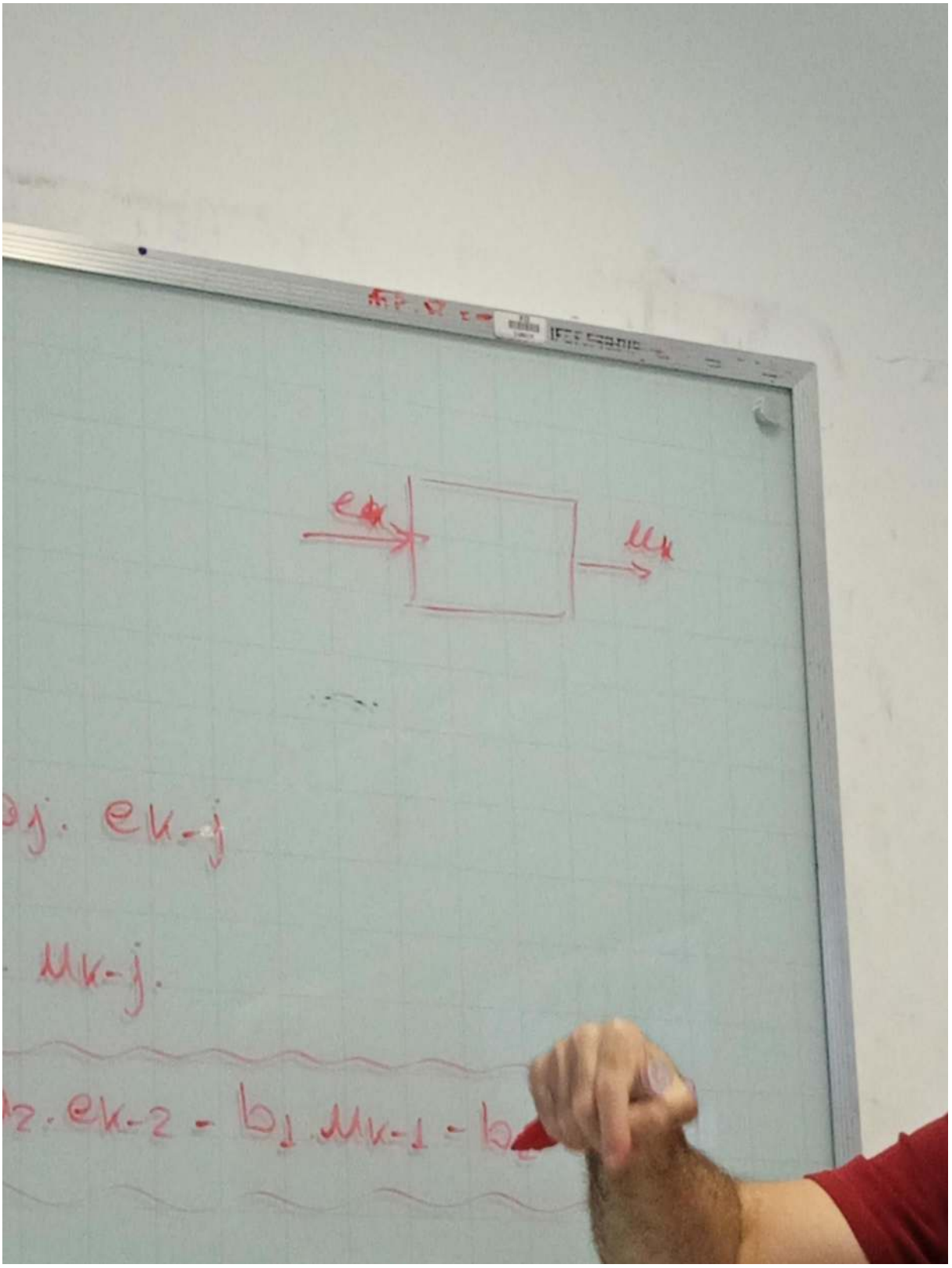
Demonstração



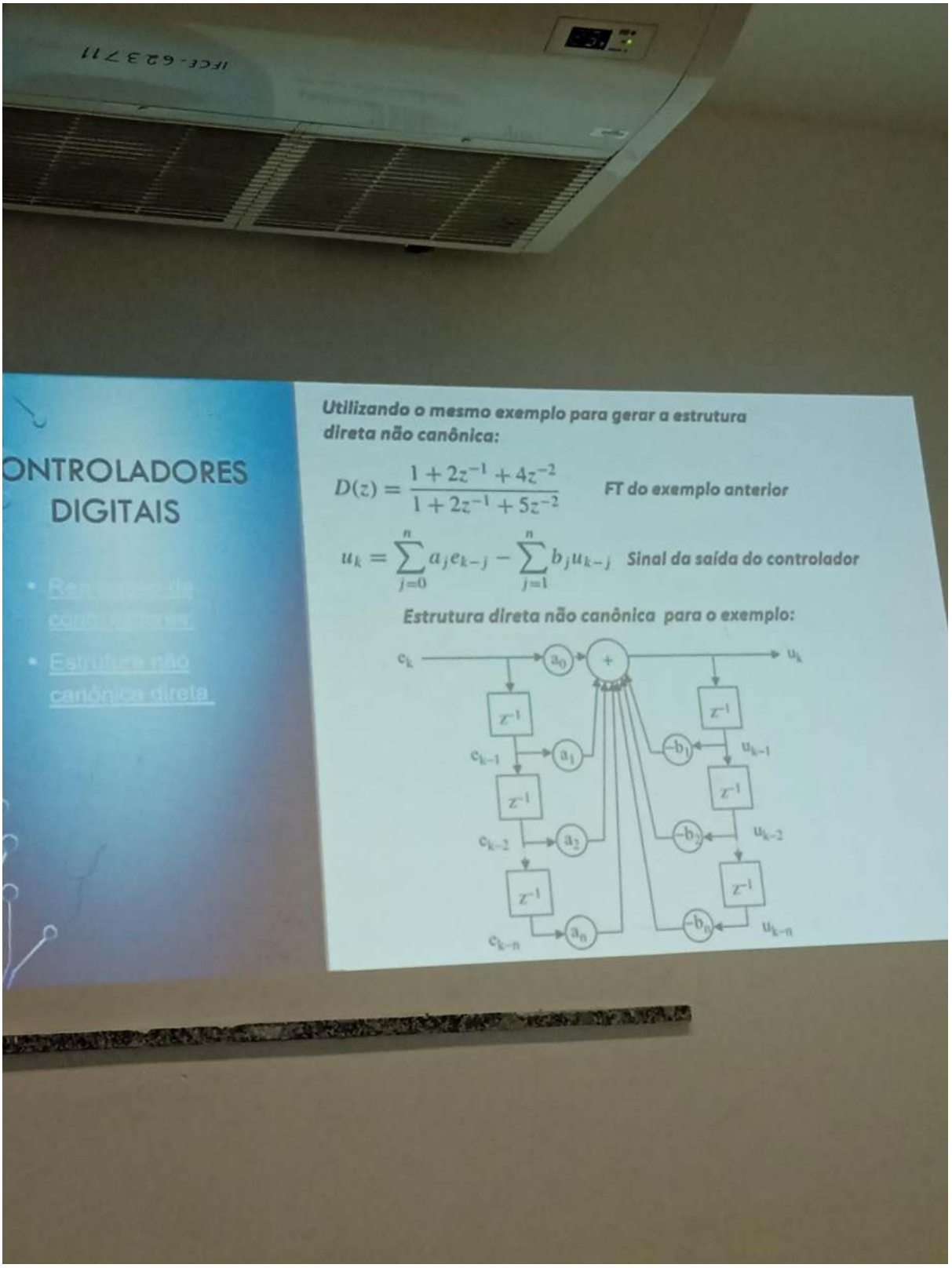
Transformada inversa de Z



A equação acima representa a equação de diferença!
K: representa as amostras em tempo discreto

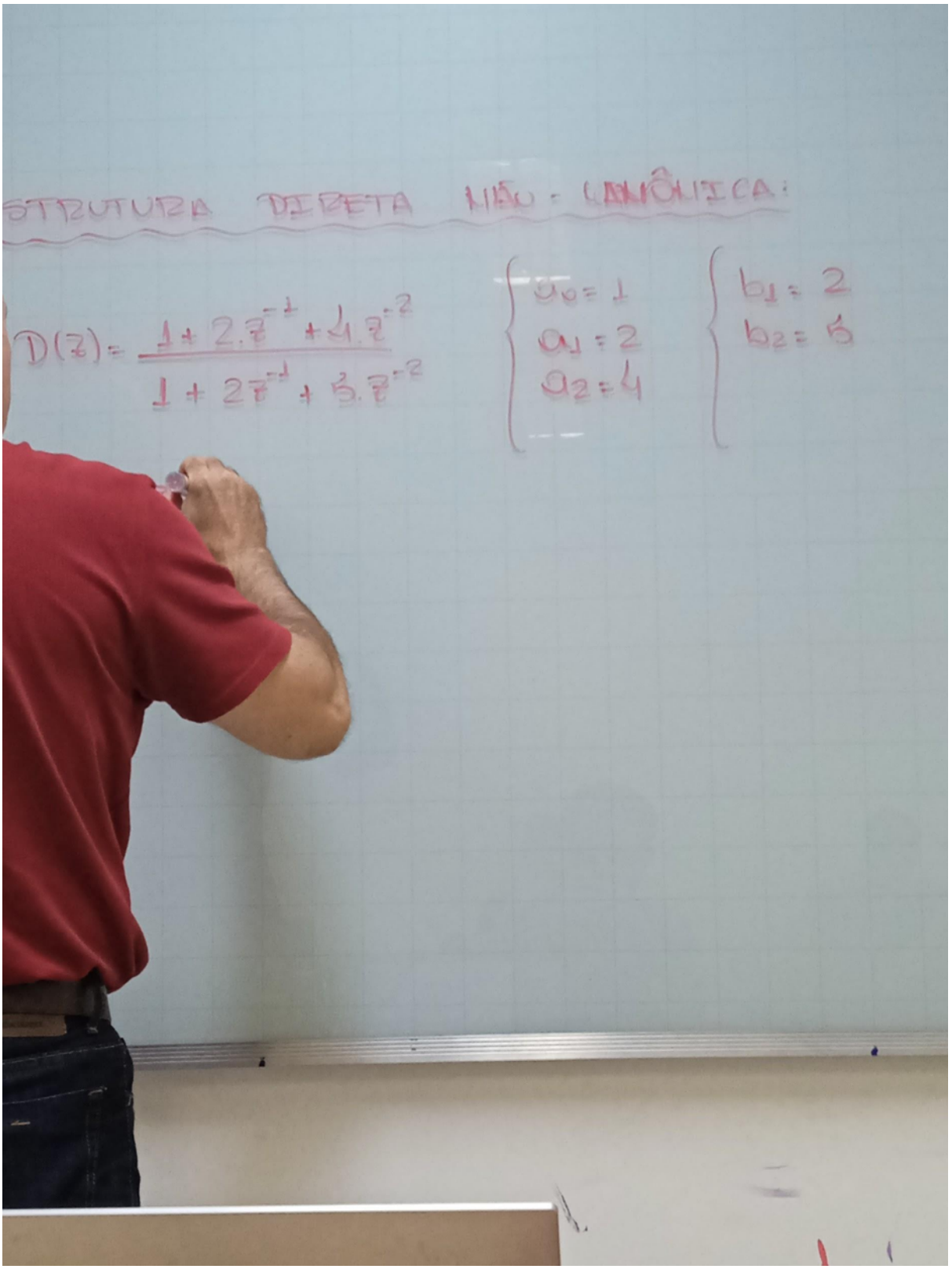


Exemplo:



a0 = 1
a1 = 2
a2 = 4

b1= 2
b2= 5



Estrutura direta não-canônica

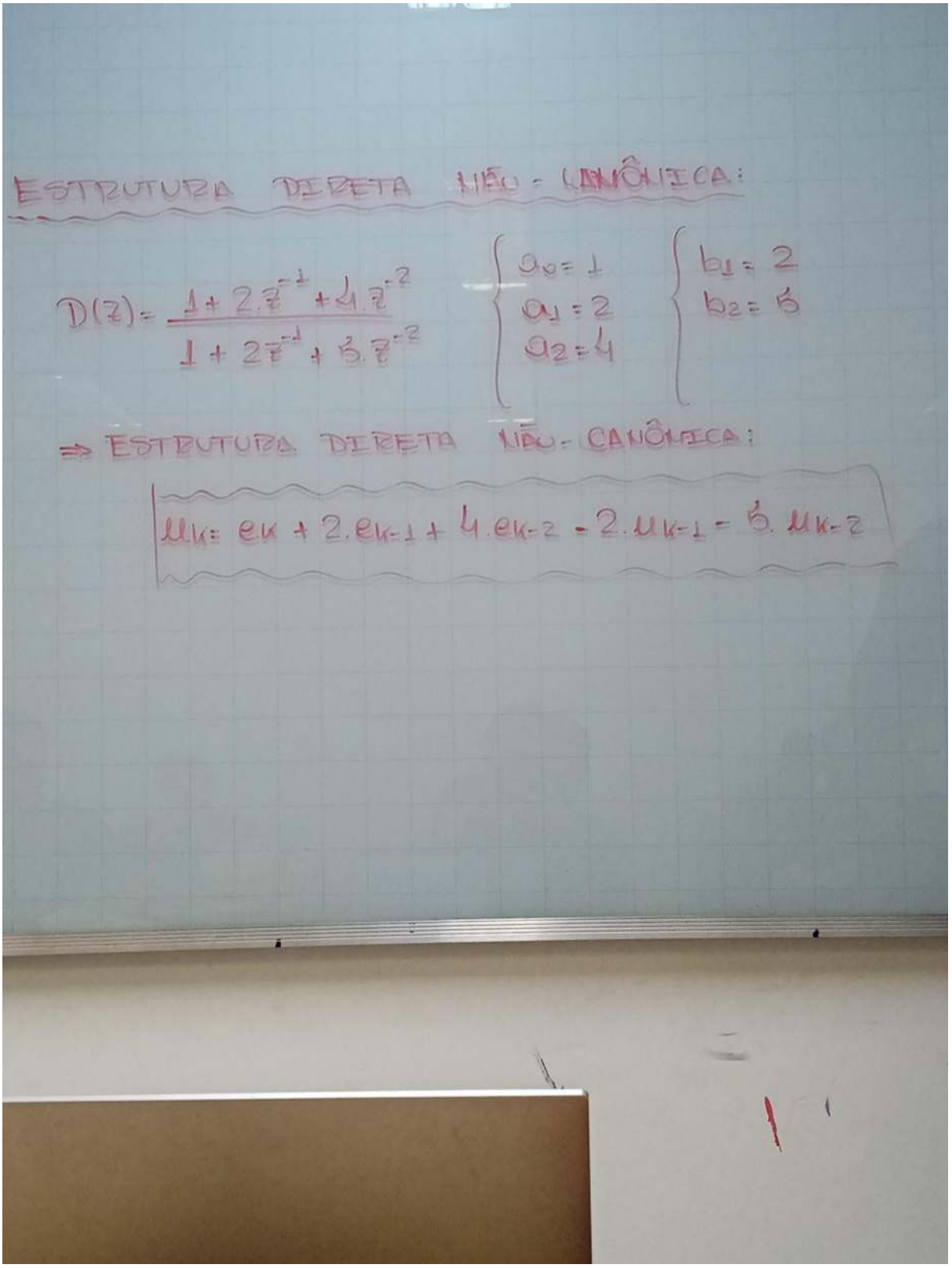


Diagrama de blocos de estrutura direta não-canônica

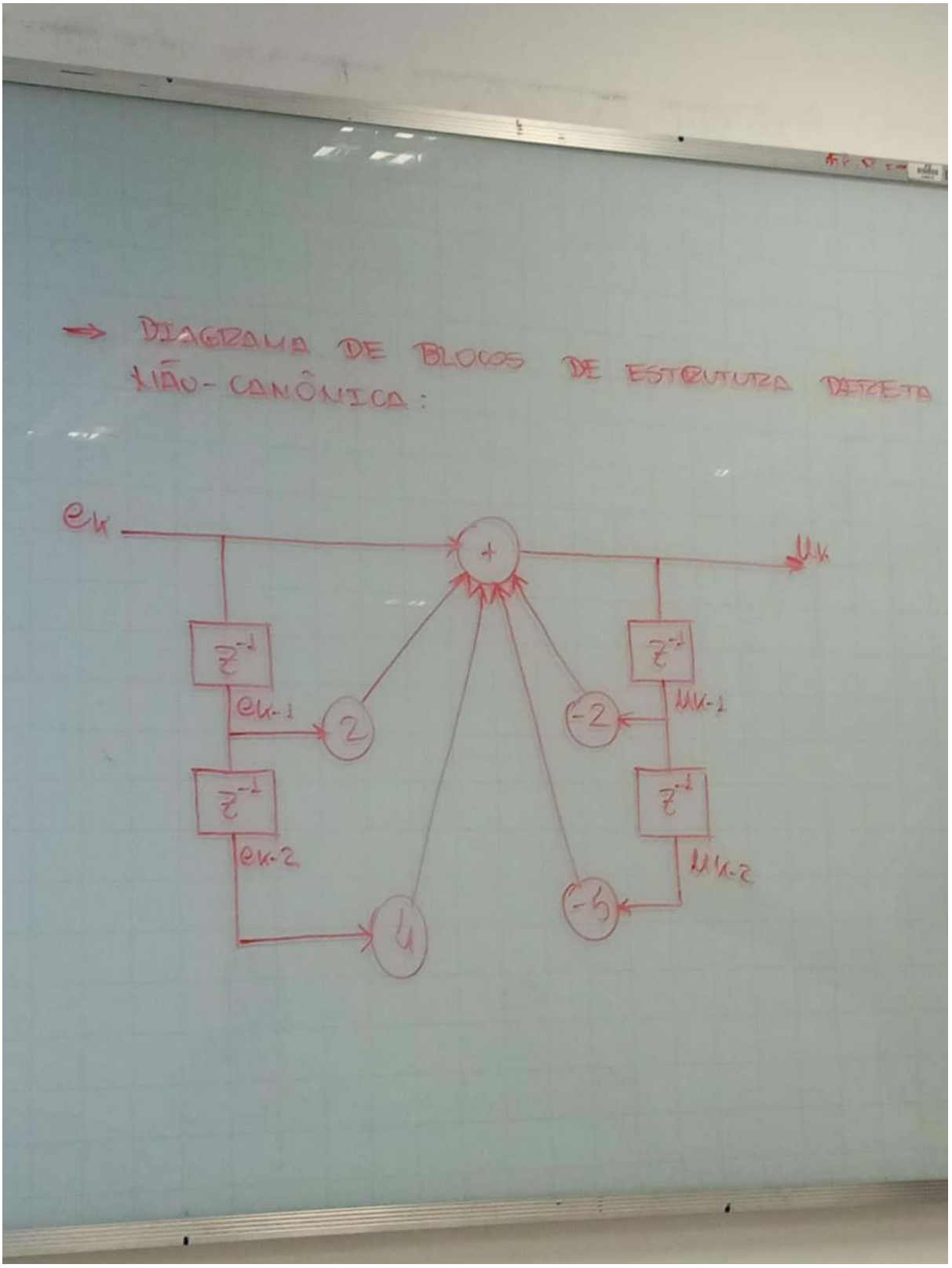


DIAGRAMA DE BLOCOS DE ESTRUTURA DIRETA
NÃO-CANÔNICA:
e_k
+
u_k
z^{-1}
e_{k-1}
2
z^{-1}
u_{k-1}
-2
z^{-1}
e_{k-2}
4
z^{-1}
u_{k-2}
-3

Exemplo 2

ESTRUTURA DIBETA NÃO - LINEAR:

$$D(z) = \frac{z^2 + 3z + 2}{z^2 - 2z - 4}$$

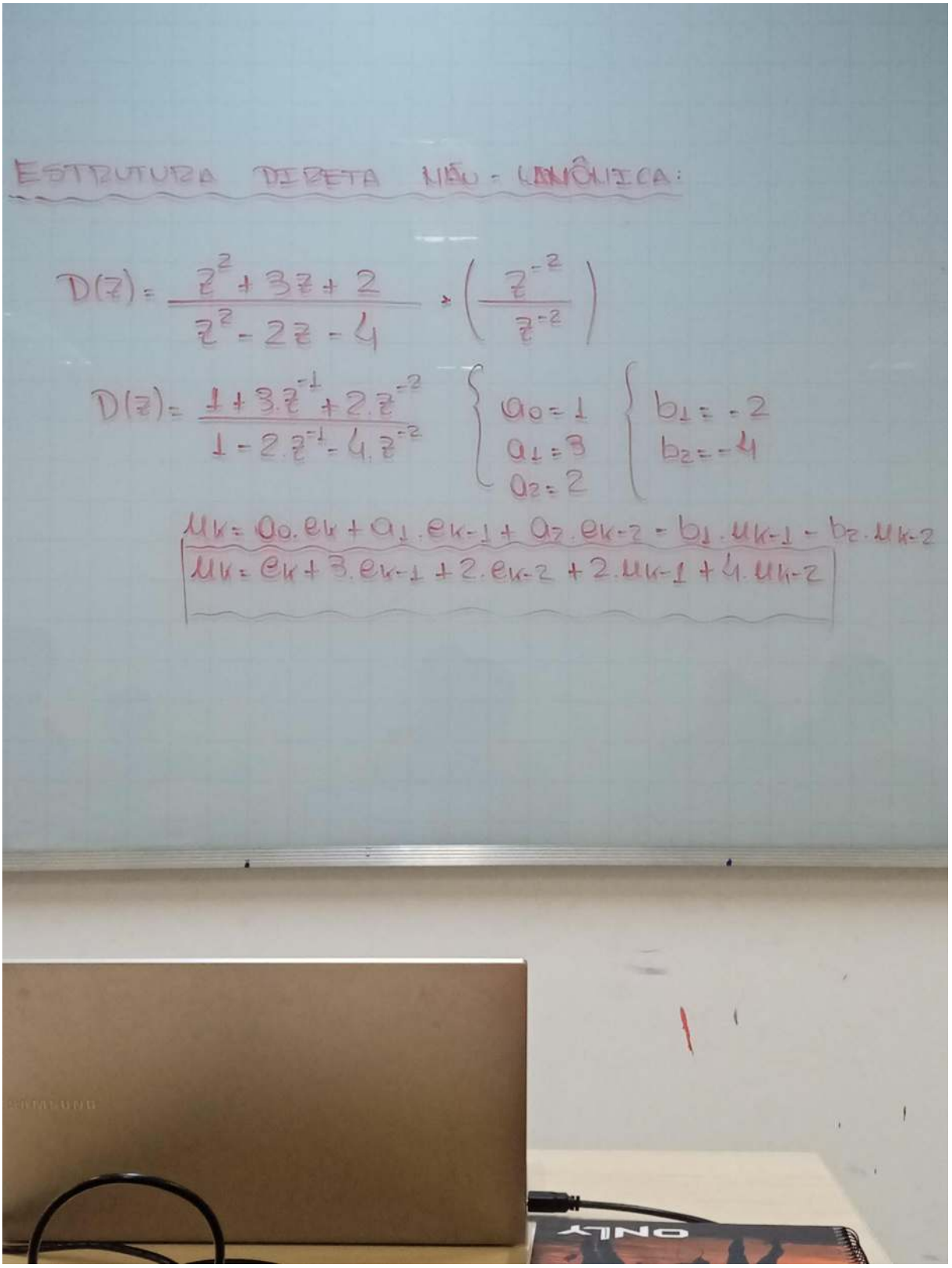


Diagrama de blocos de estrutura direta não-canônica

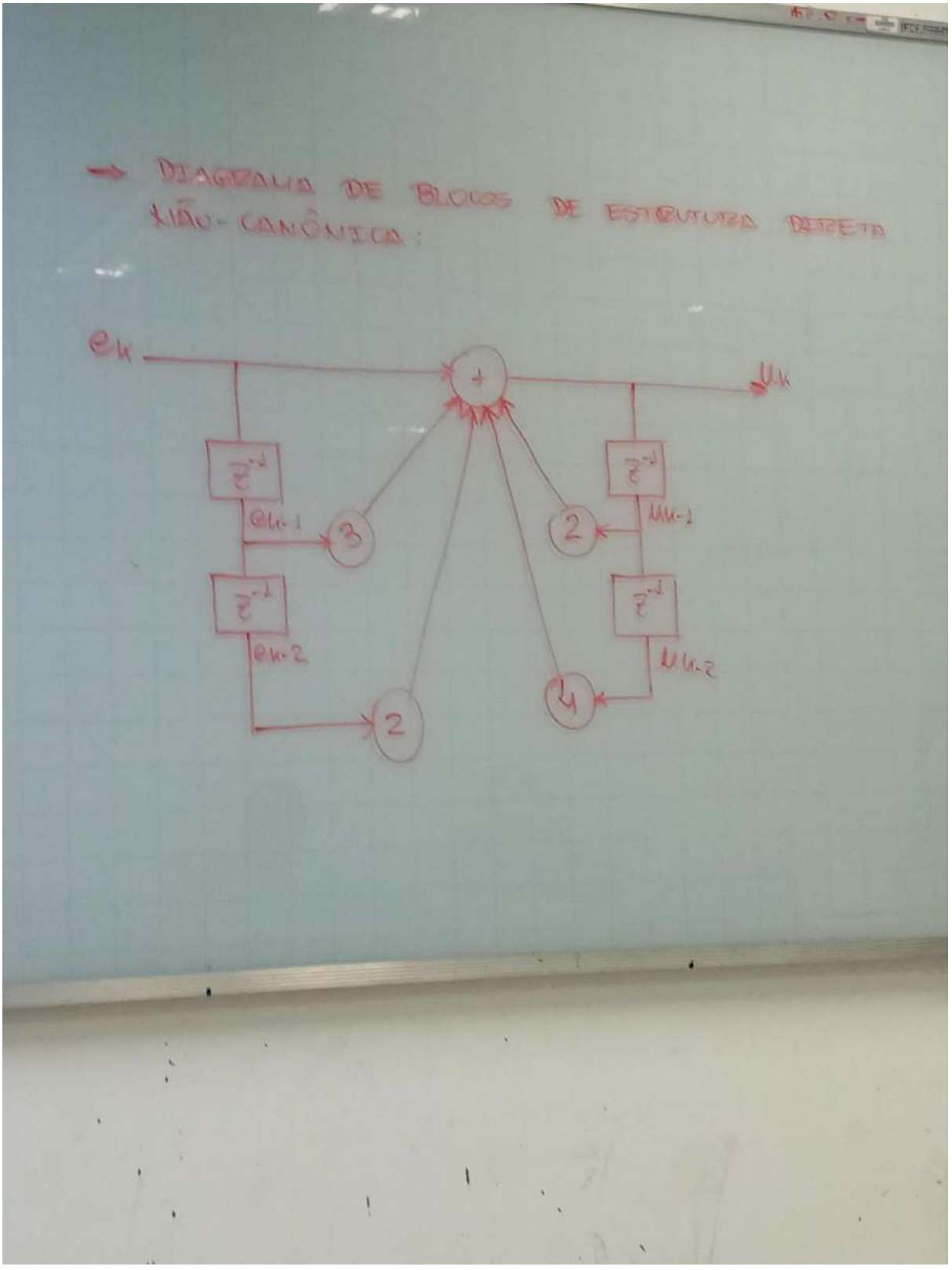
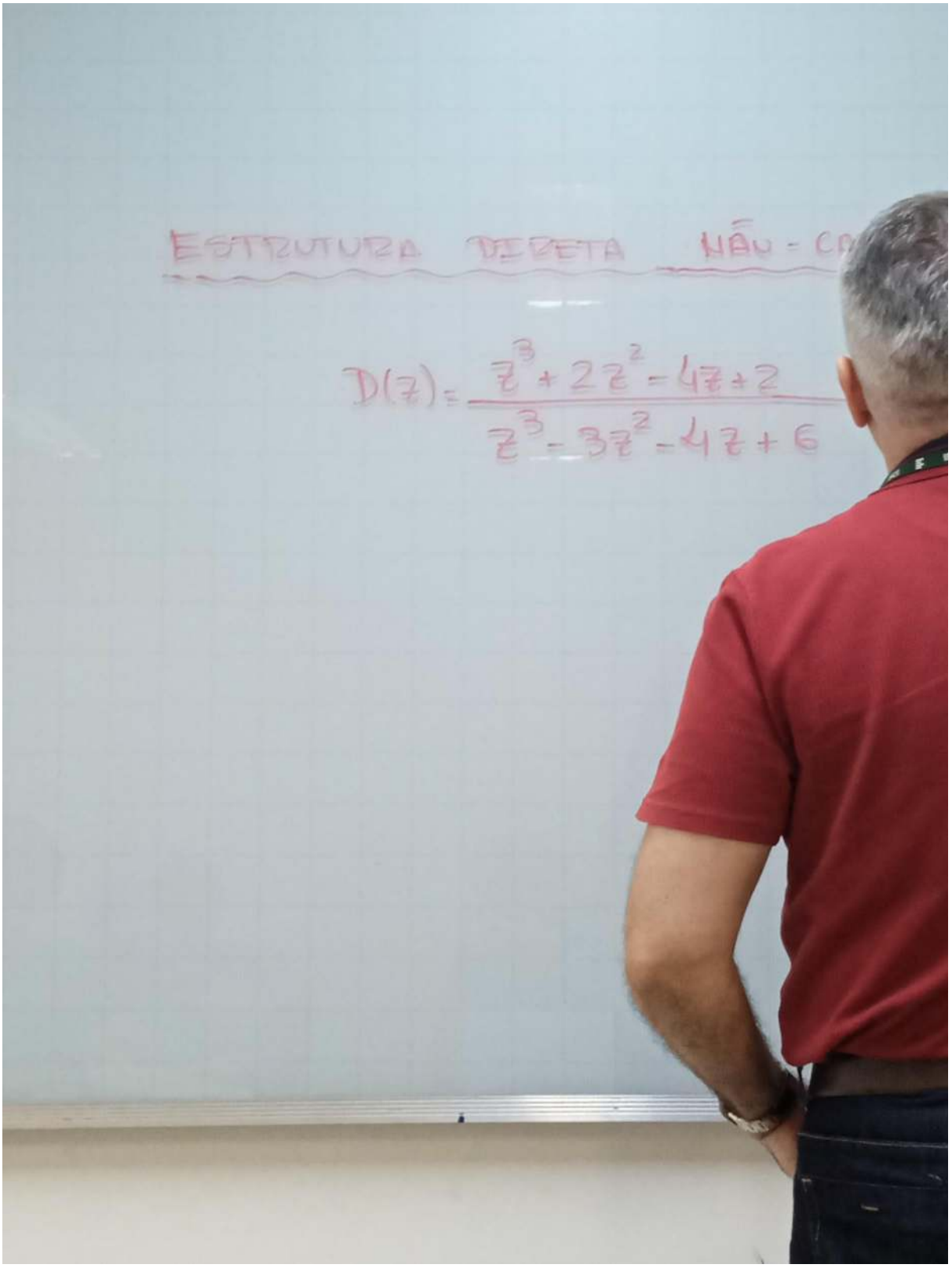
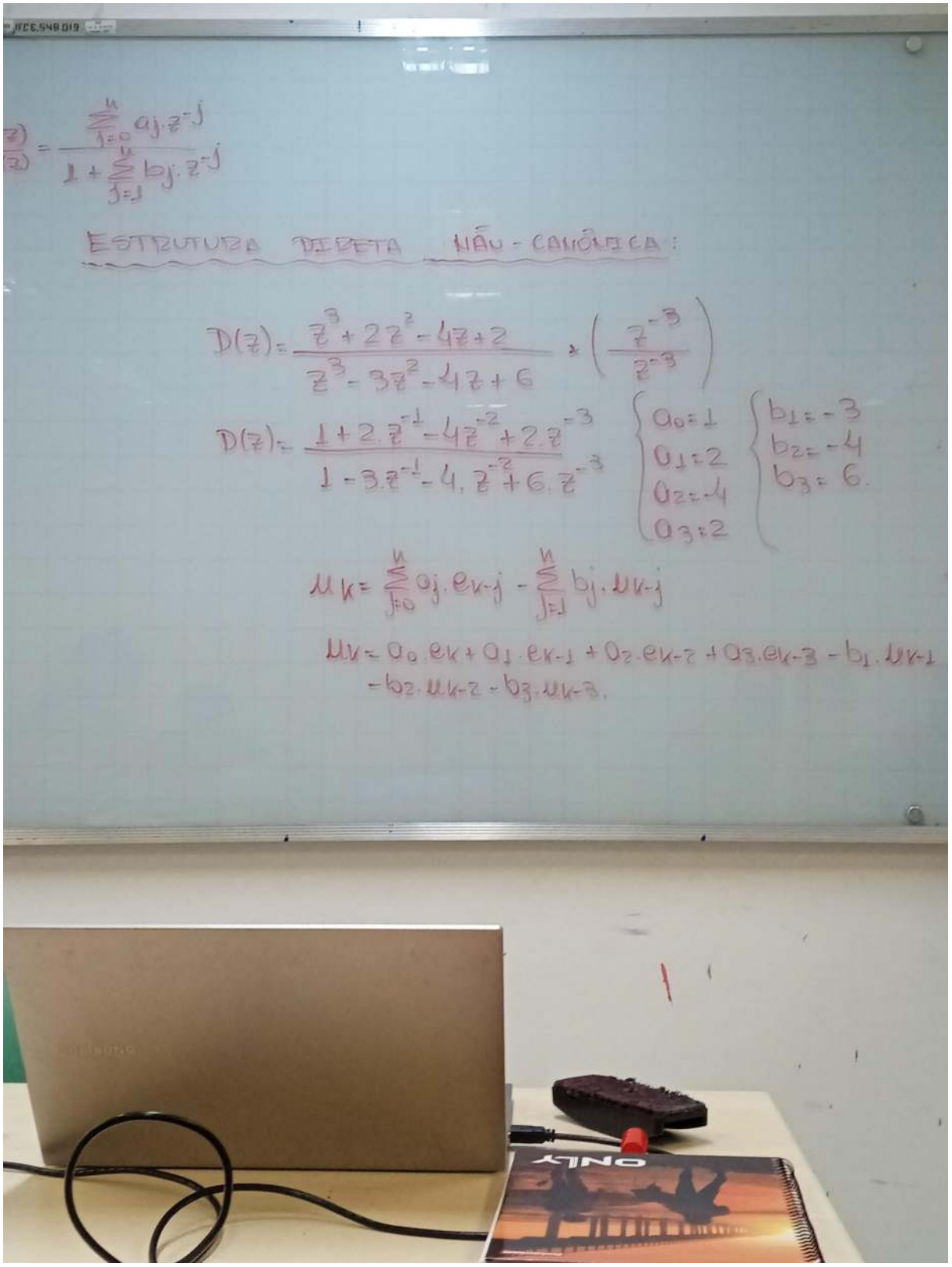


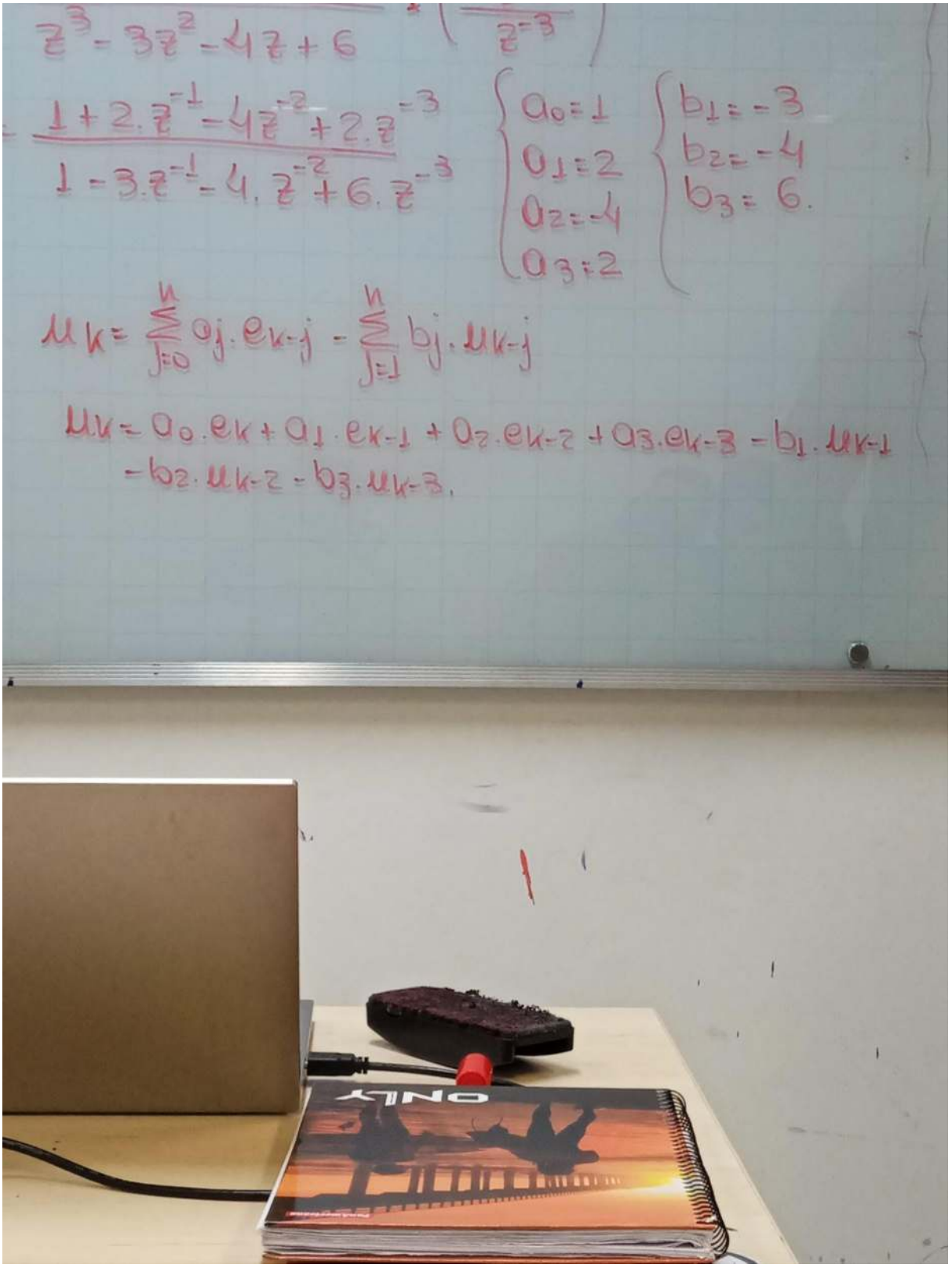
DIAGRAMA DE BLOCOS DE ESTRUTURA DIRETA
NÃO-CANÔNICA:
ek
+
uk
z-1
ek-1
3
2
z-1
uk-1
z-1
ek-2
2
z-1
uk-2
4

Exemplo 3

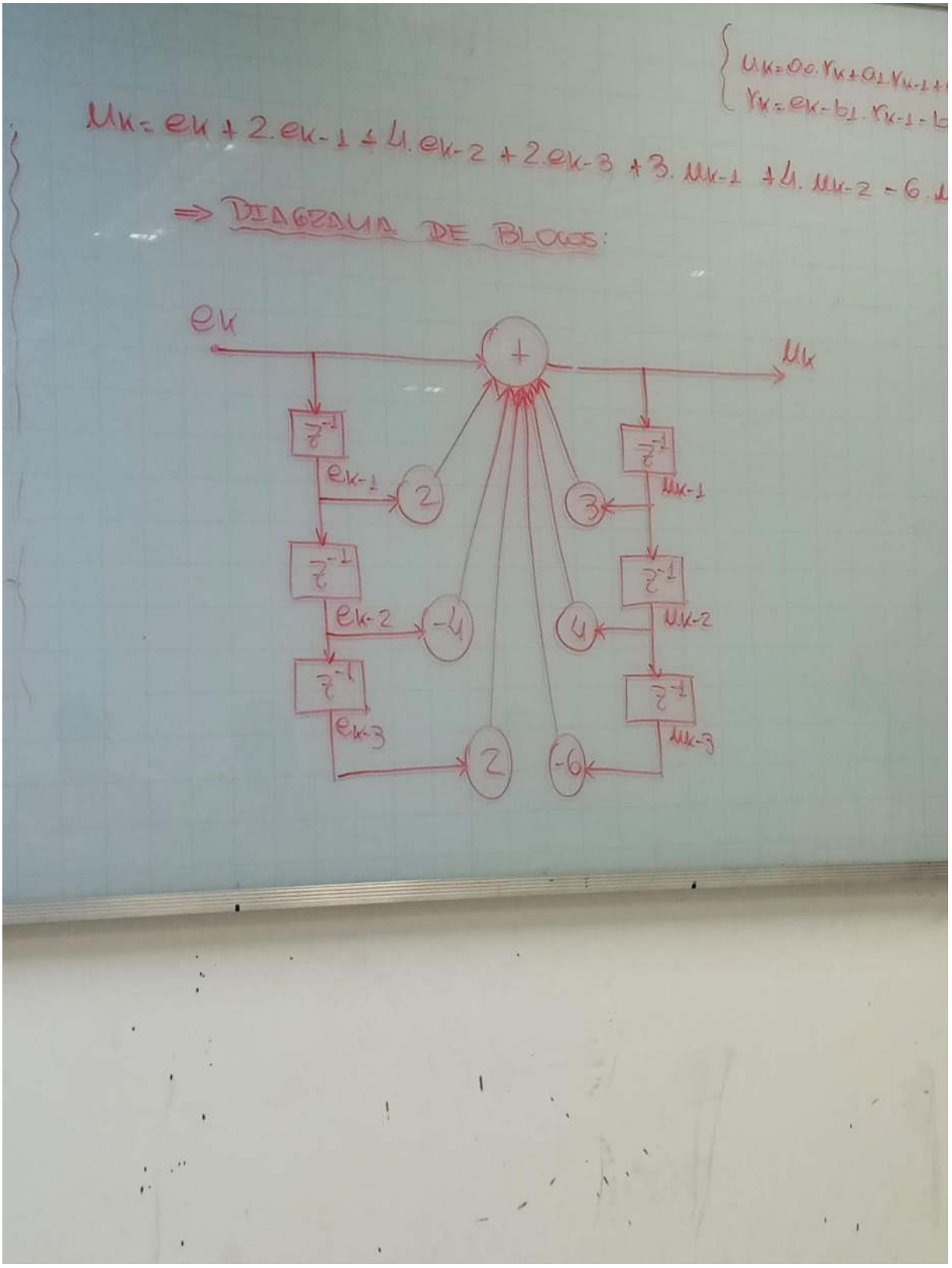

ESTRUTURA DIRETA NÃO - CA
D(z) = z³ + 2z² - 4z + 2
z³ - 3z² - 4z + 6


$\frac{Y(z)}{X(z)} = \frac{\sum_{j=0}^{M} a_j \cdot z^{-j}}{1 + \sum_{j=1}^{N} b_j \cdot z^{-j}}$
ESTRUTURA DIRETA NÃO - CANÔNICA:
$D(z) = \frac{z^3 + 2z^2 - 4z + 2}{z^3 - 3z^2 - 4z + 6} \cdot \left(\frac{z^{-3}}{z^{-3}} \right)$
$D(z) = \frac{1 + 2 \cdot z^{-1} - 4z^{-2} + 2 \cdot z^{-3}}{1 - 3 \cdot z^{-1} - 4 \cdot z^{-2} + 6 \cdot z^{-3}}$
$a_0 = 1$ $a_1 = 2$ $a_2 = -4$ $a_3 = 2$
$b_1 = -3$ $b_2 = -4$ $b_3 = 6$
$u_k = \sum_{j=0}^{M} a_j \cdot e_{k-j} - \sum_{j=1}^{N} b_j \cdot u_{k-j}$
$u_k = a_0 \cdot e_k + a_1 \cdot e_{k-1} + a_2 \cdot e_{k-2} + a_3 \cdot e_{k-3} - b_1 \cdot u_{k-1} - b_2 \cdot u_{k-2} - b_3 \cdot u_{k-3}$.

uk:



Representando no diagrama de blocos



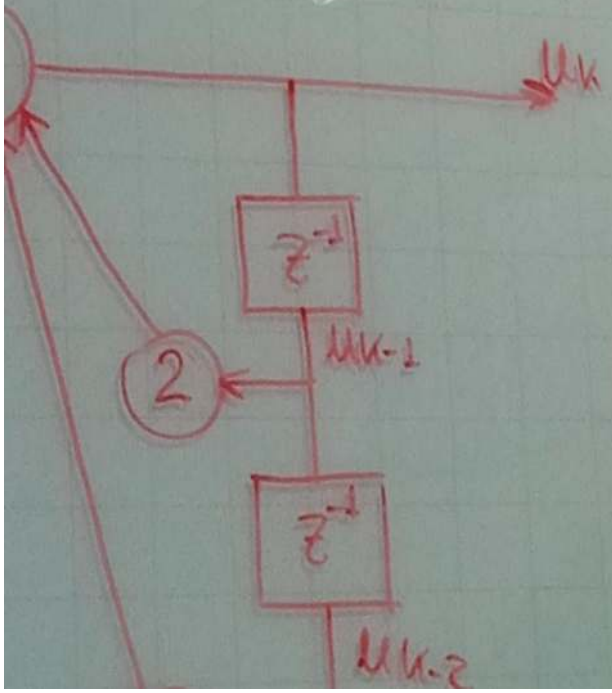
Expressão da estrutura direta canônica

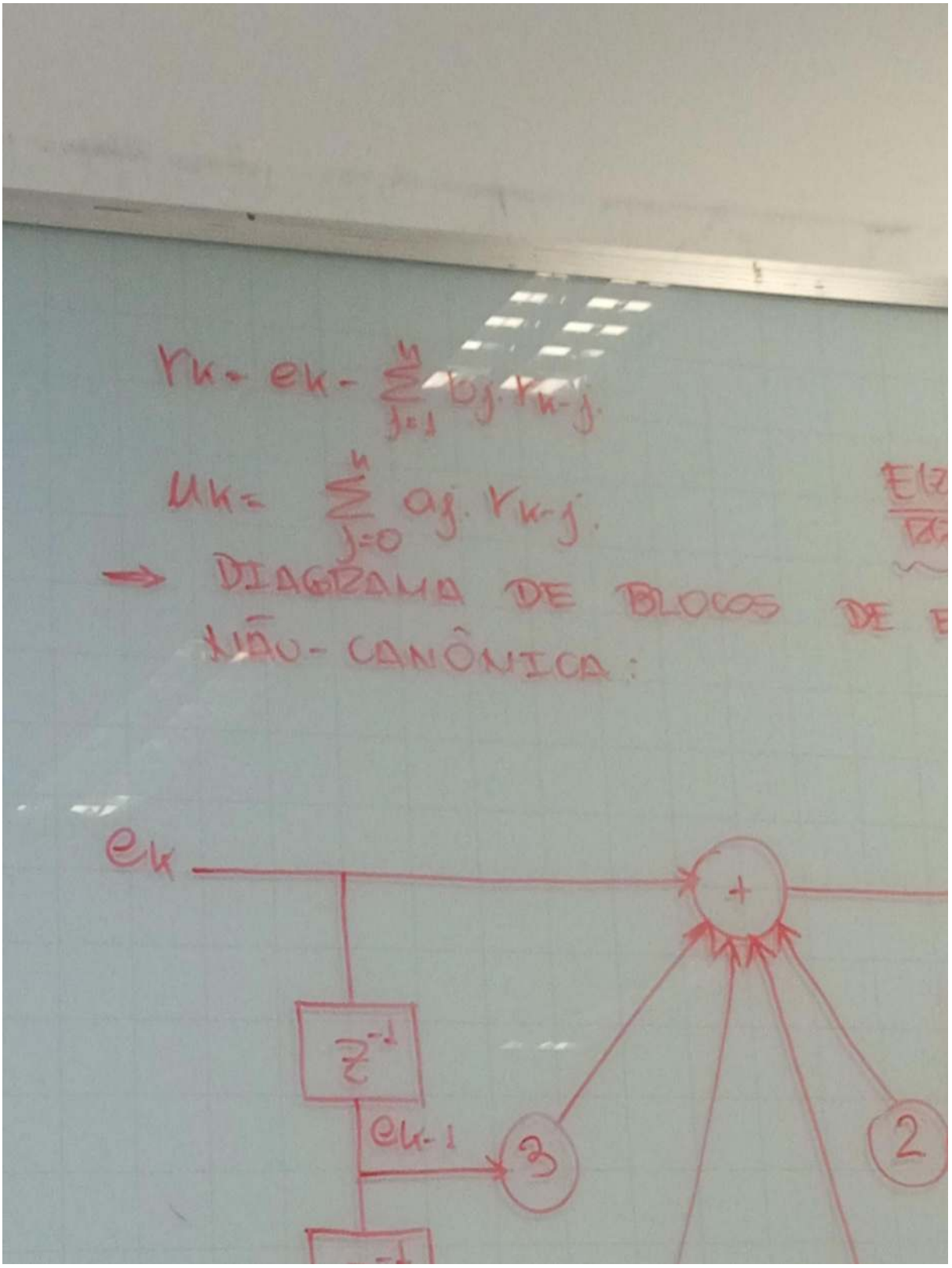
$$\frac{E(z)}{D(z)} = 1 + \sum_{j=1}^{n} b_j \cdot z^{-j}$$

$$\frac{W(z)}{D(z)} \cdot \frac{D(z)}{E(z)}$$

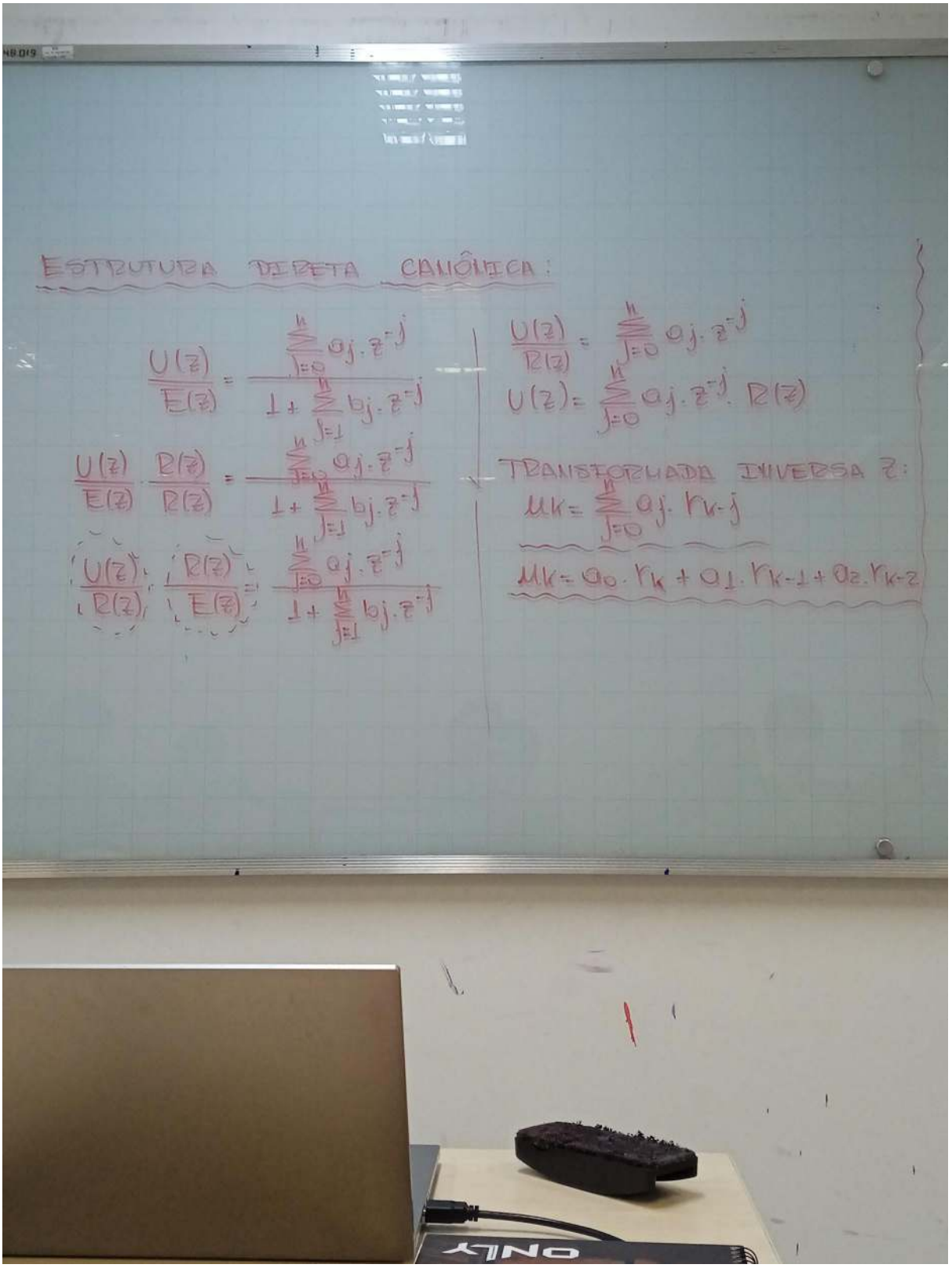
$$\frac{U(z)}{D(z)} = \sum_{j=0}^{n} a_j \cdot z^{-j}$$

S DE ESTRUTURA DIRETA





Estrutura Direta Canônica



Transformada inversa Z

$$U(z) = \sum_{j=0} a_j \cdot z^{-j} \cdot R(z)$$

TRANSFORMADA INVERSA Z:

$$u_k = \sum_{j=0}^{n} a_j \cdot r_{k-j}$$

$$u_k = a_0 \cdot r_k + a_1 \cdot r_{k-1} + a_2 \cdot r_{k-2}$$

$$\frac{R(z)}{E(z)} = \frac{1}{1 + \sum_{j=1}^{n} b_j \cdot z^{-j}}$$

$$\frac{E(z)}{R(z)} = 1 + \sum_{j=1}^{n} b_j \cdot z^{-j}$$

$$E(z) = R(z) + \sum_{j=1}^{n} b_j \cdot z^{-j} \cdot R(z)$$

$$e_k = r_k + \sum_{j=1}^{n} b_j \cdot r_{k-j}$$

$$r_k = e_k - \sum_{j=1}^{n} b_j \cdot r_{k-j}$$

$$\frac{R(z)}{E(z)} = \frac{1}{1 + \sum_{j=1}^{n} b_j \cdot z^{-j}}$$

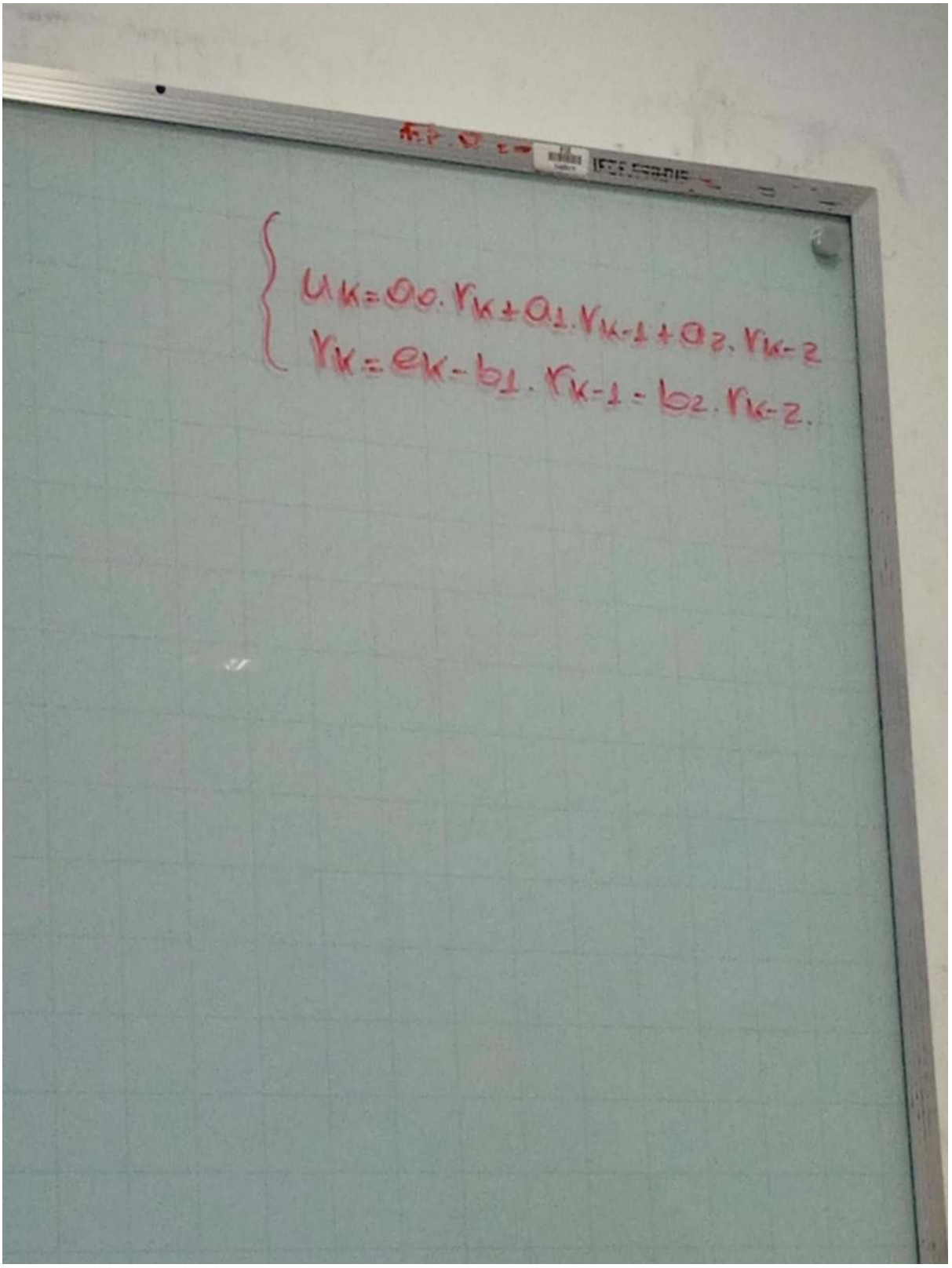
$$\frac{E(z)}{R(z)} = 1 + \sum_{j=1}^{n} b_j \cdot z^{-j}$$

$$E(z) = R(z) + \sum_{j=1}^{n} b_j \cdot z^{-j} \cdot R(z)$$

$$e_k = r_k + \sum_{j=1}^{n} b_j \cdot r_{k-j}$$

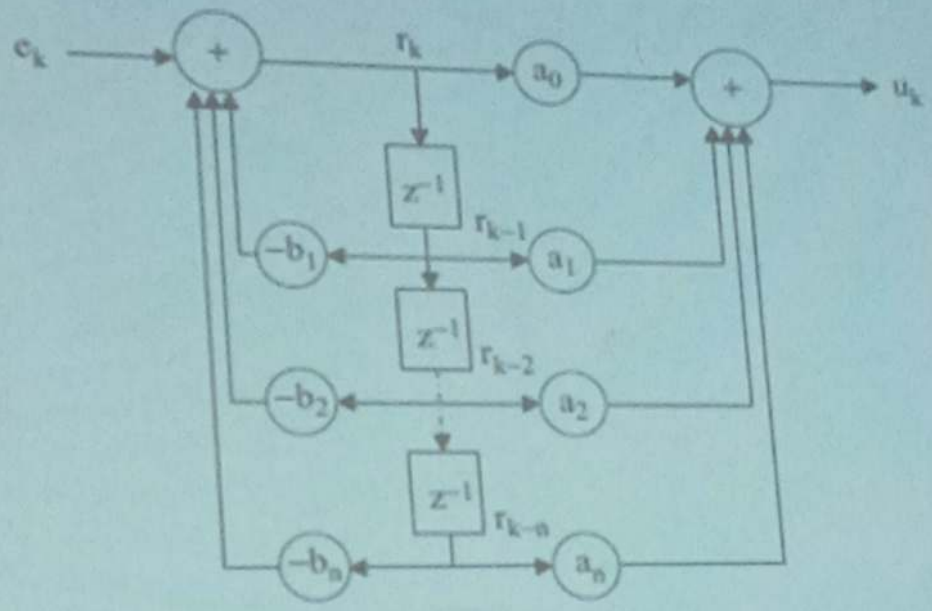
$$r_k = e_k - \sum_{j=1}^{n} b_j \cdot r_{k-j}$$

$$\boxed{r_k = e_k - b_1 \cdot r_{k-1} - b_2 \cdot r_{k-2}}$$

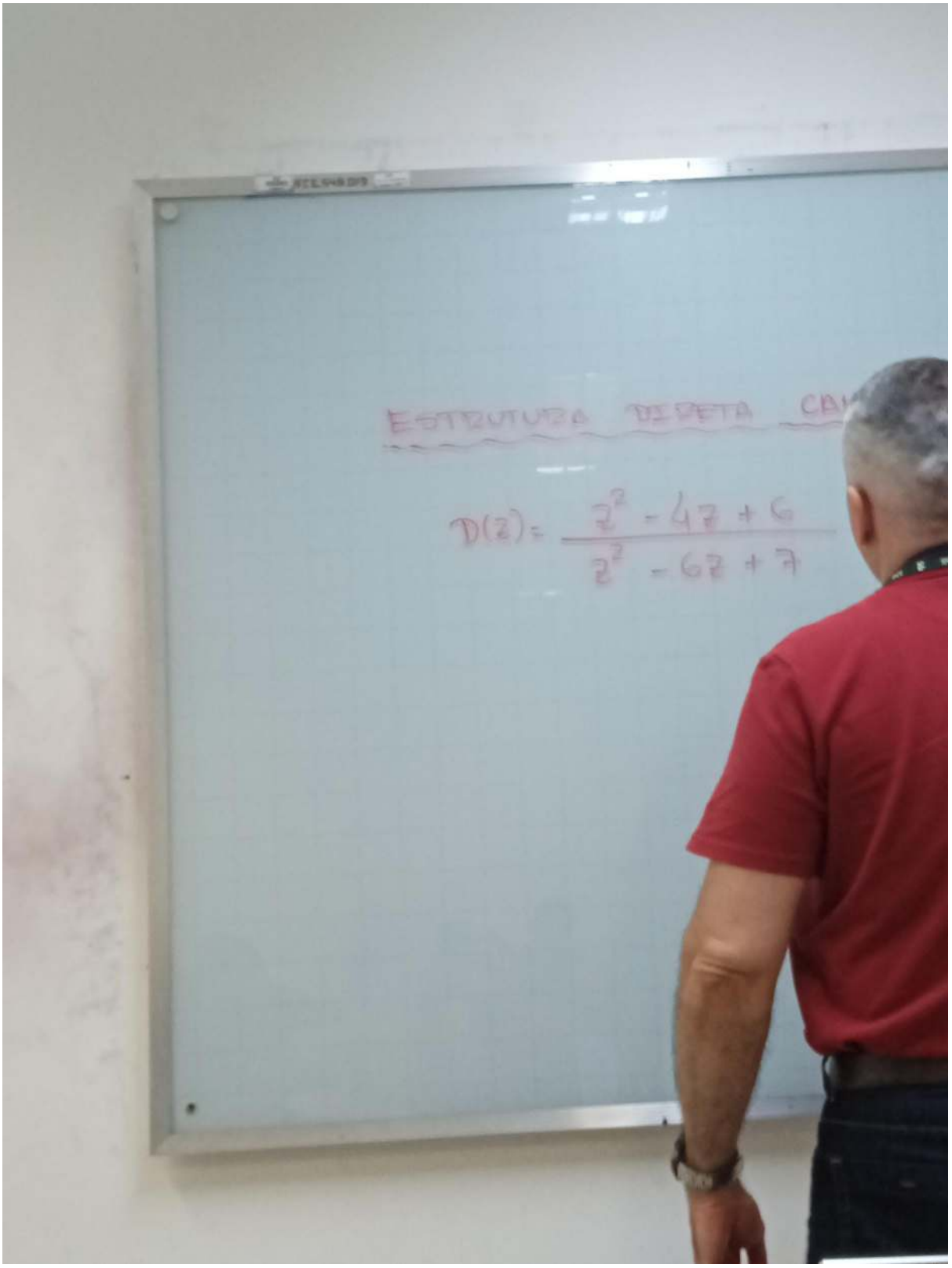

$u_k = a_0 \cdot r_k + a_1 \cdot r_{k-1} + a_2 \cdot r_{k-2}$
$r_k = e_k - b_1 \cdot r_{k-1} - b_2 \cdot r_{k-2}$

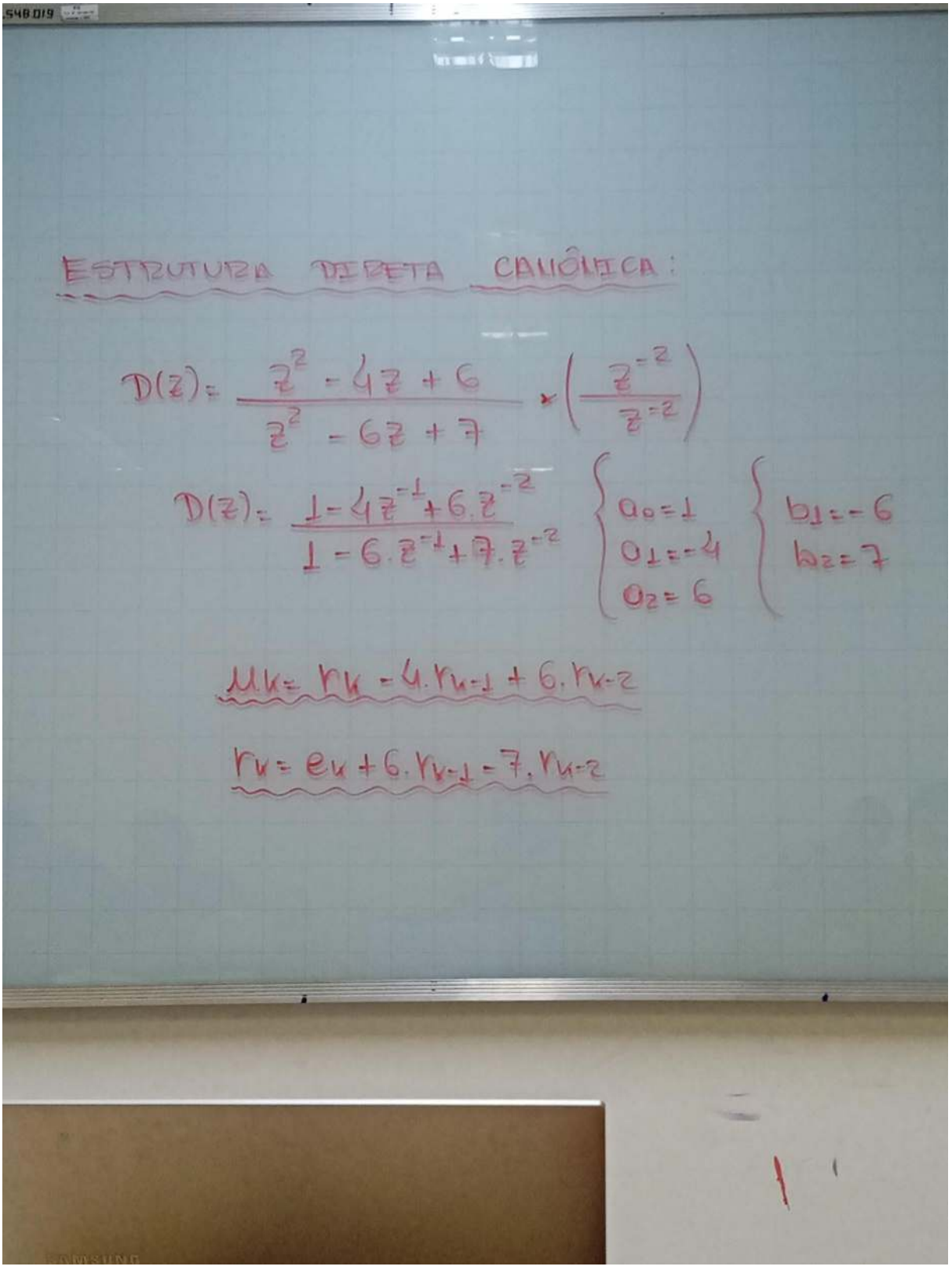
$$D(z) = \frac{1 + 2z^{-1} + 4z^{-2}}{1 + 2z^{-1} + 5z^{-2}}.$$ **FT controlador**

Estrutura direta canônica:



Exemplo 1


ESTRUTURA DIRETA
$D(z) = \frac{z^2 - 4z + 6}{z^2 - 6z + 7}$



Representando no diagrama de blocos

$$\begin{cases} u_k = b_0 \cdot r_k + b \\ r_k = e_k - b_1 \cdot \end{cases}$$

→ DIAGRAMA DE BLOCOS: