第三章：

2. （a）关键路径为 M1->A2->M2->A1->M3->A3->A4

T=10ut

（b）提供两种方法：

3. 注意：乘法器的系数！！

第三章：
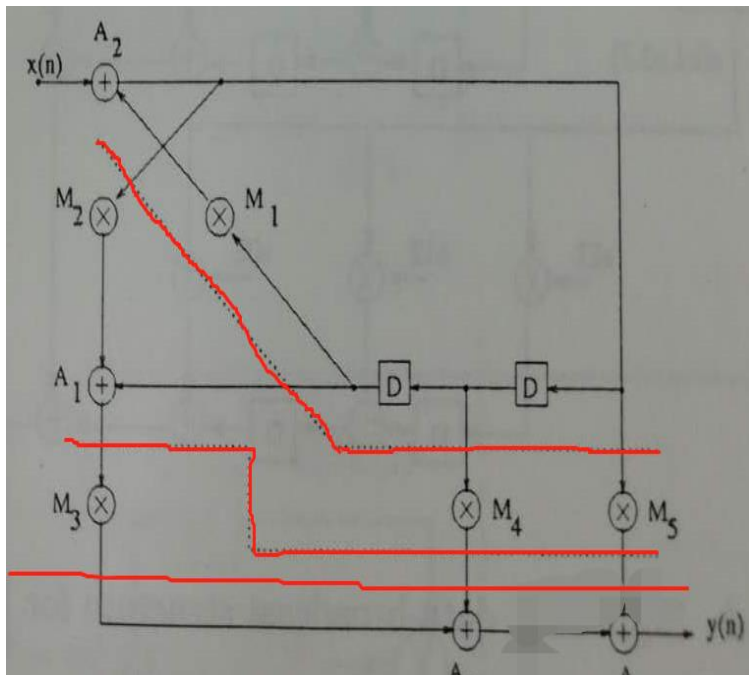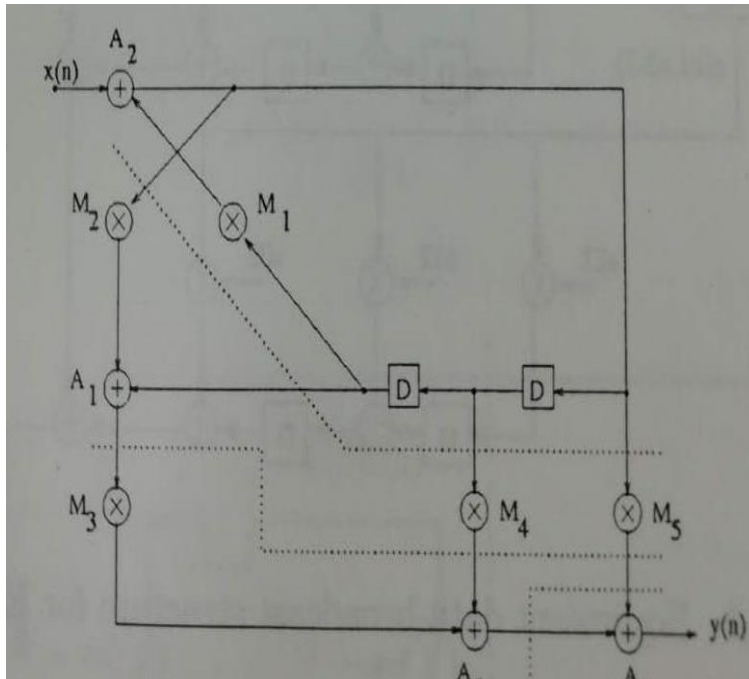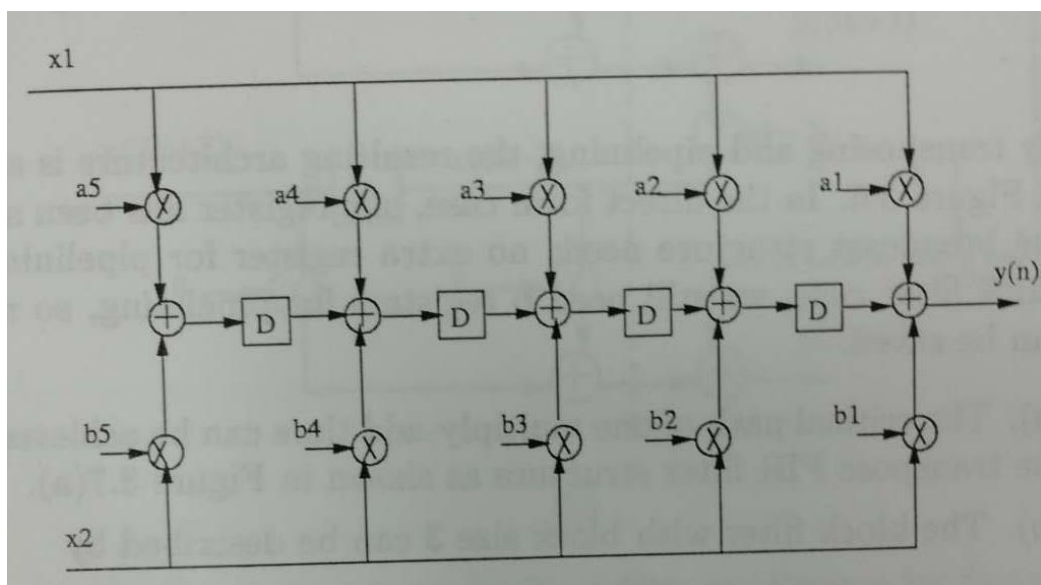
假设加法操作时间为 T_A，乘法操作时间为 T_M，则该结构关键路径为

$T_A + T_M$，采样频率为 $f \leq \dfrac{1}{T_A + T_M}$．

4. 提供两种方法：

Fig.3.4 Equivalent
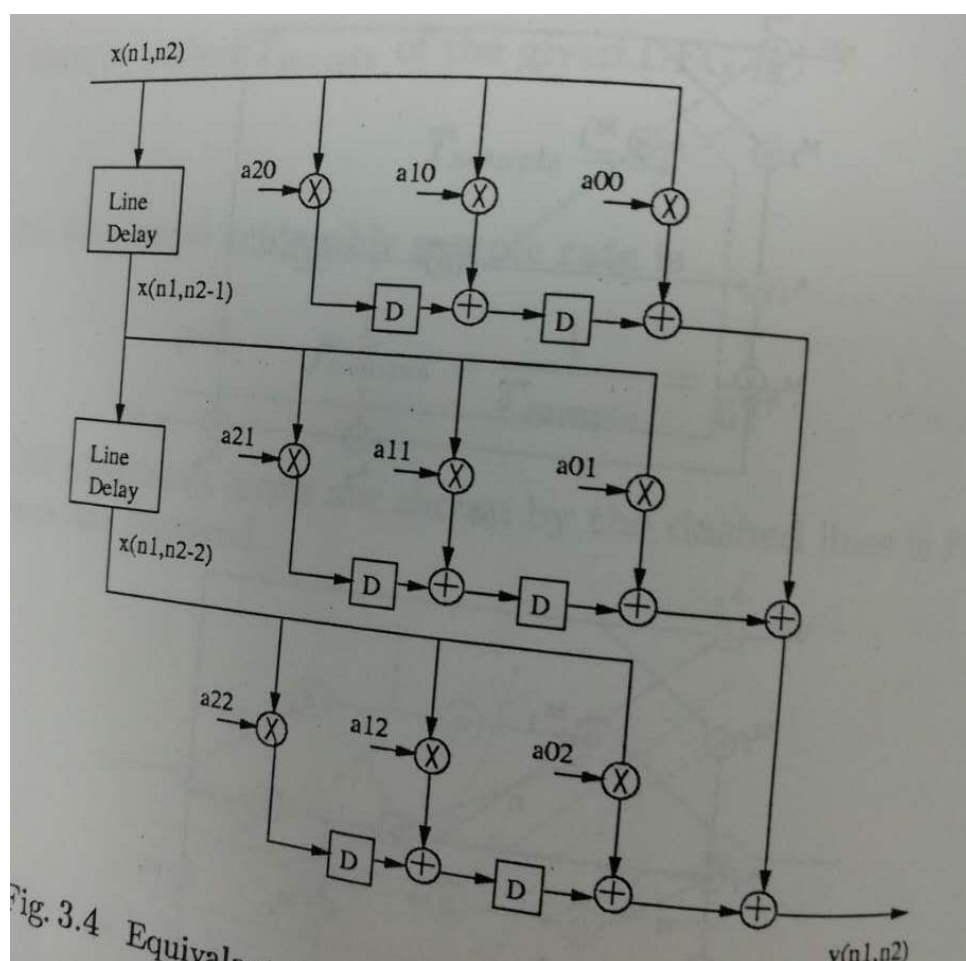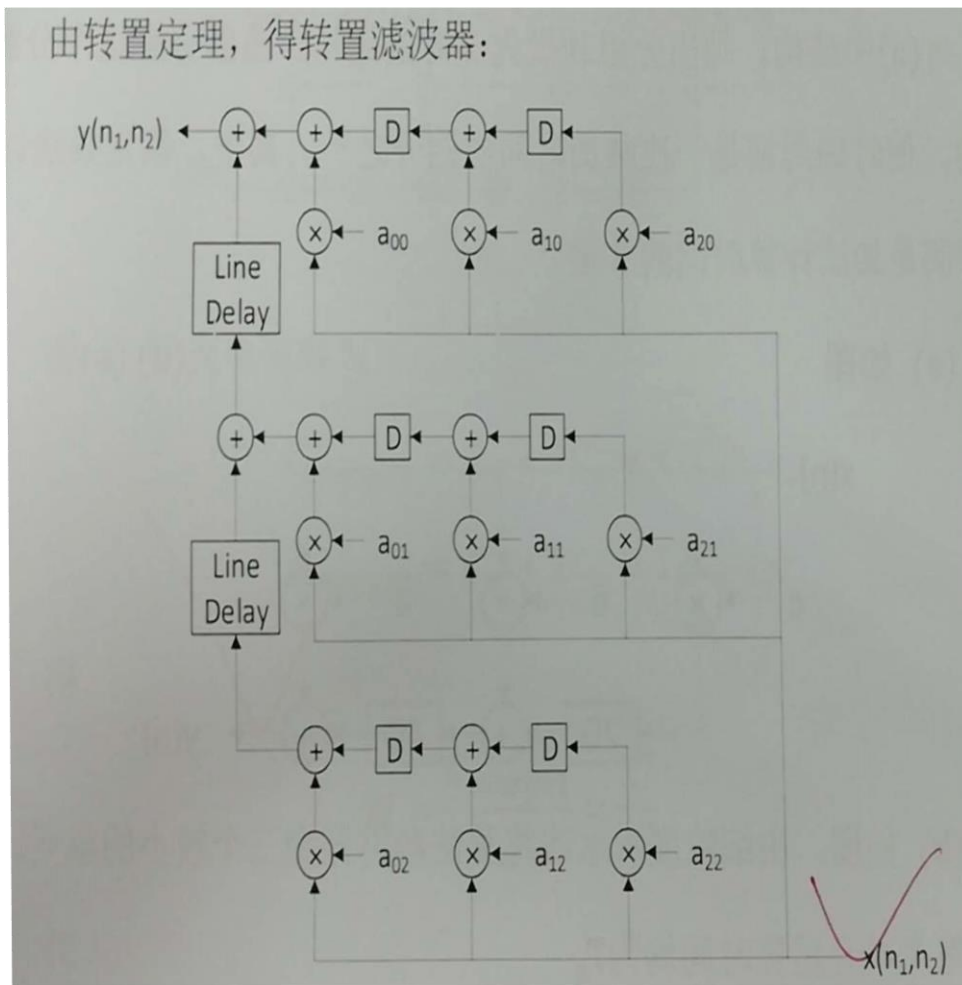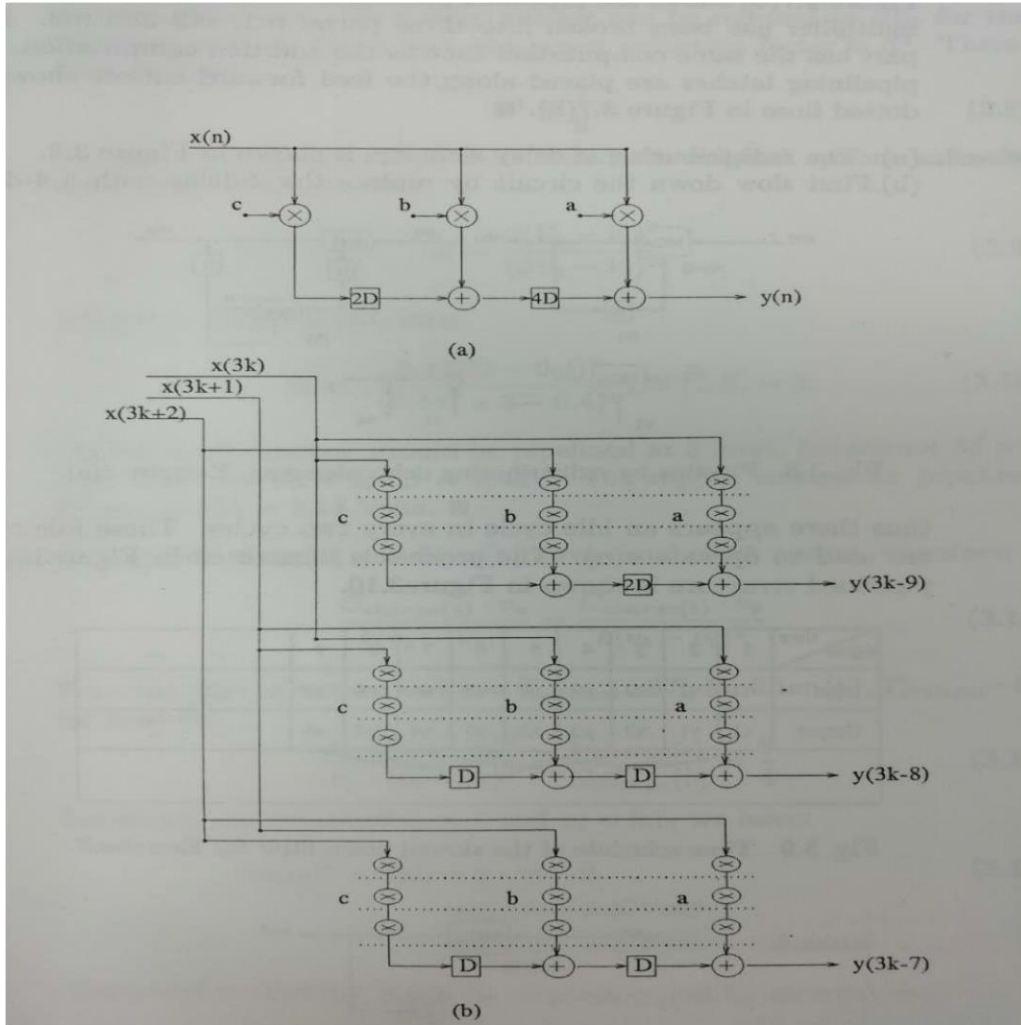
由转置定理，得转置滤波器：

7. 注意：分组规模为 3 表示 3 并行结构；时钟周期为一次乘加的 1/4，说明乘法器要被拆分，即加三级流水线，输出结果要考虑添加流水线后的延时。

(a)

(b)

10.

As required, filter(a) and filter(b) have equal clock period, therefore:

$$\frac{C_{charge(a)} \cdot v_a}{k(v_a - v_t)^2} = \frac{C_{charge(b)} \cdot v_b}{k(v_b - v_t)^2} \qquad (3.11)$$

From the filter structure we know $T_{critical} = 9T_a$ for filter (a), $T_{critical} = 4T_a$ for filter (b),

$$\frac{v_b \cdot (v_a - v_t)^2}{v_a \cdot (v_b - v_t)^2} = \frac{C_{charge(a)}}{C_{charge(b)}} = \frac{9}{4} \qquad (3.12)$$

Substitute the values of $v_a = 4$ and $v_t = 0.5$, we have:

$$36(v_b)^2 - 85v_b + 9 = 0 \qquad (3.13)$$
$$v_{b1} = 2.25Volt$$
$$v_{b2} = 0.11Volt --discard$$

Compared to filter(a), the ratio of power saved by filter(b) is

$$1 - \frac{(v_b)^2}{(v_a)^2} = 1 - \frac{2.25^2}{4^2} = 68.34\% \qquad (3.14)$$

Exercise 11. A Matlab program as following is developed to solve the problem. We obtain the final result,

注意：图 a 中的充电电容 $C_{charge} = C_m + 7C_a = 9C_a$ 和图 b 中的充电电容为 $C_{charge} = C_m + 2C_a = 4C_a$。

12.

Exercise 12. Since pipelining level $M=4$ and block size $L=4$, we have

$$16(\beta V_0 - V_t)^2 = \beta(V_0 - V_t)^2 \qquad (3.15)$$

Substitute $V_0=5$ Volts and $V_t=0.4$ Volts in to (3.15), we have

$$\beta^2 - 0.2129\beta + 0.0064 = 0. \qquad (3.16)$$

Solving for β, we get

$$\beta = 0.176675, \ or \ \beta = 0.03622. \qquad (3.17)$$

$\beta = 0.03622$ is disgarded since $0.03622V_0 = 0.181$ Volts, which is less than the threshold voltage. Therefore, the supply voltage for the parallel pipelined system is $\beta V_0 = 0.883$ Volts. The power ratio is
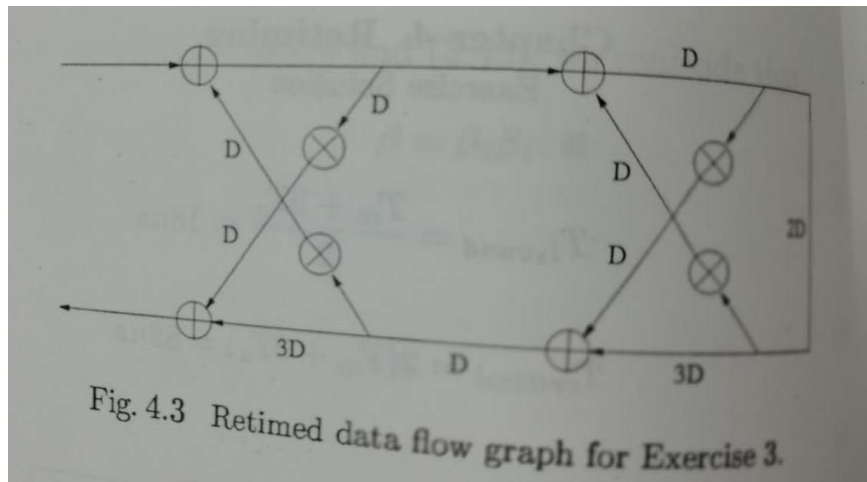
$$Ratio = \beta^2 = 3.12\%. \blacksquare \qquad (3.18)$$

第四章：

3.（a）$T_{\infty} = \dfrac{7}{4}ut$

（b）7ut

（c）

Fig. 4.3 Retimed data flow graph for Exercise 3.

5.（a）M2(M4)->A1->A2->A4->A6->A8

$T_{\infty} = 4ut$

（b）方法不限，但是电路的时钟周期不变，$T = 4ut$