Решение задач Линейные динамические системы

АВТОМАТИЗИРОВАННЫЕ СИСТЕМЫ УПРАВЛЕНИЯ ТЕХНОЛОГИЧЕСКИМИ ПРОЦЕССАМИ В ТЕПЛОЭНЕРГЕТИКЕ, ТЕПЛОТЕХНИКЕ И ТЕПЛОТЕХНОЛОГИЯХ

ДОПОЛНИТЕЛЬНЫЙ МАТЕРИАЛ

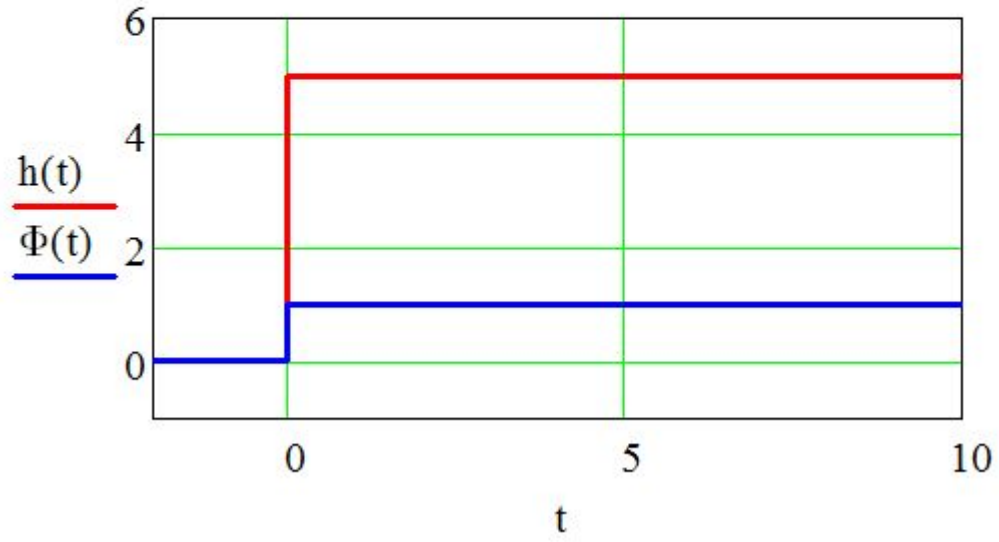
План

1. Элементарные звенья: задачи №1, 2, 3.
2. Дифференциальные уравнения линейных динамических систем: задача №4.
3. Соединения звеньев: задача №5
4. Устойчивость линейных динамических систем: задача №6

Задача №1

$kp := 5$

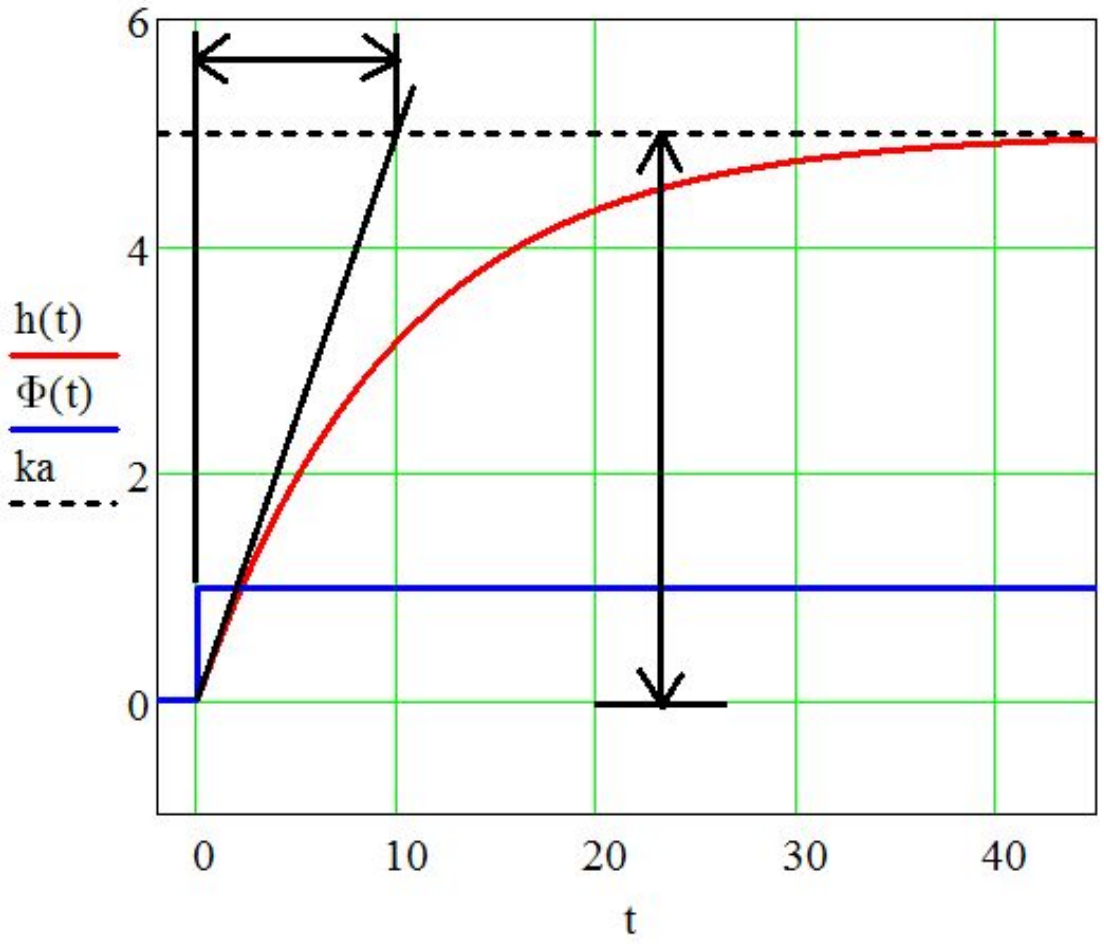
$h(t) := kp \cdot \Phi(t) \qquad t := -2, -1.99 .. 10$



Задача №2

$$ka := 5 \quad Ta := 10$$

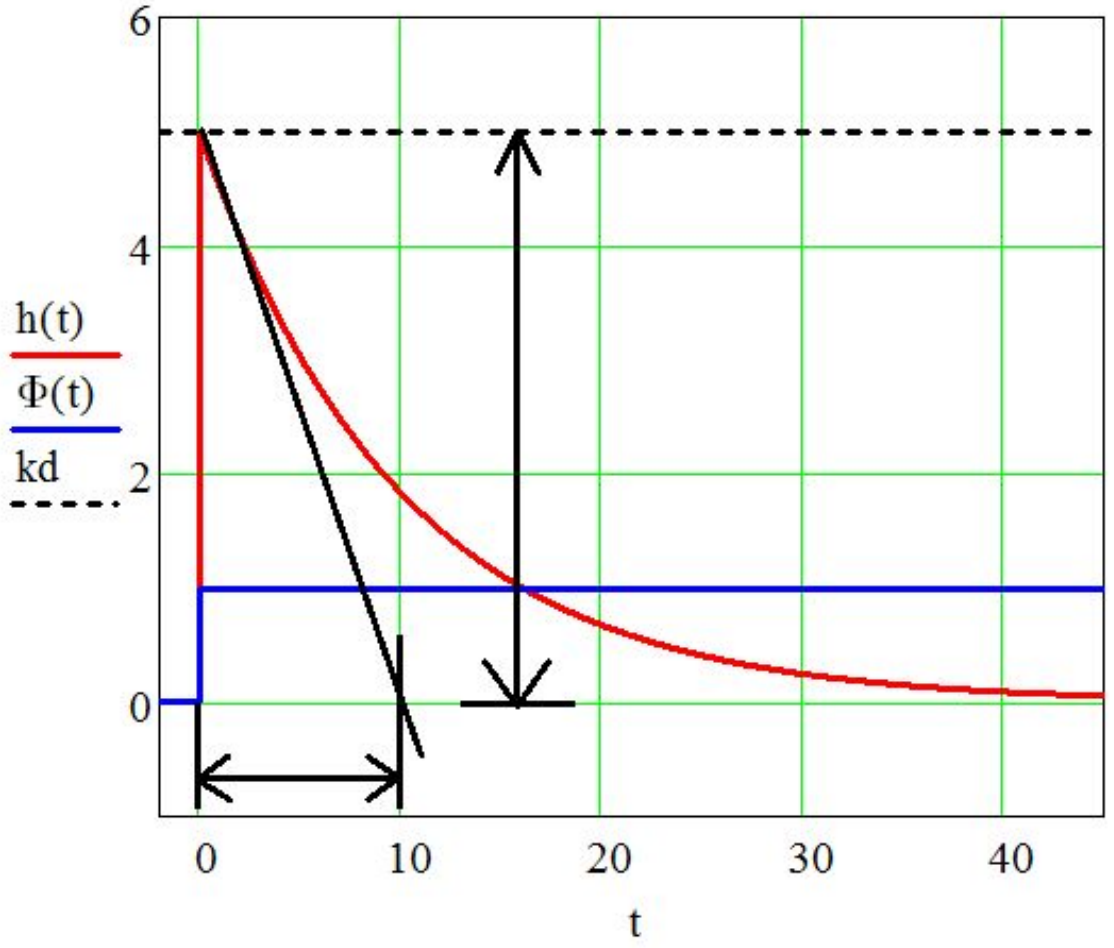
$$h(t) := ka \cdot \left(1 - e^{\frac{-t}{Ta}}\right) \cdot \Phi(t) \qquad t := -2, -1.99 .. 45$$



Задача №3

$kd := 5 \quad Td := 10$

$h(t) := kd \cdot e^{\frac{-t}{Td}} \cdot \Phi(t) \qquad t := -2, -1.99 .. 45$



Задача №4

$$y'+3y=4x \qquad x(t)=1(t)$$

$$sY(s)+3Y(s)=4X(s)$$

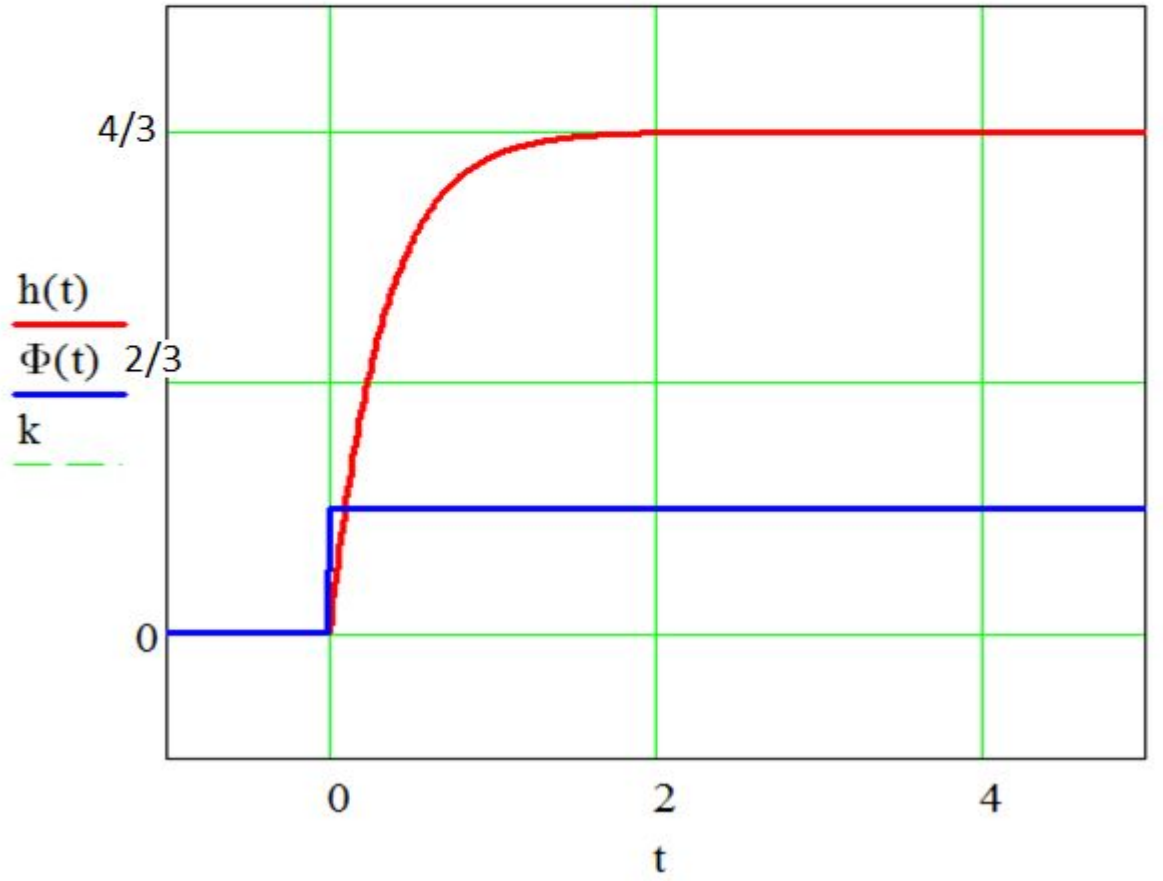
$$Y(s)(s+3)=4X(s)$$

$$W(s)=\frac{Y(s)}{X(s)}=\frac{4}{s+3}$$

Задача №4

$$ka := \frac{4}{3} \qquad Ta := \frac{1}{3}$$

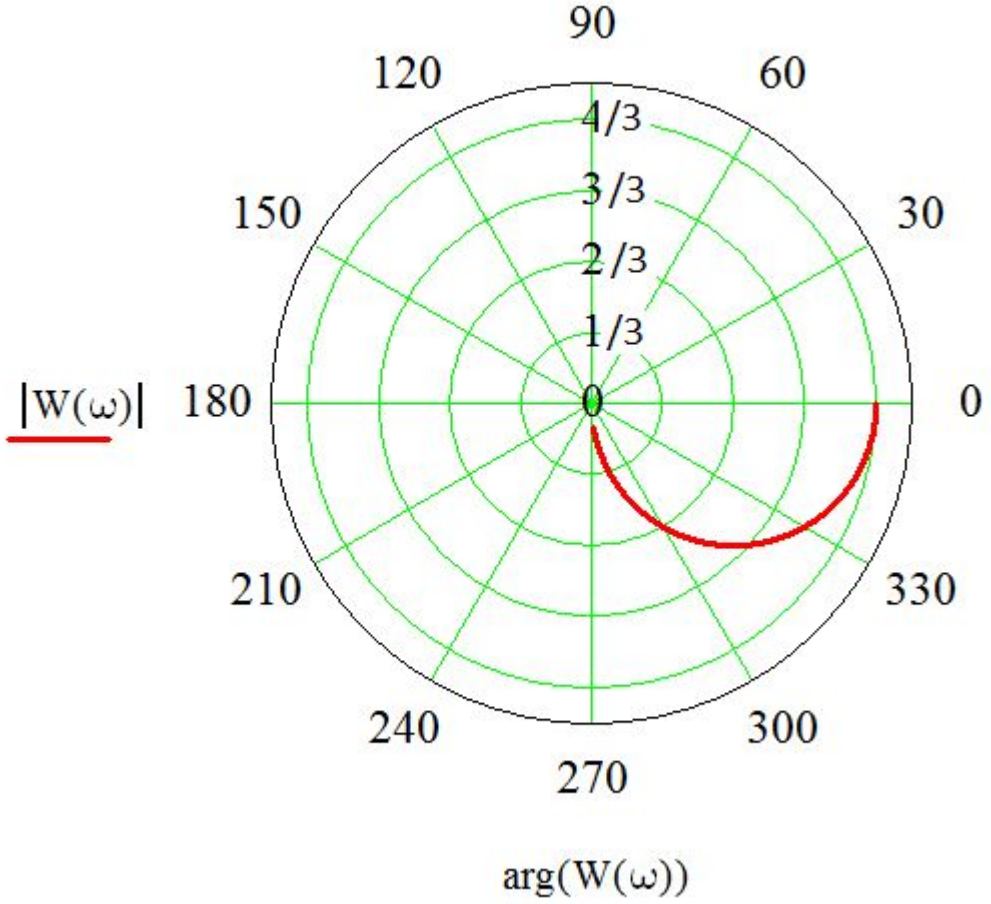
$$h(t) := ka \cdot \left(1 - e^{\frac{-t}{Ta}}\right) \cdot \Phi(t) \qquad t := -2, -1.99 .. 5$$



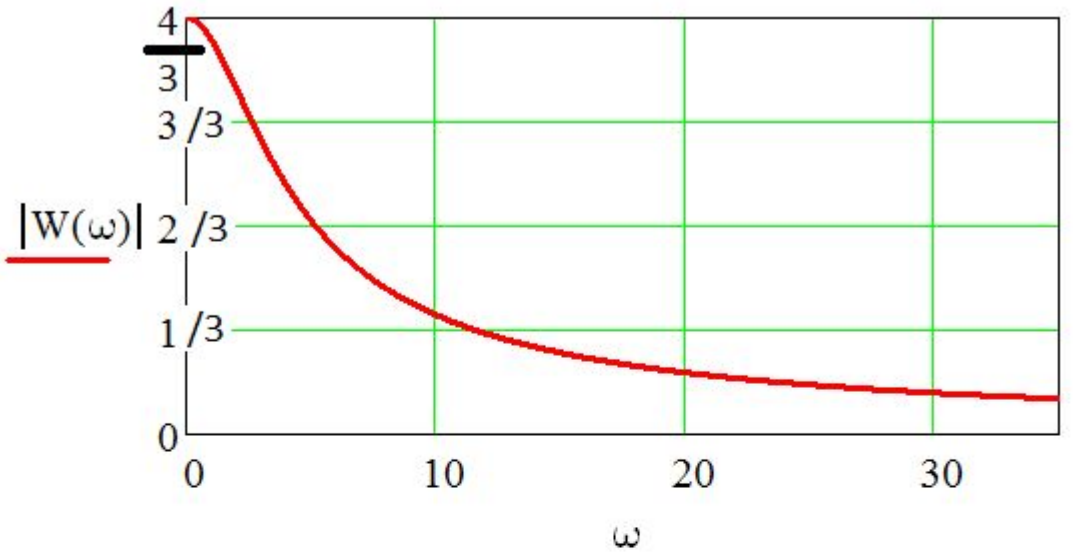
Задача №4

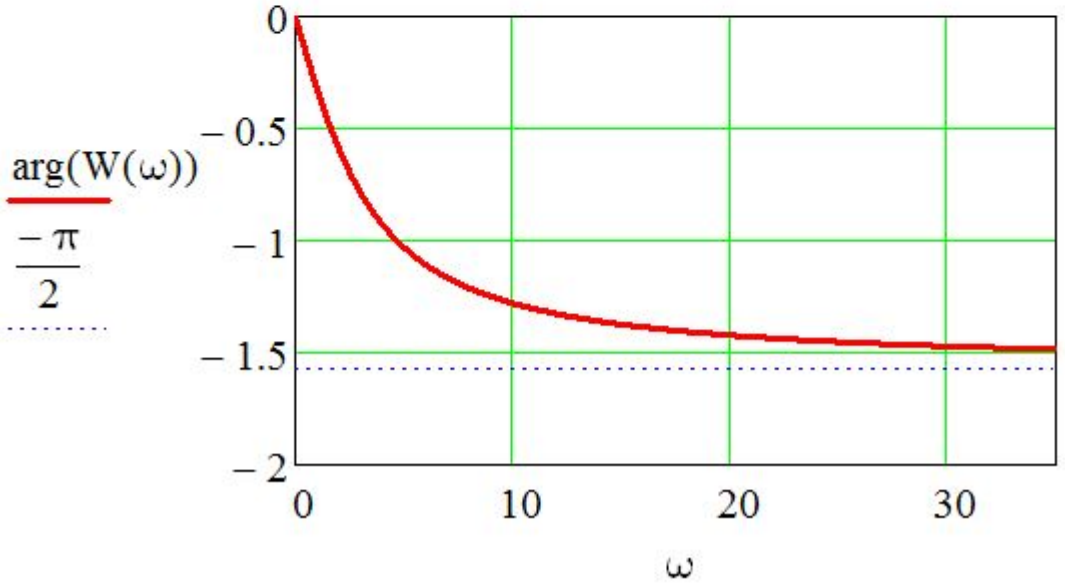
$$j := \sqrt{-1}$$

$$W(\omega) := \frac{ka}{Ta \cdot j \cdot \omega + 1} \qquad \omega := 0, 0.0001 .. 35$$

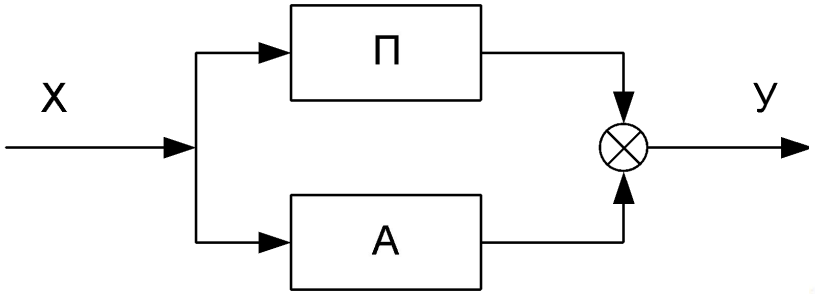


Задача №4



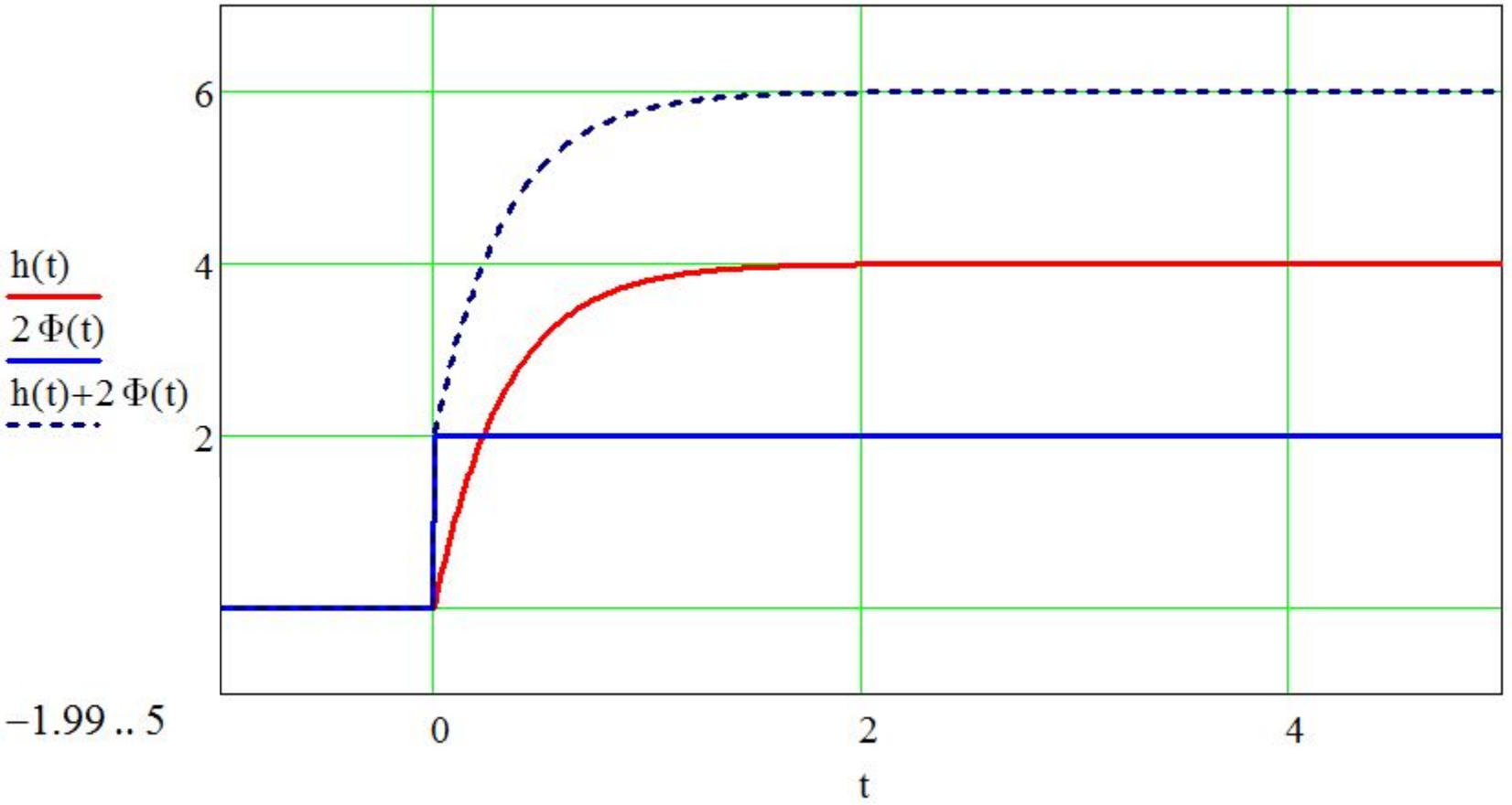


Задача №5

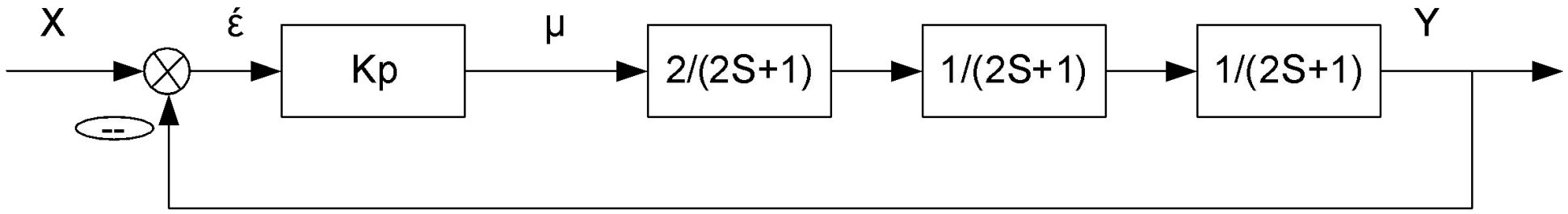


$$ka := 4 \quad Ta := \frac{1}{3}$$

$$h(t) := ka \cdot \left(1 - e^{\frac{-t}{Ta}}\right) \cdot \Phi(t) \qquad t := -2, -1.99 .. 5$$



Задача №6



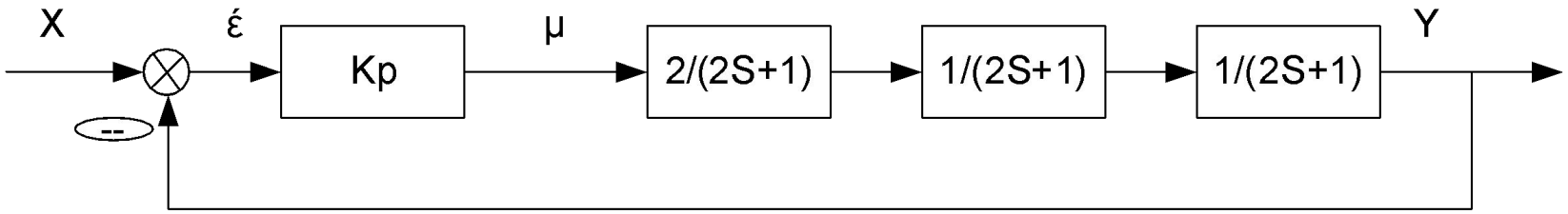
$$A_{pc}(\omega) = 1$$

$$\varphi_{pc}(\omega) = -\pi$$

$$Kp\frac{K}{\sqrt{T^2\omega^2+1}^3} = 1$$

$$0 - 3arctg(T\omega) = -\pi$$

Задача №6



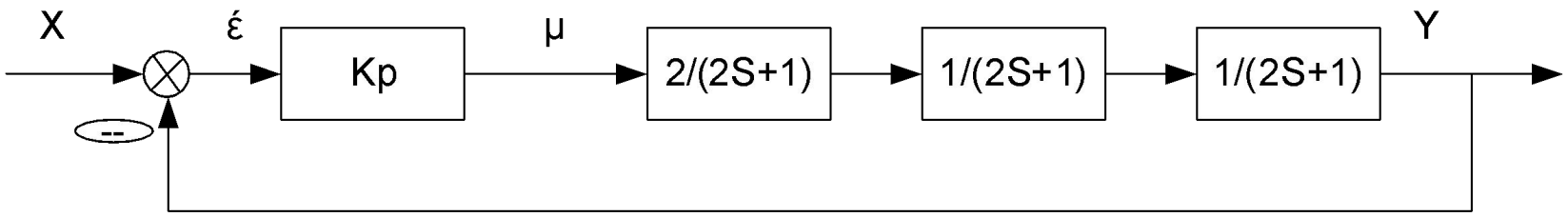
$$Kp\frac{K}{\sqrt{T^2\omega^2+1}^3}=1$$

$$0-3arctg(T\omega)=-\pi$$

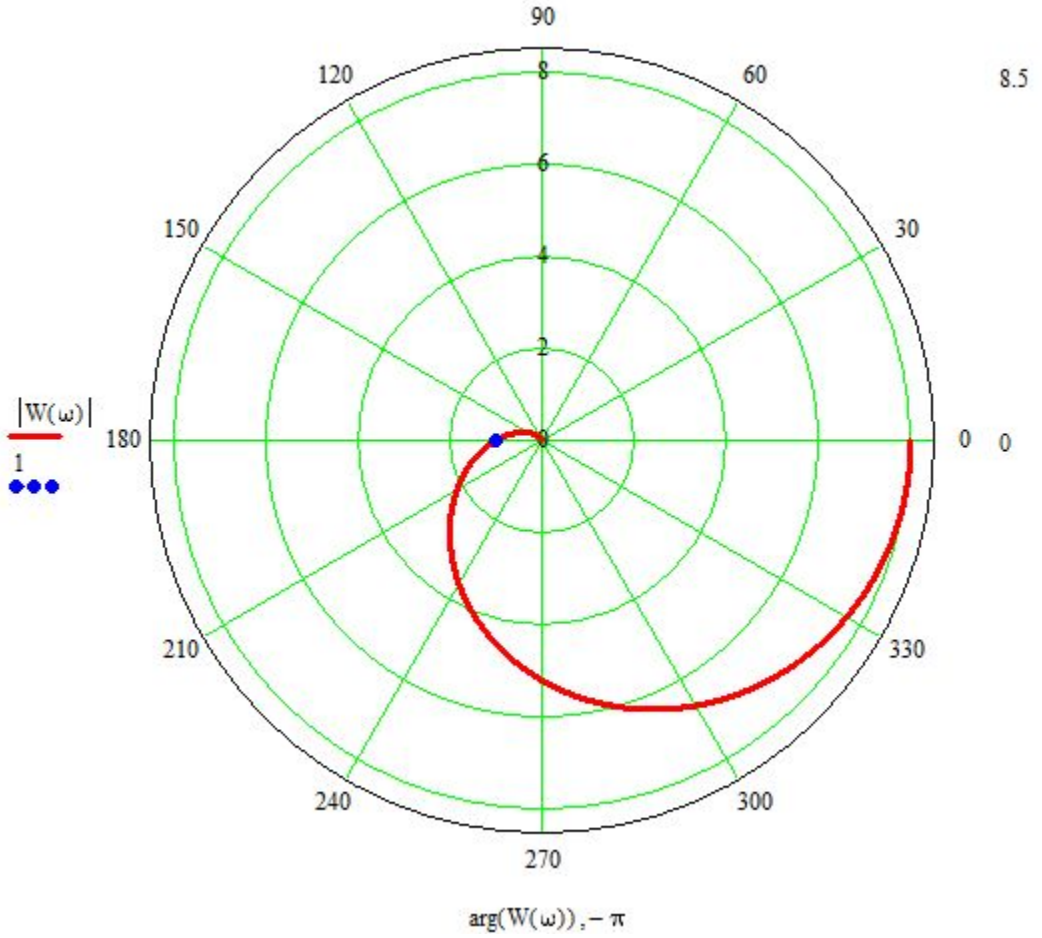
$$-3arctg(T\omega)=-\pi$$

$$arctg(T\omega)=\frac{\pi}{3}$$

Задача №6



$$T\omega = tg\frac{\pi}{3};\omega = \frac{tg\frac{\pi}{3}}{T} \Rightarrow \omega = \frac{tg\frac{\pi}{3}}{T} = \frac{\sqrt{3}}{2}$$

$$Kp = \frac{\sqrt{T^2\omega^2+1}^3}{K} = \frac{\sqrt{2^2\frac{\sqrt{3}^2}{2^2}+1}^3}{2} = \frac{\sqrt{4}^3}{2} = 4$$

Задача №6