Type 1: Transfer Function

For Concept, refer to Control Systems K-Notes, Basics of Control Systems
Pre-requisites: Laplace Transform (Signals and Systems)

Sample Problem-1:
A linear time invariant system initially at rest, when subjected to a unit step input, gives a response $y(t)=te^{-t}$, $t>0$. The transfer function of the system is

(A) $\frac{1}{(s+1)^2}$ (B) $\frac{1}{s(s+1)^2}$ (C) $\frac{s}{(s+1)^2}$ (D) $\frac{1}{s(s+1)}$

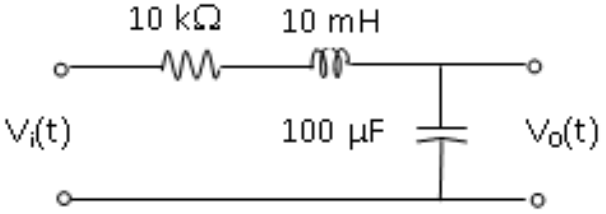
Solution: (C) is correct option.
Step input =u(t)
Output $y(t)=te^{-t}$

$$\therefore \text{TF}=\frac{\text{L[output]}}{\text{L[input]}}=\frac{\text{L}[te^{-t}u(t)]}{\text{L[u(t)]}}$$

$$\therefore \text{TF}=\frac{\frac{1}{(s+1)^2}}{\frac{1}{s}}=\frac{s}{(s+1)^2}$$

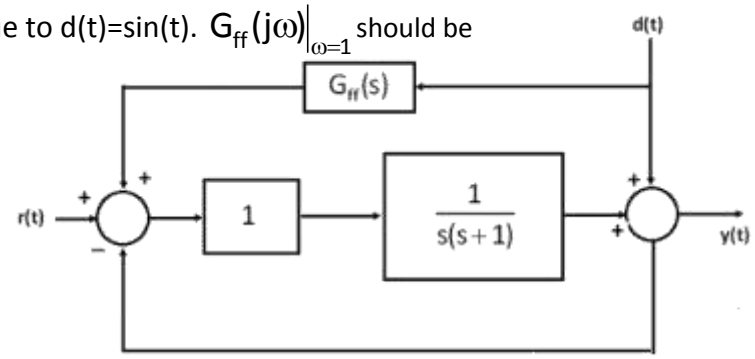
Unsolved Problems:
Q.1 For the circuit shown in figure, the initial conditions are zero. Its transfer function $H(s)=\frac{V_0(s)}{V_i(s)}$ is?

(A) $\frac{1}{s^2+10^6s+10^6}$ (B) $\frac{10^6}{s^2+10^3s+10^6}$
(C) $\frac{10^3}{s^2+10^3s+10^6}$ (D) $\frac{10^6}{s^2+10^6s+10^6}$



Q.2 A disturbance input d(t) is injected into the unity feedback control loop shown in the figure . Take the reference input r(t) to be unit step .If the disturbance is measureable ,its effect on the output can be minimized significantly using a feed forward controller $G_{ff}(s)$. To eliminate the component of the output due to d(t)=sin(t). $G_{ff}(j\omega)\big|_{\omega=1}$ should be

(A) $\frac{1}{\sqrt{2}}\angle\frac{-3\pi}{4}$ (B) $\frac{1}{\sqrt{2}}\angle\frac{\pi}{4}$
(C) $\sqrt{2}\angle\pi$ (D) $\sqrt{2}\angle\frac{-\pi}{4}$



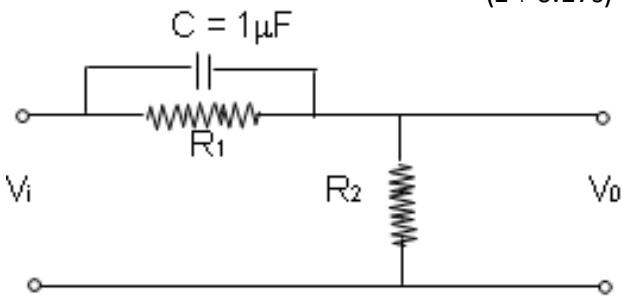
Q.3 The transfer function to the given electrical network, shown in figure, is $\frac{K(1+0.3s)}{(1+0.17s)}$ The values of R_1 and R_2 are respectively.

(A) 300kΩ and 300kΩ

(B) 300kΩ and 400kΩ

(C) 400kΩ and 300kΩ

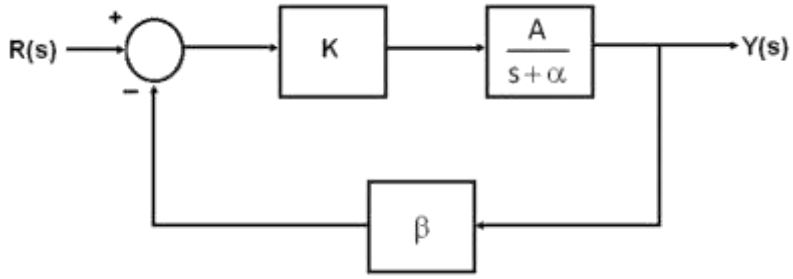
(D) 400kΩ and 400kΩ



Q.4 For the given system below, the feedback does not reduce the closed loop sensitivity due to variation of which one of the following?

(A) K (B) A

(C) α (D) β



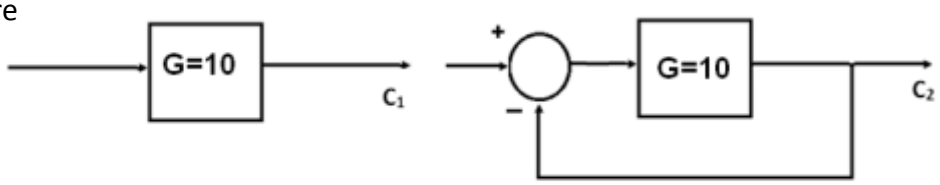
Q.5 For the systems shown in figure below if the G changes by 10% , the % changes in C_1 and C_2 respectively are

(A) 10%, 1%

(B) 10%, 2%

(C) 5%, 3%

(D) 5%, 10%



Q.6 The response y(t) of a linear system to an excitation $x(t)=e^{-3t}u(t)$ is $y(t)=(2t+1)e^{-2t}u(t)$. Poles and zeroes will be at?

(A)-1,-1 and -2,-2 (B)-2,-2 and -3,-4 (C)-3,-3 and -4,-5 (D) None of these